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"MADE IN EUROPE FOR THE WORLD": MAKING A CLAIM FOR A EUROPEAN CHEMISTRY IN PUBLICATION PROGRAMS. THE CASE OF THE SUPRAMOLECULAR CHEMISTRY (1987-2005)

Marianne Noel ⋆

ABSTRACT

The University of Strasbourg is the birthplace of a research specialty (supramolecular chemistry or SMC) which has grown considerably in the last 40 years and has had a significant scientific impact. The emergence of SMC was orchestrated to a large extent by Nobel laureate Jean-Marie Lehn, but a network of scientists, as well as the University and the Alsace Region, were also key players in this regard. Lehn was instrumental in the creation of a series of European chemistry journals in the late 1990s, whose genealogy I trace. My purpose is to examine the conditions of the success of a case of European integration that is not a major technological program but simply a "publication infrastructure". Based on an historical analysis completed with a fieldwork study, I argue that the circulation and appropriation of concepts and languages of the SMC were central in the development of a European "publication program". I show that this program created a sense of Europeanness that was also shaped in relation to the extra-European world, both in opposition (standing against the USA) and yet open to the world, as illustrated in the motto "Made in Europe for the world".

Keywords: Supramolecular Chemistry, University of Strasbourg, History of Scientific Journals, Europe.

1. Background and Context

The University of Strasbourg was recently rewarded with a series of prestigious prizes awarded to scientists who have developed their research

⋆ Laboratoire Interdisciplinaire Sciences Innovations Société (LISIS), CNRS, ESIEE, INRA, UPEM, F-77454, Marne-la-Vallée. Address for correspondence: noel@ifris.org.

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program in Strasbourg. Thirty years after Jean-Marie Lehn received the Nobel Prize for Chemistry (1987), other awards have succeeded one another over a recent (and short) period of time: Jules Hoffmann (Nobel Prize in Physiology of Medecine in 2011), Martin Karplus (Nobel Prize in Chemistry in 2013) and Jean-Pierre Sauvage (Nobel Prize in Chemistry in 2016). Strasbourg is the birthplace of a research specialty (supramolecular chemistry or SMC) which has grown considerably in the last 40 years and has had a significant scientific impact. The Nobel Prize 2016 awarded to J.-P. Sauvage, J. Fraser Stoddard and Bernard L. Feringa for "the design and synthesis of molecular machines" can be considered as the result of developments in SMC.

The emergence of SMC was orchestrated to a large extend by Lehn, but a network of scientists, as well as the University of Strasbourg in partnership with the CNRS, and the Alsace Region, were also instrumental in this regard. In 1996, Lehn created *Chemistry - A European Journal*, a periodical that became the forum for advances in SMC. One of the main aims of *Chemistry* was explicitly "to highlight and support the outstanding research produced by groups across Europe" (Lehn and Gölitz 1996). Lehn, who has repeatedly declared himself to be a "convinced European", claimed with regard to chemistry that "the launch [of European journals] has to be compared to the introduction of the euro!" (Lehn in Bléneau-Serdel, 2005). I use this quote as a starting point for this article.

Large transnational projects have been an important vehicle for European integration since the second half of the 20th century. Collaborative research infrastructures, such as the European Organization for Nuclear Research (CERN), for instance, have contributed to the construction of a new supranational identity called Europe (Trischler and Weinberger 2005). However, little work has been done on the actors of European integration (in this particular case, scientists), their social groups, the particularities of their trajectories, and their internationalization strategies. My purpose is to explore the construction of European identity by scientists "from below".

EU studies are dominated by policy and legal studies, and often limit their investigation to Europe's formal and informal policies and institutions, the dynamics of cooperation between nation-states, and the emerging of European policy networks (Misa and Schot 2005: 2). It is generally acknowledged that the contemporary process of European integration has been and still is steered and driven by the initiative of political and economic elites. The scientists that I study were not initially part of this political and economic environment but have, as we will see, established links with local and national political circles. In their book *The Elites of Europe*, Best, Lengyel and Verzichelli (2012) describe the process of European integration as "much more colorful and even contradictory than concepts

of a straightforward normative and structural integration suggest". Based on surveys of national parliaments and top business leaders in 18 European countries, this study strongly supports the view of an elitist process of European integration, while challenging the idea that European national elites have merged or are even merging into a coherent "Eurelite". In particular, this process is shown to be deeply rooted in and contingent on the social and political settings in national contexts.

There is a vast body of theoretical and empirical literature on European identity (Scalise 2015). The sense of belonging of groups socialized in the transnational dimension (the "highly Europeanized" citizens) has been investigated, whether they are EU-financed students (King and Ruiz-Gelices 2003) or play professional roles within the EU: civil servants at the European Commission (Shore 2000), journalists who cover the EU in Brussels (Siapera 2004), or EU officials (Wodak 2004). The link between cross-border movements within Europe and citizens' identities has also been examined (Recchi and Favell 2009). In her work, Scalise (2015) highlights the very local nature of the construction of European identity, arguing that the narratives of Europe shared in transnational networks contribute to the construction of European identity.

One of the most significant conceptual developments on collective identity is the work of Benedict Anderson. Seeking to understand nations and nationalism, Anderson introduced the concept of "imagined community" (Anderson 1983) which leads him to consider nationalism as a way of imagining and thereby creating a community. He argues that "print language" was the means whereby given vernaculars became standardized, being disseminated through the market of books and newspapers. In this way, mechanically reproduced print-languages become unified fields of linguistic exchanges, fixed national languages, thereby creating new idioms of power. Collective identity thus stems from the material elements of sharing. In line with Anderson, I characterize the SMC circles and track material elements that contribute to shaping a European identity in this particular domain and how Europe has been imagined by the actors and has become an "imagined community".

In the field of chemistry, studies on European integration focus mainly on the construction of European agencies. Waterton and Wynne (2004) have shown, in their analysis of the European Environmental Agency (EEA), how the way institutional information is produced and disseminated can now constitute a fundamental element of legitimacy within public bodies (in this case departments of the EU administration). Their study details how the EEA has fought since its creation at the end of the 1980s for its independence from the Commission's Directorate-General for Envi-

ronment, highlighting in particular its ability to produce information that is supposedly "politically neutral" and "objective". It is by acting as a guarantor of a certain "information model" that it has been able to defend the originality and independence of its missions, and thus avoid becoming no more than a tool for providing information to the administration. In their work on the formation of a European medicine licensing system, Hauray and Urfalino (2007) underlined the complexity of the intertwined processes that explain the formation of what they called "European policy spaces".

My aim is to integrate technology into these relevant contributions, which are mainly anchored in the field of political science. In their programmatic paper, Misa and Schot (2005) discussed the central issue of the co-construction of Europe and technology. They encouraged us to focus on international junctions (or sites) in the circulation and appropriation of knowledge and material artifacts. Considering Strasbourg[1] as an 'international city' whose internationality can be traced back to medieval times, I assume that the University of Strasbourg can be thought of as a junction. Moreover, this institution, where Lehn studied and spent most of his career, has international openness rooted in its history (Craig 1984; Olivier-Utard 2010; Crawford and Olff-Nathan 2005).

Following Misa and Schot (2005: 8-9), I consider Europe as an actor category. Seeing "Europeanization" as "a category of practice which has been projected and performed, experienced and exported, labelled and legitimized, appropriated and emulated in a range of contexts" (von Hirschhausen and Patel 2010), I will develop the idea here that SMC was the breeding ground of a "European chemistry" and that its study can make the processes of European identity formation visible.

In line with a previous book chapter (Noel, forthcoming), I develop a socio-historical approach in which I consider a new research specialty[2] as both a concept and a social object anchored in an institutional context and shaped by professionals and scientific policies.

Work on the emergence of disciplines or research fields, whether recent (Merz and Sormani 2016) or older (Lemaine *et al.* 1976), often uses

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[1] The very name of Strasbourg (*Strassburg*) refers to its location as a crossroads.

[2] In this work I rely on Mullins' definition (1972): "A specialty is an institutional cluster which has developed regular processes for training and recruitment into roles which are institutionally defined as belonging to that specialty. Members are aware of each other's work, although not necessarily deeply involved in communications with one another. They may share a paradigm and a set of judgements about what general work should be done in the field, although the details of those ideas might differ. The specialty, then, has many aspects of a formal organisation, *i.e.*, recruitment procedures, tests of membership, journals, meetings, etc., and the locations which support its work become much more important than they were at earlier stages".

journals, as well as conferences, as reflections of scientific activity. In these instances journals are seen as historical sources rather than historical phenomena in their own right. With notable and recent exceptions (Baldwin 2015; Fyfe *et al*. 2017; Csiszar 2017), the existence of periodicals is taken for granted, without their existence being seen as requiring explanation (Secord 2009: 444). Aside from work on the history of the book, the transmission of knowledge in print is generally considered to be relatively transparent. In contrast, regarding scientists as drivers of the process of Europeanization, I look at the Europeanization of a discipline (chemistry) in light of its "publication program". Europeanization is here understood as organized regionalization and represents political dynamics at the regional level of Europe (Smeby and Trondal 2005). By publication program, I mean the complex set of operations which consists in publishing (i.e. editing, producing and printing) journals. It is thus understood to be a resource for action, not a dogma.

A strong point of Misa and Schot's proposal is to push us to make the "linking" and "delinking" of infrastructures[3] visible. In this article I focus on the efforts that a network of scientists has put on the development of a European "publication infrastructure". Here this term[4] encompasses all the technological components and the rules governing their use, which make the formal scientific communication system possible (Weingart and Taubert 2017: 5).

In this article I do not discuss in depth what kind of entity SMC represents (a discipline, a sub-discipline, an 'interdiscipline', a specialty or a field). The object of our study is "European chemistry", which I capture through the trajectory of a key player, Jean-Marie Lehn, and the research specialty that he has developed throughout his entire career.

My aim is to bring together historical and more contemporary approaches. Lehn has been instrumental in the launch of *Chemistry – A European Journal*, whose genealogy I trace.

To tackle the question of European identity formation, my study has two main thrusts: first, I trace the emergence of SMC, with an emphasis

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[3] Misa and Schot's definition is not very precise. "Linking refers to the regional and national linking of infrastructures, railroads, highways, energy systems and communication networks. […] While sometimes creating structures of long duration, linking can be followed by de-linking. The example of de-linking that is chosen is the Cold War, which is interpreted as a massive de-linking and relinking of transport, energy and communication infrastructures in the very middle of Europe" (Misa and Schot 2009: 9)

[4] Here I follow Weingart and Taubert (2017: 5) who choose the term "publication infrastructure" (rather than "publication system") because it is more comprehensive and emphasizes the integration of individual components into a functioning whole by means of the word "infrastructure".

on its conceptual specificity; I then suggest that beyond the creation of a journal labelled as European, it is the combination of national publishing infrastructures, and the processes of articulating and disarticulating them that contributed to the sense of Europeanness that emerged in our fieldwork study.

This article is structured as follows. Based on Lehn's co-publications profile, I first summarize the successive stages of development of SMC and show how concepts and material artifacts travelled between individual scholars and their networks, between infrastructures, between geographically dispersed academic communities, and between historical periods. This section highlights the main results of an upcoming article (Noel, forthcoming). Second, I zoom-in on the crucial years for the institutionalization of SMC (1987-2005). These were also the years of the beginning of European integration and the appropriation, by a group of chemists, of the first European funding schemes (COST Actions). Third, I look at the launching of *Chemistry – A European Journal* in 1995, and then at that of an extended "European" publication program, enlarged to journals other than *Chemistry*.

The empirical investigations are based on various methods: the use of scientometric tools, and archival studies from the archives that document Guy Ourisson's whole career.[5] As regards the epistemic pattern of emergence, I used the substantial material underpinning SMC's growth: Nobel lectures, review articles,[6] textbooks, and other publications. I also drew on a descriptive bibliography to scrutinize the launch of *Chemistry – A European journal* (mandatory and advertising inserts, contents of editorials). For the most recent period, I relied on fieldwork carried out in Strasbourg and Zurich as part of a wider study (the ANR project PrestEnce).[7]

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[5] Guy Ourisson (1926-2006) is a French chemist, specialized in the chemistry of natural substances. He obtained two doctorates, the first at Harvard University in 1952 and the second in Paris in 1954. In 1955, at the age of 29, he was appointed Professor at the University of Strasbourg, where he pursued his entire scientific career. In 1971, he was one of the first founders of the Louis Pasteur University in Strasbourg of which he was the first president. He has received numerous French and international awards and other distinctions (Rohmer 2006). Guy Ourisson has supervised many Ph.D. theses, including that of Jean-Marie Lehn. The Guy Ourisson collection entered the archives department of the University of Strasbourg in 2011. References are: FR Service Archives de l'Université de Strasbourg/Guy Ourisson.

[6] There are more than 3,600 review articles indexed in the Web of Science that match the query condition "Topic= Supramolecular chemistry".

[7] 28 semi-structured interviews were collected between April 2010 and November 2013 (25 professors, researchers or staff belonging to the University, 3 outside scholars). Lasting an average time of 45 to 90 minutes, they were tape-recorded, then fully transcribed and anonymized. Some relevant excerpts of the transcripts are indicated in quotation marks. The analysis presented in section 4 is based on a series of interviews (28) conducted within the same framework (PrestEnce project) and with the same protocol at ETH Zurich between September 2010 and June 2011.

2. The Conceptual Specificity of SMC

What is SMC? The Larousse dictionary actually provides the following definition: it is a sub-discipline of chemistry which studies weak, non-covalent interactions between molecules.

Jean-Marie Lehn was the first to lay its foundations and formalize its concepts, in a seminal article published in 1978 (Lehn 1978). This work, especially the synthesis of cryptands performed in his laboratory ten years earlier, earned him the 1987 Nobel Prize for Chemistry, which he shared with Charles J. Pedersen (DuPont) and Donald J. Cram (University of California, Los Angeles) "for their development and use of molecules with structure-specific interactions of high selectivity".[8]

SMC is a term coined by Lehn as the "'chemistry beyond the molecule', bearing to the organized entities of higher complexities that result from the association of two or more chemical species held together by intermolecular forces" (Lehn 1988). In an editorial published on the occasion of the 50th anniversary of Pedersen's discovery, Lehn stated that he introduced the term SMC, "which is now widely accepted and has deeply permeated chemical literature, in order to define, consolidate and generalize the areas of crown ether chemistry, host-guest chemistry and the chemistry of molecular recognition, thus allowing for the emergence of the concepts and perspectives offered" (Lehn 2017). A prominent aspect of Lehn's work is his intense concern with chemical semiotics and the wide scope he addressed. The concepts and languages of SMC can to a large extent be attributed to his scientific creativity (Bowman-James *et al.* 2012). His great innovation was to argue that the synthesis of molecules was primarily guided by new functions and essentially by the information contained in the molecules.

Where does the specialty stand today? Diederich (2007) estimated that 20 to 30% of publications in leading chemistry journals were concerned with the practical achievements arising from concepts and visions that were developed in this research domain.[9] Cryptands are now found in chemical product catalogues (for example Merck offers Kryptofix® 22 or 222 for synthesis). At the present time, there are basically two facets to the

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[8] The Nobel Prize in Chemistry 1987. Available at: https://www.nobelprize.org/prizes/chemistry/1987/summary/ (accessed: April 8, 2019).

[9] Research domain is the terminology used by the author (Diederich), which well exemplifies the polysemic nature of the term "SMC". In his paper Diederich referred to journals such as *Angewandte Chemie*, *Chemical Communications, Chemistry: a European Journal* and *The Journal of the American Chemical Society*. The percentage announced (20 to 30%) means a considerable number of papers since a journal like the JACS publishes16,000 articles per year.

specialty: the one is oriented mainly towards synthesis, attempting to design constructions with given molecular bricks, while the other, focusing primarily on observation, seeks to explain, understand and partly control existing self-assemblages. The rise of SMC has also been accompanied by a development of new concepts and methods able to monitor the sometimes quite fast dynamics of supramolecular systems. With this, SMC has become fruitful also for other areas in chemistry.

In this paper I trace the history of SMC from the trajectory of Lehn, whose articles (nearly 900 publications between 1961 and 2011) are cited extensively, even today.[10] I produced his co-publications profile with the Demography module of the CorText Manager tool.[11] First 49 co-authors of Lehn (from a list of 488) are identified, whose names and affiliations are retrieved from Web of Science records (Figure 1).

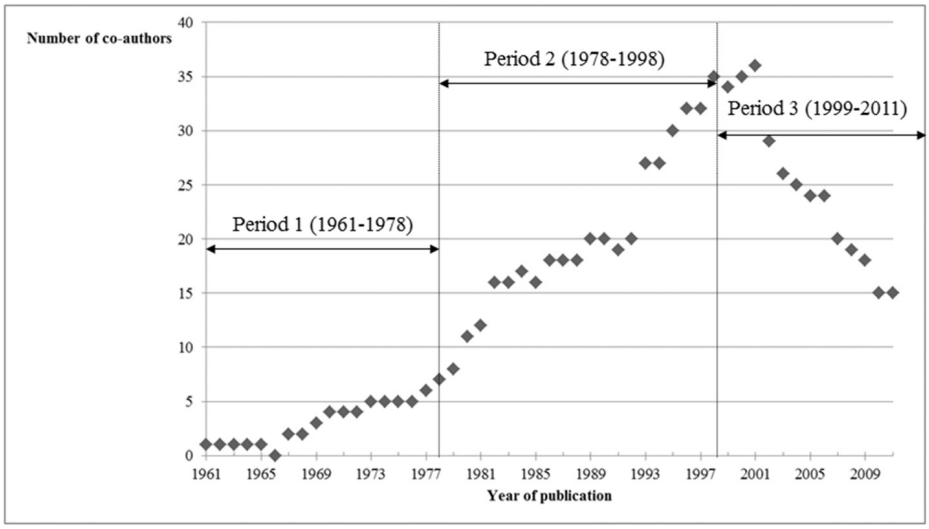

Figure 1. Jean-Marie Lehn's co-publications profile (first 49 co-authors identified).

[10] At the time of writing, his review article entitled "Perspectives in SMC" published in 1990 in *Angewandte Chemie* had been cited 2,000 times.

[11] The corpus analyses a .txt file built from a Web of Science request (set of 897 publications released between 1961 and 2011, 488 co-authors, number of co-authored publications ≥ 2). The "Demography" module of the CorText Manager tool (http://www.cortext.net/projects/cortext-manager.html) treats each variable of the corpus (authors, journals, terms, etc.) and follows the occurrence of the main variables, which may vary in number (20 or 50). Moving averages are used with time series data to smooth out short-term fluctuations and highlight longer-term trends.

Lehn's profile features some interesting elements. First, there was acceleration in the pace of co-authored publications in the two central decades (the slope, which seems fairly stable from 1966, suddenly increases). This is probably related to the "Nobel effect" (a period where Lehn received multiple proposals) but may also be emblematic of the growing importance of teamwork and the increasing division of labor in contemporary chemistry (Cronin *et al.* 2004). Broadly speaking the 1990s were also the years of the growth of co-authorship, since the percentage of articles with international co-authorship rose from 2% in the 1970s to nearly 10% in the 1990s (Olechnicka *et al.*, 2018).

Second, Lehn's co-authors diversified in the second and third periods: they were numerous and different from previous authors. Table 1 illustrates a mainly national partnership with a profile that extended to Europe throughout his career, with co-authors from Germany, Italy, Finland, Switzerland, Spain, Sweden, UK, etc. Lehn also published with American and Japanese colleagues. In the early '90s, the proportion of German co-authors rose significantly. I will discuss this aspect further below.

	Country where the majority of co-authors are located	Countries of origin (affiliation) of the collaborating authors
1961-1978	France (predominantly)	USA (from 1973)
1979-1998	France	USA
		Sweden (from 1981); Italy (from 1982); Netherlands, Switzerland, Spain, UK (from 1984)
		Canada (from 1988)
		Poland (from 1990); Germany, Finland (from 1991);
		China, Croatia, Israel, Japan (from 1995); Australia (from 1996); Lebanon (from 1997); Denmark (from 1998)
1999-2011	France	Germany, USA, Italy, Japan, Finland, Switzerland, Spain, Sweden, UK, Canada, China, Netherlands, Poland, Israel, Denmark, Croatia, Australia

Table 1. Jean-Marie Lehn's co-publications profile (first 49 co-authors, 20 countries identified).

Based on the slope variations that I have identified, I describe three periods (of almost equal duration) below: that of the emergence of the SMC paradigm, then of the research specialty, and finally of institutionalization.

2.1. *The Emergence of The SMC Paradigm (1961-1978)*

The 1960s, when Lehn entered the University, was a time of rapid growth of synthetic organic chemistry. After a thesis on triterpene NMR obtained under Ourisson's supervision, Jean-Marie Lehn left for a year to do a post-doc at Harvard, where he took part in the total synthesis of vitamin B12 (the most complex natural product synthesized to date), finally completed in 1971.

During the same period, natural macrocyclic compounds with antibiotic properties were synthesized (e.g. valinomycin in 1963), followed by synthetic cycles able to selectively complexify metallic cations that spontaneously insert themselves at the center of the molecule. The receiving molecule thus serves to recognize the substrate (in this case the cation). The selection operated by these host molecules fascinated chemists, as these processes mimicked those found in biological systems.

Upon his return from Harvard in 1964, Jean-Marie Lehn went to Strasbourg and joined the CNRS to create his own laboratory. Following his PhD, he had become a recognized specialist in the use of NMR for understanding the physical properties of organic molecules. Searching for different themes to those he had studied with Ourisson and Woodward, he decided to direct his research towards physical chemistry. NMR studies of the movements of a liquid's molecules ensued. In parallel, he developed an entirely theoretical theme in his group: ab initio calculations of structural and conformational properties (Lehn in Kleinpeter and Eastes 2011).

In 1966, Lehn's interest turned to "how a chemist might contribute to the study of […] highest biological functions" (Lehn 1988: 448). In this context, the first synthesis of crown ethers performed in 1967 by Pedersen, an engineer at DuPont, supported his idea that it was possible for a cage molecule (which has a cavity) to capture another molecule with a complementary form. This led to the development of the chemistry of cryptands and cryptates in his laboratory.

The first cryptand was synthesized in September 1968 by two researchers doing their PhDs, Jean-Pierre Sauvage[12] and Bernard Dietrich.[13] The

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[12] For a complete biography of Jean-Pierre Sauvage, see Biographical. Available at: https://www.nobelprize.org/prizes/chemistry/2016/sauvage/biographical/ (accessed: April 8, 2019).

[13] Bernard Dietrich's (1940-2004) professional activity began as a technician chemist at Louis Pasteur University in 1961. He joined Jean-Marie Lehn's laboratory in 1966 where, with

cryptand was rationally designed by Lehn, who took into account the little information available at that time on the complexation and transport of alkali metal ions by natural ionophores. It was a cage molecule, capable of selectively fixing a chemical substance (of the appropriate shape and size, in this case a potassium ion) in its cavity, called a crypt. The cryptand (from the Greek word kryptos, meaning hidden) was a new molecular object, with a bond between the potassium ion and the crypt which had nothing to do with the covalent bond. Even though the first cryptand was synthesized "by chance" (as mentioned in the closing lecture on 4 June 2010[14] at the Collège de France), this situation was not artificial. The first direct proof of cryptands' structure was provided with X-ray diffraction techniques[15] that Raymond Weiss developed at the University of Strasbourg (where he was professor from 1957). Work in the following years was to demonstrate the power of the concept of "molecular recognition"[16] and its generality.

Articles describing the synthesis and properties of cryptands were published in 1969 in *Tetrahedron Letters*, of which Guy Ourisson was the regional editor. These were short articles (4 pages), published in French. Initially owned by Pergamon Press, the journal was subsequently sold to Elsevier, in 1991.

In his Nobel Lecture, Donald J. Cram[17] recognized that "the work of C.J. Pedersen provided [us] an entry into a general field" (Cram 1988: 419). Cram described a speed race after the publication of Pedersen's work: "Although we tried to interest graduate students in synthesizing chiral crown ethers from 1968 on, the efforts were unsuccessful. In 1970 we insisted

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Jean-Pierre Sauvage, he developed the synthesis of new molecules. His doctoral thesis, defended in 1973, focuses on cryptands synthesis and anionic activation. After a post-doc at Harvard Medical School dedicated to the synthesis of cyclopeptides, he was recruited at CNRS in 1974. Back in Strasbourg, he developed the synthesis of anion complexants and was involved in the supervision and mentoring of doctoral and post-doctoral fellows. He is the author of many review articles and co-authored, in 1991, the reference manual *Aspects de la chimie des composés macrocycliques* with Paulette Viout and Jean-Marie Lehn.

[14] Available at: http://www.college-de-france.fr/site/jean-marie-lehn/closing-lecture-2010-06-04.htm (accessed: April 8, 2019).

[15] This was a long-term task because at that time, it took from 6 months to one year to determine the structure of a small molecule.

[16] Molecular recognition is the specific interaction between two molecules, which are complementary in their geometric and electronic features (like two fitting pieces of a jigsaw puzzle). The formulation of fundamental principles of molecular recognition goes back to the early 20th century, when Emil Fischer and Paul Ehrlich introduced the terms "lock and key principle" and "receptor/substrate". Lehn was the first to propose that molecular recognition be based on the pre-organization of the molecular species concerned and that it involve the storage and processing of molecular information.

[17] For a complete biography of Donald J. Cram, see Biographical. Available at: https://www.nobelprize.org/prizes/chemistry/1987/cram/biographical/ (accessed: April 8, 2019).

that several postdoctoral co-workers enter the field" (Cram 1988: 419). By 1974, he published (with his wife, Dr. Jane M. Cram) a first general article entitled "Host-Guest Chemistry" summarizing their thoughts, methods, and results (Cram and Cram 1974).

In their definition, hosts were synthetic counterparts of the receptor sites of biological chemistry, and guests, the counterparts of substrates, inhibitors, or cofactors. Cram and colleagues designed and prepared more than 1,000 hosts, each with unique chemical and physical properties (Cram and Cram 1994). Cram underscored the importance of visualization and the use of Cory-Pauling-Koltun (CPK) molecular models:

> From the beginning, we used Corey-Pauling-Koltun (CPK) molecular models, which served as a compass on an otherwise uncharted sea full of synthesizable target complexes. We have spent hundreds of hours building CPK models of potential complexes, and grading them for desirability as research targets (Cram 1988: 420).

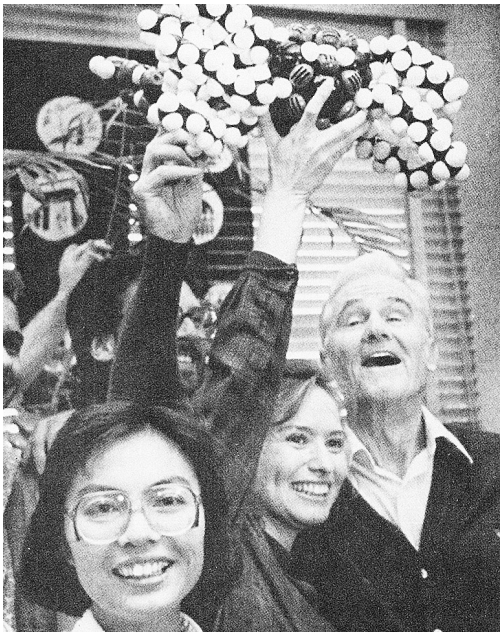

Figure 2. Cram and colleagues (one brandishing a CPK model) at the announcement of the Nobel Prize in 1987 (source: Lewin 1987.)

These artefacts, which provided better insights than usual graphs, tables and figures, were used to organize discussions and move collective work forward. Like Lehn, Cram and colleagues showed the relevance of their balls-and-sticks models and posed behind them in the photographs taken by the press after receiving the Nobel award in 1987.

2.2. *The Emergence of a Research Specialty (1979-1998)*

In 1978, Lehn introduced the term "supramolecular chemistry" to generalize the early developments and, at the same time, present concepts and visions that resulted from a better understanding and application of the noncovalent bond (Lehn 1978). Supramolecular structures are indeed a result of various noncovalent interactions (including electrostatic inter-

actions, hydrogen bonding, van der Waals forces, hydrophobic interaction, coordination, etc.), some of which are often cooperatively working in one supramolecular complex. More importantly, properties of the formed supramolecular complexes were found to be far beyond summation of the individual components.

In the following years, scientists extended their research questions to the study of supramolecular entities formed by self-organization processes, using molecular recognition to control and direct the spontaneous formation of complex architectures. The early 1990s saw the introduction of the notions of adaptation and evolution into chemistry, the extension of self-organization processes to the selection of the species contributing to it, and the implementation of "informed" chemical and dynamic diversity.

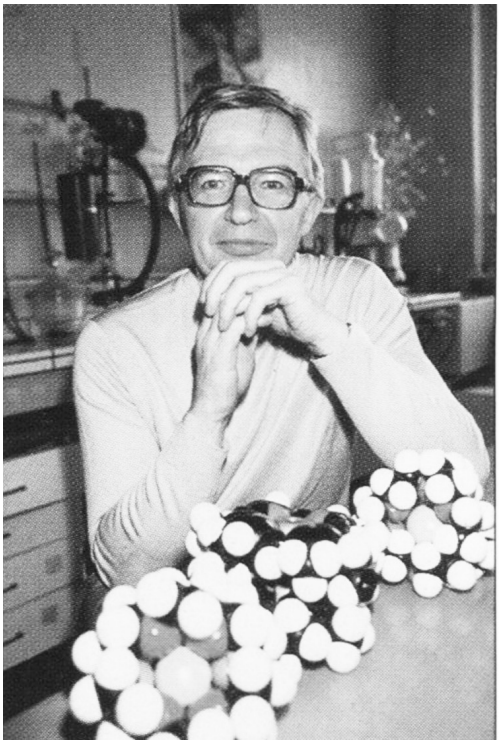

Figure 3. Highly cited. Jean-Marie Lehn (source: Bradley, 1993, initial legend).

In 1979, Lehn joined the Collège de France and became the holder of the Chair of Chemistry of Molecular Interactions (*Chaire de Chimie des interactions moléculaires*). This position gave him prestige and time to carry out research activities. He directed both laboratories (Paris and Strasbourg) at the same time. Between 1981 and 2000, he devoted time to extended stays at European universities (especially in Germany), outside Harvard, with which he had been in contact since the beginning of this career (Table 2). Lehn became co-director of the Institute of Nanotechnology of the Forschungszentrum Karlsruhe in 1998.

Dates	Hosting University	Title
1984	Cambridge University	Alexander Todd Visiting Professor of Chemistry
1985	University of Barcelona	Visiting Professor
1985-86	Frankfurt University	Rolf-Sammet Gastprofessor
Nov-Dec. 1989	Karlsruhe University	Heinrich-Hertz Gastprofessor
1997, 2000	Harvard University	Robert Burns Woodward Visiting Professor
1999-2000	Lincoln College, Oxford University	Newton Abraham Professor

Table 2. List of universities that hosted Jean-Marie as a visiting professor (1981-2000). Source: https://www.nobelprize.org/prizes/chemistry/1987/lehn/cv/.

During this period (1979-1998), the members of the initial cluster[18] began to develop more formal means of communication, thus becoming a specialty. Participants recruited students, while a multitude of collaborations developed and resulted in co-publications. In groups of two or three, scientists began to standardize their vocabulary: the term "molecular machine" was first discussed in an article by Vincenzo Balzani,[19] J. Fraser Stoddart[20] and collaborators in 1993. They were also building new resources that contributed to the dynamics of their relationships: textbooks and curricula, originally written in their mother tongue, became key elements of the educational agenda.[21]

Initiatives abounded, as the list of symposiums on (and surrounding) SMC attests. The topics listed in the consortium agreements covered included liposomes as well as nanogels or surface science, which were considered from a new angle (some conferences were on their 9th, 11th or 13th

[18] This study focused on an initial group of chemists (3 Nobel laureates and their collaborators).

[19] Vincenzo Balzani is an Italian chemist, now Emeritus Professor at the University of Bologna. Together with Jean-Marie Lehn he defined supramolecular photochemistry as the incorporation of photoactive units in supramolecular structures, known as receptor/substrate complexes. There have been controversies in Italy around the absence of Balzani, a pioneer in molecular machines, in the list of Nobel Prize winners in 2016.

[20] For a complete biography of J. Fraser Stoddart, see Biographical. Available at: https://www.nobelprize.org/prizes/chemistry/2016/stoddart/biographical/ (accessed: April 8, 2019).

[21] *Aspects de la chimie des composés macrocycliques* by B. Dietrich, P. Viout and J.-M. Lehn, 1991, *Supramolekular Chemie* by F. Vögtle, 1989.

editions). Jerry L. Atwood, professor at the University of Missouri, became interested in SMC in 1968. He considered the founding conference to have been the one organized in Jachranka, close to Warsaw in Poland:

> There was a key meeting in Poland in 1980 and that meeting formed the basis for the development of the field of supramolecular chemistry. It was one of those meetings where I knew no one when I went there; all of us came from different areas and in that week I made many of my best friends.[22]

Although the 50 participants were overwhelmingly European, neither Jean-Marie Lehn nor his group were present.

This period was also the time of the creation of journals dedicated to SMC, some of which were short-lived (*Supramolecular Science*, founded in 1994, merged with *Materials Science and Engineering C* in 1999). The scope of many of these journals varied. Founded in 1983, the *Journal of Inclusion Phenomena* became the *Journal of Inclusion Phenomena and Macrocyclic Chemistry* in 1999. These journals were hosted by commercial publishers (respectively Elsevier and Springer).

Lehn published *Supramolecular Chemistry – Concepts and Perspectives* in 1995.[23] Chapter 1 focuses on "concepts and languages in supramolecular chemistry". The book was translated into Japanese (1997), then Russian (1998) and Chinese (2002). Atwood set up an editorial board which finally produced a set of eleven volumes (197 chapters, 6672 pages), published in 1996, covering the entire range of this rapidly expanding specialty (*Comprehensive Supramolecular Chemistry*, Pergamon Press, 1996).

The resources created became increasingly collective and consubstantial with the existence of the specialty: Volume 11 of the manual mentioned above is a cumulative subject index, further aiding the location of specific pieces of information.

During this period, connections to political circles developed in Strasbourg. After holding the position of President of the University, Guy Ourisson assumed the responsibilities of Head of the Directorate General of Higher Education and Research at the Ministry of Education (1981-1982). Among many other things, his efforts focused on the recognition of Strasbourg chemistry, in particular Lehn's entry into the French *Académie des Sciences*, to which he was elected on 29 April 1985, at the age of 46. Sauvage

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[22] ChemComm, An Interview with Professor Jerry Atwood, 2012. Available at: http://www.rsc.org/Publishing/Journals/cc/News/AtwoodInterview.asp (accessed: April 8, 2019).

[23] The book was built upon the Baker Lectures at Cornell University in 1978 and the Lezioni Lincee at Accademia Nazionale dei Lincei (Roma) in 1992. At the date this article was written, it had been cited more than 12,000 times.

was elected correspondent of the *Académie* in 1990, and member in 1997. Ourisson himself was appointed Vice-President of the *Académie* in 1997, a position he held until 1998. From 1999 to 2000, he was finally the first non-Parisian President of the *Académie* since its creation in 1666.

Others chemists from Strasbourg, such as Maurice Gross, focused on more institutional work locally. As scientific adviser to the President of the Alsace Region (Marcel Rudolff) for 10 years (1984-1994), he worked closely with the local authorities to encourage the creation of a supramolecular chemistry institute and the financing of the construction of the building. Rudolff was deputy Major of Strasbourg under the mandate of Mayor Pierre Pflimlin; their team is known to have made Strasbourg a European City.

In 1987, Jean-Marie Lehn defined SMC as the "chemistry beyond molecules". It is a polysemic object, both a concept and a specialty, even a discipline, with the main characteristic of being situated "at the borders of" (Noel forthcoming).

In Strasbourg, the Nobel Prize award helped to remove some institutional barriers. Lehn was already at the very top of recognition scientifically, as he received the CNRS Gold Medal in 1981. As Picard points out in his history of French public research, it is difficult for science historians to explain the place of the CNRS in the history of each discipline (Picard, 1990). The CNRS was not seen as a major actor in the early emergence of the SMC (it was rarely cited by the scientists in our fieldwork). The situation however changed in 1992, with the creation of Section 15 "Complex Molecular Systems" [24] and the concomitant creation of a CNRS research unit (*Unité Propre de Recherche*, UPR) in Strasbourg, directed by Lehn. In 1996, Jean-Claude Bernier, professor of chemistry at Louis Pasteur University,[25] was appointed Head of the CNRS Chemistry Department. The conditions were then created to allow resources to be allocated to the institute that was being planned.

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[24] The CNRS is currently divided into 46 sections that form the National Committee for Scientific Research (CNRS's evaluation body). Of these, 5 sections are headed by the Institute of Chemistry, two with shared governance with the Institute of Physics (Section 11) and the Institute of Biological Sciences (Section 16). There are some 2,000 researchers reporting to the CNRS Institute of Chemistry, while 3,000 professors teach chemistry at the university, i.e. a total of about 5,000 chemists working in French public R&D (2015 figures).

[25] Like most universities in major French regional metropolitan areas, the University of Strasbourg was divided after 1968 into three universities: scientific and medical (Strasbourg I, Louis Pasteur), human and social sciences (Strasbourg II, Marc Bloch) and legal sciences (Strasbourg III, Robert Schumann).

2.3. Institutionalization Processes: Materializing Concepts (1999-2011)

The third period was the institutionalization. Jean-Marie Lehn endeavoured to materialize the concepts of SMC in its successive senses and devoted part of his efforts to ensuring the long-term survival of the bodies created: the Supramolecular Science and Engineering Institute (*Institut de Science et d'Ingénierie Supramoléculaire*, ISIS), which was hosted in a new building from 2002, then the thematic network of advanced research (RTRA).[26] As shown on his co-publications profile, Lehn was involved in many and diverse collaborations and travelled extensively. In 2002, Maurice Gross became Adviser to the Cabinet of the Minister of Research and New Technologies, Claudie Haigneré, and then to Minister François d'Aubert, in 2004. After a national competition and evaluation by an international jury, the associated scientific foundation was allocated with € 17 million by the French government in 2007, to which were added endowments from the CNRS (€ 2 million), Louis Pasteur University (€ 1 million), BASF France (€ 0,5 million) and Bruker Biospin (€ 0,25 million). In 2012, the AXA Research Fund awarded € 2.25 million euros to the University of Strasbourg to create an endowed Chair of Supramolecular Chemistry, held by Prof. Luisa De Cola.

ISIS was designed to allow Lehn to develop his research, based on a concept which he himself defined: that of a scientific project incubator, where "the most brilliant young researchers in the supramolecular sciences will be able to express themselves freely, before pursuing their career in other research centres".[27] This new institute (in a way the major achievement of his career), supported by the Louis Pasteur University in partnership with the CNRS and funded by local government (Alsace region), was thought of as an organizational innovation on the French research scene. Based on Strasbourg's reference, public research organizations (CNRS, INSERM, etc.) and universities encouraged the creation of such "research hotels" (*hotels à projets*) in France. In Bordeaux, the European Institute of Chemistry and Biology (*Institut Européen de Chimie et de Biologie, IECB*), opened in 2003, was built with a specific reference to Lehn's project.

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[26] The RTRA (*Réseau Thématique de Recherche Avancée*) – CIRFC (*Centre International de Recherche aux Frontières de la Chimie*) was created in 2006 resulting in the creation of 13 RTRAs. This was the only one in France mainly concerned with chemistry. The associated scientific foundation FRC was established in 2007 with the University of Strasbourg, the CNRS, BASF-France, and Bruker-Biospin as funders, and with funding by the Ministry of Higher Education and Research. The administration of the RTRA and of the foundation is located in the ISIS building, where the laboratory of its Director is also located.

[27] Declaration by Claudie Haigneré, French Minister for Research and New Technologies, inauguration of the ISIS, 9 December 2002.

In December 2011, the ISIS counted nine laboratories and four industrial branches. Even if firms are now located in the ISIS building, SMC did not initially develop with a horizon of applications. This original structure consisted of senior laboratories, headed by recognized and internationally renowned scientists, and junior laboratories, where researchers beginning their career develop independent research as part of a project that is not scheduled to last more than six years. The ISIS stands out in the French research ecosystem: the recruitment of foreign professors on the international market has strongly impacted an organization that still has strong local roots.

3. Building of a European publication program (1987-2005)

The 1980s saw the beginning of the European institutional construction in S&T, and the growth in scale and importance of European political institutions. From 1958, Strasbourg had been one of the key centers of the European Parliament and also home to the Council of Europe (an international organization, distinct from the EU, founded in 1949) and the European Court of Human Rights.

As Misa and Schot (2005) emphasized, political leaders embraced European integration mostly to create the European market they believed was necessary to compete economically with the USA. Political and economic integration promised also to bind together the two powerful but frequently opposed nations of Germany and France. It was in this context that a European journal started to develop from Strasbourg. 1984 was also the launch year of the first Framework Program for Research and Technological Development that aimed to group together all the research and development actions in a multi-annual program, thus giving them coherence.

In the following sub-section, I will see how the notion of "European chemistry" was shaped in relation to the extra-European world (the USA), through the comparison of the "quality" of outputs in terms of numbers of papers and citation counts. I will zoom in on the crucial years for the institutionalization of SMC (1987-2005) and look in detail at the launching of *Chemistry – A European Journal*, and the series of journals that followed. I will then examine the corresponding reality of European chemistry beyond Strasbourg.

3.1. *Comparing Itself to the USA*

In 1993, the (American) journal *Science* devoted one of its issues to science in Europe (Bradley, 1993). The article, titled "European elites

envy American cohesion", was written by an English columnist David Bradley, who covered chemistry news for many magazines, journals and websites. It provided an overview of European research in the field of chemistry, and was completed with a variety of rankings. Bradley pointed out that 23 of the 55 Nobel Prize winners in chemistry since 1960 were European, and that Jean-Marie Lehn was one of the most cited authors in the world.

Country scoreboard				
Rank	Nation	Papers	Nation	Cites/paper
1	USA	94,237	USA	4.47
2	USSR	47,870	Israel	4.01
3	Japan	42,229	Switzerland	3.92
4	Germany*	36,859	Netherlands	3.48
5	United Kingdom	26,685	Canada	3.37
6	France	21,342	Sweden	3.36
7	India	15,719	Denmark	3.11
8	Canada	13,430	United Kingdom	3.00
9	Italy	12,508	Australia	2.98
10	Spain	10,566	New Zealand	2.96
11	Poland	8,408	Ireland	2.94
12	Netherlands	6,872	France	2.88
13	Peo. Rep. China	6,178	Germany*	2.87
14	Australia	5,716	Hong Kong	2.80
15	Czechoslovakia	5,681	Italy	2.75
16	Switzerland	5,197	Japan	2.64
17	Sweden	4,440	Austria	2.51
18	Hungary	3,570	Belgium	2.32
19	Belgium	3,316	Norway	2.22
20	Egypt	3,067	Greece	2.13

Europe's Top 25				
Rank	Name	Papers	Citations	Cites/paper
1	Fritz Haber Inst.	457	2532	5.54
2	Max Planck Inst. Coal Research	379	1832	4.83
3	University of Cambridge	1809	8531	4.72
4	University of Strasbourg 1	810	3807	4.70
5	Max Planck Inst. Biophys. Chem.	257	1204	4.68
6	Swiss Federal Inst. Tech. (ETH)	1372	6396	4.66
7	University of Basel	453	2112	4.66
8	University of Southampton	743	3344	4.50
9	Centre d'Etudes Nucléaires (all)	385	1702	4.42
10	University of Bristol	849	3738	4.40
11	University ofLausanne	426	1867	4.38
12	University of Mainz	897	3862	4.31
13	Philips Res. Labs (worldwide)	356	1535	4.31
14	University of Oxford	1574	6722	4.27
15	KFA Jülich GmbH	449	1910	4.25
16	University of Florence	488	2445	4.24
17	State University of Gronigen	672	2832	4.21
18	University of Frankfurt	488	2038	4.18
19	University of Zürich	410	1711	4.17
20	University of Sussex	714	2928	4.10
21	University of Exeter	396	1608	4.06
22	University of Bielefield	410	1651	4.03
23	Catholic University of Nijmegen	600	2406	4.01

24	University of Liverpool	484	1918	3.96
25	University of Constance	335	1323	3.95

Table 3. Rankings of: a) European countries, and b) institutions in the field of chemistry. Citation counts were conducted for *Science* by ISI's research department, which surveyed papers published between 1988 and 1992 in chemistry journals and multidisciplinary journals such as *Science* and *Nature*. Lists for Germany included the papers and citations of the German Democratic Republic and the Federal Republic of Germany together. Rankings included only institutions that published more than 250 papers papers (Adapted from Bradley, 1993).

American universities topped the world ranking (Harvard was ranked n° 1 with 937 publications in the covered period, with an average of 9 citations per paper). Among the European institutions, Strasbourg held an honorable 4th position, with high citation scores (Table 3). These results were also used to highlight the quality of chemistry in Strasbourg, in particular in the dossier for the creation of the Graduate School of Molecular and Supramolecular Chemical Sciences in 1994.[28]

"Chemistry is doing exceptionally well in Europe, said J. Fraser Stoddart, professor at the University of Birmingham at the time, in an interview. "Europe is doing excellently compared with both the United States and Japan", added Dieter Seebach, professor at ETH Zürich.

"It is difficult to say [what Europeans do best] because research is so varied", explained Jean-Marie Lehn. The diagnosis presented in the article is: each country has its own national research bodies that spread resources around dozens of labs. There is no European equivalent of the American Chemical Society (ACS) to provide a continent-wide sense of community, nor a European chemistry journal. All interviewees regretted the absence of a European scholarly society which, like the ACS, would defend the interests of European chemists. Moreover, there was widespread resentment towards the so-called "Brussels bureaucracy": "the inefficiency with which Brussels handles applications for grants, etc. strongly suggests some innovative thinking [is needed]", commented Per Ahlberg of Gothenburg University in Sweden.

Lehn and others considered that the main role of such a pan-European organization was not so much to demand more central funding for research, but to publish a European journal of chemistry that would rival the *Journal of the American Chemical Society*. This journal would have to com-

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[28] FR Service des archives de l'Université de Strasbourg; Fonds Guy Ourisson; GO 459; Ecole Doctorale des Sciences Chimiques Moléculaires et Supramoléculaires de Strasbourg.

pete not only with a plethora of small-circulation and "national" chemistry journals, but also with two existing top-rated journals: *Angewandte Chemie,* published by VCH Publishers Inc. under the auspices of the *German Chemical Society*, and the UK *Royal Society of Chemistry*'s *Chemical Communications*. Lehn argued that a European journal could exist alongside *Angewandte Chemie* and *Chemical Communications*, but at least some rationalization of the smaller journals might be needed. Such a feeling was shared by Manfred Reetz, director at the Max Planck Institute for Nuclear Research in Germany, who noted that: "Each relevant country would have to 'sacrifice' one of its own present national journals".

This was an old concern for chemists. In 1974, Lehn was associated with a forum that denounced the proliferation of scientific journals in chemistry (Ballhausen *et al.*, 1974). This opinion piece entitled "Too many chemistry journals" [29] was signed by 11 chemists, including two Nobel Prize winners (H.G. Khorana, Nobel Prize laureate in physiology of medicine in 1968 and R. Hoffmann, who was to become a laureate in chemistry in 1981). Nine of the 11 signatories were affiliated with European universities.

Their statement and call for action was addressed to both colleagues and libraries, and targeted mainly the "new commercial journals" that flourished in the 1970s. The signatories were concerned about costs and "lax refereeing standards that are characteristic of some of new commercial journals", which they compared with those of "other established [ones]". They furthermore regretted the "compartmentalization of chemistry into more and more specialized sections [which] encourages these new journals and is encouraged by them". They urged libraries "to exercise the greatest reticence on subscription to new commercial journals". Acknowledging that "national chemical societies are not perfect", the petitioners also ask their colleagues to "refrain from publishing" in commercial periodicals. They specifically blamed some national journals that "deplorably have imposed penalties, in the form of delays, for nonpayment of page charges".[30]

The signatories concluded their forum with a wish:

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[29] Initially published in December 1973 in *Chemical & Engineering News* (C&EN), this piece was reprinted in three professional journals. Two were dedicated to chemists (*Chemistry in Britain*, ancestor of *Chemistry World*, published by the UK *Royal Society of Chemistry*, and *Chimica & L'Industria* published in Italian by the Italian Chemical Society), while the third was an international professional journal for librarians (*College & Research Libraries)*.

[30] In a context of economic crisis and social movements, the 1970s were a period of severe turbulence for journals. In 1975 this resulted in sharply increasing paper costs (+64% compared to 1973). On the budgetary balance of scholarly societies and the emergence of page charges, see Noel 2017.

Ideally, some international agency ought to be constructed for examining and assessing the foundation of new journals. At the present time this is probably an unrealistic thought. […]. [National societies] should, however, be urged to set up an impartial mechanism for evaluating the need for a new journal and require that criteria for assuring the level of quality are met. A set of criteria for refereeing practice, statistics concerning rejection rates, criteria for terminating a journal, restrictions on language or national origin of work, pages charges, etc., would be the proper concern of any committee.

This call has a particular resonance today. With the development of Open Access policies but also of journals qualified as "predators", a large number of reference lists of journals have been created over the past two decades: Directory of Open Access Journals,[31] SHERPA RoMEO,[32] SCIMAGO Journal and Country Rank,[33] etc. These independent general-purpose databases are mostly maintained by public institutions or organizations, and their operation is based on membership. The lists provide more or less the certification function that is described in the quote ("examining and assessing the foundation of new journals"). In high-energy physics, there has also been an attempt to convert all the journals of the field to Open Access at no cost for authors, whether they are commercial or published by learned societies. Benefiting from the fact that the field is driven and coordinated by one central organization (CERN), scientists, publishers and policy-makers have established a "regulatory publishing authority" (Sponsoring Consortium for Open Access Publishing in Particle Physics, SCOAP). It is in a sense this kind of organization that chemists are calling for in 1974.

In the rest of the article, I will see how a network of chemists has dealt with the "proliferation of journals" issue. After a long period of maturation, the creation of the European journal proved to be successful quite quickly.

3.2. *Launching of Chemistry* – A European Journal *(1995)*

As illustrated above, there have been several unsuccessful attempts over the years to develop the idea of a "European quality journal". Lehn reported discussions started from the 1970s with Lionel Salem and continued in the 1980s with Jean Cantacuzène, then Head of the CNRS

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31 Available at: https://doaj.org/ (accessed April: 8, 2019).

32 Available at: http://www.sherpa.ac.uk/romeo/about.php?la=en&fIDnum=|&mode=simple (accessed: April 8, 2019).

33 Available at: https://www.scimagojr.com/aboutus.php (accessed April 8, 2019).

Chemistry Department (Lehn in Bléneau-Serdel 2005). In 1977, this resulted in the creation, by the CNRS, of the *Nouveau Journal de Chimie*, an "interdisciplinary journal". NJC was to be renamed *New Journal of Chemistry* in 1986, and was then published by the *Royal Society of Chemistry*. The attempt to make it a European journal was unsuccessful but Lehn was not giving up.

> In 1991, [J.F. Stoddard] wrote to one of us: "You know I feel very strongly that European chemists should be addressing the issue of a medium in which to publish full papers... I keep dreaming about the *European Journal of Chemistry*..." (Lehn and Gölitz 1995).

Testimonies bear witness to the fact that the concept of a "European forum for top-quality full papers" became a reality in 1993 (Lehn in Bléneau-Serdel 2005). The idea was born from discussions at a symposium in Münich between Lehn, Heinrich Nöth, then president of the German Chemical Society (GDCh), and Peter Gölitz, Editor of *Angewandte Chemie* from the VCH publishing house. The principle was to make *Chemistry* "the first European journal publishing full papers from all disciplines of chemistry". In doing so, *Chemistry* stood apart from *Angewandte Chemie* whose articles were in the form of communications or review articles.[34] When dealing with SMC, *Chemistry* also differed from more specialized journals dedicated to organic synthesis or coordination chemistry. Based on what already existed, the editorial mechanism aimed at producing classifications and categories that helped to define what a "full paper" in a "European quality journal" should be. In the advertisements accompanying the publication of the first issue, full papers were represented as a genius in a bottle, suggesting that once the genie was out, it would be impossible to put it back. This was most probably the challenge that Lehn and Gölitz took up in developing this "full paper" format.

An Editorial Board bringing together leading figures in all aspects of chemistry from all regions of the world was assembled under the leadership of Jean-Marie Lehn from the beginning. The first call for papers was issued in September 1994. The inaugural issue, published in April 1995, featured 10 full papers on a wide range of topics. In the editorial, Lehn ex-

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[34] Communications report on experimental and/or theoretical studies in all branches of chemistry and adjacent fields (length: up to 20,000 characters). Review articles (length: up to 100,000 characters) deal with topics of high current interest in any area of chemistry. Rather than an assembly of detailed information with a complete literature survey, a critically selected treatment of the material is desired; unsolved problems and possible developments should also be discussed.

pressed his satisfaction that Stoddard was publishing an article in this first issue (Lehn and Gölitz 1995).

Chemistry was initially bound and distributed with *Angewandte Chemie International Edition*.

> *Angewandte Chemie* was the driving force behind the project. We thought that associating *Chemistry* initially with a single company [VCH] and a single country [Germany] would be compensated by the efficiency of the system, because the association with *Angewandte* guaranteed a wide circulation and a quick visibility (Lehn in Bléneau-Serdel 2005).

The economic argument (two journals for the price of one) was used to attract readers of potential "outstanding full papers", as emphasized in a promotional flyer attached to the first issue.

> The *European Journal* will appear with every second issue of *Angewandte Chemie* **at no extra cost** to the subscriber. This will guarantee a **high circulation and top quality**. After the initial start-up phase, *Chemistry* will be launched as an independent journal.
>
> So if you would like to subscribe to *Chemistry*, please make use of our attractive personal subscription rates for *Angewandte Chemie* by filling in the order form on the back page of *Angewandte*. When the time is ripe for *Chemistry* to break away, you will be able to choose to subscribe to one or both of the journals. In the meantime, we are offering you **two top quality journals for the price of one**! (emphasized in the original).

The idea of independence from *Angewandte Chemie* was affirmed from the beginning:

> Those who view *Chemistry* as just the full paper section of *Angewandte Chemie* may be in for a shock: the *European Journal* will be trying out its wings as an independent journal in the New Year (Lehn and Gölitz, 1996).

This was a necessity for the journal, and efforts were made early on to attract scholarly societies other than GDCh. Grand principles and the general idea of merging national society journals were quickly agreed on in 1990, but the negotiations stalled over concrete details. VCH was then "persuaded to take the risk", and "the treasurer of the German Chemical Society to advance some extra money" (tom Dieck 1996).

As Lehn affirmed in an interview, for him there was one condition for supporting the journal: "being European" (Lehn in Bléneau-Serdel 2005: 3). He suggested replacing "the manuscripts must be in English" by "the manuscripts should be in English", and ensured that authors were given the opportunity to publish an abstract in their own language, whatever it may be.

One of the interesting features is that the debate about the forms that knowledge should take was at every point involved in the making of knowledge. In the previous paragraph, I underlined Lehn's interest in the conceptual part of the research pursued. Here is how the notion of "Concept articles" was introduced as a new feature in *Chemistry* in September 1996.

> This new section will contain short articles (about five journal pages) emphasizing the general concepts that have guided important developments in a specific area and their implication for future research. They will be written by authorities who have been instrumental in shaping the conceptual advances in the field under review. […]. The Concepts in *Chemistry* will thus be broader in scope than the personal research accounts now common in many journals, since they will go beyond the most recent research of individual scientists. They will be shorter than comprehensive reviews, but longer than the Highlights in *Angewandte Chemie* or the News and Views in *Nature*. Concepts in *Chemistry* will complement the full paper section perfectly: the non-specialist reader will be provided with a useful conceptual guide through less familiar areas; for those directly involved in a field, Concepts will look at familiar problems from a new angle (Lehn and Gölitz, 1996).

The idea of revising old questions with a new prism was put forward in this new format. Although concept articles were generally written upon invitation of the editor, unsolicited manuscripts were also welcome. The number of concept articles published was regularly announced in editorials: "This month we celebrate the appearance of our fiftieth concept article in print" (No.12, 1998) or "The 100 issues of *Chemistry – A European Journal* have contained almost 1,950 full papers and 140 concept articles" (No.19, 2001). Over 250 concept articles were published in the first ten years, which was a significant outcome for the editors. This category of contributions was an opportunity to engage collective reflection on the very notion of concept, through interactions between all those engaged in the writing and reviewing of concept articles.

As far as submissions were concerned, the intention behind "the original motto 'Made in Europe for the World' was fulfilled over the first 100 issues" (Lehn and Gölitz 2005). About 70% of the manuscripts were of European origin, although papers were also received from the US, Japan, and other parts of the world (Figure 4).

Chemistry became the tribune for the SMC advances, which developed into a lively body of concepts and objects that gradually generated and incorporated new areas of investigation. Some key authors were particularly prolific: J. Stoddard, J.-M. Lehn, K.C. Nicolaou and David N. Reinhoudt contributed more than 30 articles in 10 years.

Figure 4. Advertizing insert published in the first issue of *Chemistry* (vol. 1, n. 1, April 1995), highlighting the European nature of the periodical ("European in Spirit, International in Appeal"). Europe is at the center of the world map.

3.3. *Extension of the Publication Program to Journals other than* Chemistry

"It soon became clear that *Chemistry* constituted a nucleus around which a whole new structure could crystallize" (Lehn 1997). Given the success of *Chemistry*, the partnership among the European chemical societies grew. In 1998, nine titles were merged to form two companion titles, *European Journal of Inorganic Chemistry* (EurJIC) and *European Journal of Organic Chemistry* (EurJOC). These titles were published by Wiley and co-owned by a collection of European societies, most of whose publishing activities were grouped under the Editorial Union of Chemical Societies (EUChemSoc).

EurJIC and EurJOC were designed on the same model and published full papers, short communications, and micro-reviews. The intended audience was "chemists of all disciplines". While EurJIC covered "the entire spectrum of inorganic, organometallic, bioinorganic, and solid-state chemistry",[35] Eur-

[35] https://onlinelibrary.wiley.com/journal/10990682c (Accessed 9 April 2019).

JOC targeted "the entire spectrum of synthetic organic, bioorganic and physical-organic chemistry".[36]

The long history underlying the development of each national journal can be seen in Table 1. Whether they were rooted in the landscape (as in Germany) or more recent (as in Greece), these national journals were linked in an infrastructure that was labelled as European. Major developments were driven by the publisher (Wiley), in particular the introduction in March 2002 of an online platform (ManuscriptXpress) for the submission and refereeing of manuscripts, and for the production process. Significant resources were allocated to the Editorial Office, which was composed of about 15 people in 2005 (Compton 2005).

Country	"Precursor" journal (ISSN)	
	European Journal of Inorg Chem	European Journal of Org Chem
Germany	Formed by the merger of part of (1947-1998): Chemische Berichte (Germany) (0009-2940)	Formed by the merger of part of (1818-1998): Liebigs Annalen (Germany) (0947-3440)
	Which was formed by the merger of part of (1929-1947): Berichte der Deutschen Chemischen Gesellschaft Abteilung A: Vereins-Nachrichten (Germany) (0365-947X)	Which was formerly (until 1995): Liebigs Annalen der Chemie (Germany) (0170-2041)
	Part of (1929-1947): Berichte der Deutschen Chemischen Gesellschaft Abteilung B: Abhandlungen (Germany) (0365-9488)	(until 1978): Justus Liebigs Annalen der Chemie (Germany) (0075-4617)
	Both of which superseded (1868-1928): Berichte der Deutschen Chemischen Gesellschaft (Germany) (0365-9496)	(until 1840): Annalen der Pharmacie (Germany) (0365-5490)
		(until 1832): Magazin fuer Pharmacie (Germany) (0369-1462)
		(until 1825): Magazin fuer die Neuesten Erfahrungen, Entdeckungen und Berichtigungen im Gebiete der Pharmacie (Germany) (0369-1004)

[36] https://onlinelibrary.wiley.com/journal/10990690 (Accessed 9 April 2019).

		(until 1823): Allgemeine Bordische Annalen der Chemie fuer die Freunde der Naturkunde und Arzneiwissenschaft im Russischen Reiche (Germany) (0365-4923)
Italy	Part of (1871-1998): Gazzetta Chimica Italiana (Italy) (0016-5603)	
Portugal	Part of (1905-1998): Revista Portuguesa de Quimica (Portugal) (0035-0419)	
Hungary	Part of (1951-1998): Acta Chimica Hungarica: Models in Chemistry (Hungary) (1217-8969)	
France	Part of (1907-1998): Société Chimique de France. Bulletin (France) (0037-8968)	
	Which was formerly (until 1946): Bulletin de la Société Chimique de France. Mémoires (France) (0366-3132)	
Greece	Part of (1972-1998): Hemika Hronika. Nea Seira (Greece) (0366-693X)	
	Which was formerly (1969-1970): Hemika Hronika. Epistemonike Ekdosis (Greece) (0366-5496)	
Netherlands	Part of (1882-1998): Recueil des Travaux Chimiques des Pays-Bas (Netherlands) (0165-0513)	
	Which was formerly (until 1920): Recueil des Travaux Chimiques des Pays-Bas et de la Belgique (Netherlands) (0370-7539)	
	until 1897): Recueil des Travaux Chimiques des Pays-Bas (Netherlands) (0034-186X)	
Belgium	Part of (1945-1998): Sociétés Chimiques Belges. Bulletin (Belgium) (0037-9646)	
	Which was formerly (until 1944): Société Chimique de Belgique. Bulletin (Belgium) (0374-6585)	
	(1887-1903): De l'Association Belge des Chimistes. Bulletin (Belgium) (0770-3201)	
Spain	Part of (1990-1998): Anales de Quimica (Spain) (1130-2283)	
	Which was formed by the merger of (1989-1990): Anales de quimica. Serie A, Quimica Fisica e Ingenieria Quimica (Spain) (0214-9397)	
	Which was formerly (until 1989): Anales de Quimica. Serie A, Quimica Fisica y Quimica Tecnica (Spain) (0211-1330)	

	(1903-1990): Anales de Quimica. Serie B, Quimica Inorganica y Quimica Analitica (Spain) (0211-1349)
	(1903-1990): Anales de Quimica. Serie C, Quimica Organica y Bioquimica (Spain) (0211-1357)
	All of which superseded in part (in 1980): Anales de Quimica (Spain) (0365-4990)
	Which was formerly (until 1967): Anales de la Real Sociedad Espanola de Fisica y Quimica. Serie B, Quimica (Spain) (0034-088X)
	Which superseded in part (in 1948): Anales de Fisica y Quimica (Spain) (0365-2351)
	Which was formerly (1903-1940): Anales de la Sociedad Espanola de Fisica y Quimica (Spain) (0365-6675)

Table 4. All the titles that merged when the *European Journal of Inorganic Chemistry* (EurJIC) and the *European Journal of Organic Chemistry* (EurJOC) were created in 1998.

25 years after its launch, *Chemistry* is a well-established journal that scientists target when their results qualify (multi-disciplinarity is required). For one of the chemists in Strasbourg that we interviewed, what matters is that the periodical has an impact comparable to that of the JACS (without naming it):

If you want to be read these days – given that your paper includes multidisciplinary aspects – at the moment we have good European journals […], all the other journals that resulted from the merger of the different national societies have an impact that has nothing to envy of American journals (CNRS Director of Research, University of Strasbourg, 22/11/2010).

Again, the European identity is constructed against something else (the American journals): another chemist maintained that journals with a European dimension needed to be largely favored:

Angewandte Chemie is a really good journal, it's obvious for me. Because, well, it has its American equivalent, the JACS, but I think that as European researchers, we need to support our European publishing system, really! (CNRS Director of Research, University of Strasbourg, 13/07/2011).

As emphasized in these quotes, the sense of Europeanness was a reality in Strasbourg's chemistry labs.

3.4. *Role of the Networking Instruments (COST Actions)*

As illustrated by their multiple links with groups in European countries, chemists in Strasbourg became involved in transnational networks at an early stage, in particular through the COST Actions scheme. Launched in 1971, COST is a pan-European intergovernmental initiative that aims at strengthening scientific and technical research in Europe. COST Actions receive funding for a period of 4 years to develop cooperation by way of meetings, workshops, scientific exchanges, training schools, joint publications and dissemination activities. There are no thematic priorities (scientists can submit their proposal on any subject) and proposals are submitted per domain. Chemistry and Molecular Sciences and Technologies is one domain.

In 1990, a chemist from Toulouse, Gilbert Balavoine, was entrusted with chairing the COST-chemistry program. COST Chemistry Actions were launched, numbered D1, D2, etc. Balavoine's correspondence with Ourisson[37] attests to the links maintained between the two researchers about COST Actions. In a letter to Ourisson dated April 1998, Balavoine reminded him that the COST Chemistry Actions were a success (600 research groups had been involved in 120 projects) and that "we have succeeded in chemistry in making the most important European cooperation actions work [*dixit Madame la Commissaire*]".

After D7 Action entitled "Molecular Recognition" (1993-1997), D11 Action ("Supramolecular Chemistry") was launched in 1998. L. Mandolini (University La Sapienza, Roma) and M.W. Hosseini (University of Strasbourg) were the coordinators. The continuity of these Actions over 4 years supported in-depth discussions, created new cooperation (especially with scientists who joined the Action after its start), and sustained pre-existing collaboration. D11 action encompassed 60 research groups from some 20 European countries and was endowed around 40 million euros over five years. At the inauguration of the ISIS building in 2002, Minister Haigneré affirmed the vocation of ISIS (being "European and global") and said: "it is up to us to build the European research area. Participation in networks of excellence and integrated projects under FP6 should give a new impetus to the EU's research policy".

While the EU funding schemes were of paramount importance, COST with its 'lower' budget served a crucial role in the shaping of "European chemistry".

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[37] FR Service des archives de l'Université de Strasbourg; fonds Guy Ourisson; GO454; Programmes de coopération scientifique.

4. Discussion

The influence of local conditions and the special place of Strasbourg are tangible in this historical reconstruction of the emergence of SMC in France. In the quotes above, we see how chemists in Strasbourg stressed their commitment to a European "publication infrastructure". In concluding his Nobel Lecture in Stockholm, Jean-Pierre Sauvage placed Strasbourg at the center of Europe.

Figure 5. Last slide of the Nobel Lecture given by Jean-Pierre Sauvage, Stockholm, 8 December 2016. Available at https://www.nobelprize.org/prizes/chemistry/2016/sauvage/lecture/.

How has this sense of Europeanness spread in chemistry circles? The mirroring of movements in transnational networks needs to be mentioned if we are not to stick exclusively to Strasbourg's narratives. Aside from a few pro-European declarations by Lehn and other personalities, or the growing collaboration between European chemistry scholars, is Europeanness a reality among researchers in SMC?

The literature review presented in Section 1 shows that this is a difficult question to address methodologically. As part of the PrestEnce project, we also interviewed scientists in the chemistry department of a Swiss institution (ETH Zurich). This department – which has one of the highest of all international disciplinary rankings – is unquestionably cosmopolitan since 26 countries were represented at the time of our visit. There were many mentions of Europe, whether we talked about funding, recruitment procedures or positioning:

> In the recruitment committee, there are on average two members representing other Swiss universities or European universities. We had a recent committee with someone who was from Sweden, even Americans. We often take Germans, there have already been French, yes, Strasbourg (Full professor, ETH Zurich, 13/04/11).

> On the topic I'm working on, most of the work comes from those 10 or 15 groups across the world. Most of them are in Europe or in the USA (PhD candidate, ETH Zurich, 19/01/11).

Often compared (or opposed) to the United States, Europe emerged as a legitimate frame of reference in the interviews. In accordance with the Bologna process, the transition of all Master's courses to English was completed at the ETH Zurich in 2004. This probably strengthened the organization's coherence in a multilingual country and paved the way for a "transnational" identity, despite Switzerland's unusual position in the EU (that of a non-member State).

More than individual identities, which are complex to grasp, I focus here on the work of scholarly societies and their actions in a context of growing Europeanization. In 1999, nine European journals, all with a long history, merged into two (EurJIC and EurJOC). First two (GDCh and KNCV, the chemical society of the Netherlands), then six, nine, ten and finally fourteen European chemical societies federated their activities to form a co-owned publishing platform (EUChemSoc) in 2002. The chronology of the complex process of articulating/disarticulating national publishing infrastructures is shown in a video,[38] which covers the period 1995-2013.

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[38] History of ChemPubSoc Europe (1995-2013). Available at: https://www.youtube.com/watch?v=jVd9GSBIPyM (accessed: April 8, 2019).

The creation in 2006 of the European Association for Chemical and Molecular Sciences (EuCheMS) was a way to develop activities, in particular the publication program. Its first president, Giovanni Natile, saw EuCheMS as a way to "put European chemistry as an entity on the map, very much as the American Chemical Society does for its continent".[39]

EuCheMS has been active since 1970, initially under the name of FECS (Federation of European Chemical Sciences). FECS was established on 3 July 1970 in Prague by 17 scholarly societies from both eastern and western Europe. At its General Assembly in Bucharest in 2004, the FECS decided to change its name to EuCheMS, for European Association for Chemical and Molecular Sciences, with its headquarters in Belgium, and to draft a new constitution, which was published in the Belgian Gazette on 28 April 2006. The first editorial union EUChemSoc was transformed into ChemPubSoc Europe (CPSE) in 2009, which became EuCheMS' publishing branch, under a contract with the publisher Wiley-VCH. In the summer of 2018, a new name, acronym and logo were adopted: EuChemS, the European Chemical Society.

Based in Belgium, EuChemS has the status of a non-profit international association. In terms of the 2016 statutes, the association may acquire personal property, enter into contracts, accept gifts, sell or mortgage property, and so on, in the direct or indirect pursuit of its purpose (supporting and promoting the development and implementation of chemical and molecular sciences in Europe and in neighboring countries). EuChemS has a functioning similar to that of the ACS: other than its constitution, the European Chemical Society is also guided by its bylaws. Divisions and Working Parties implement the activities of the Society in the fields relevant to their competences, under the supervision of the General Assembly. The number of votes granted to each member, whether it is a European, national or regional organization, is directly proportional to the share of its financial contribution.

From 1996 onwards, national scholarly societies were offered the possibility of becoming *Chemistry* shareholders. The 6 chemical societies that participated in the early merger discussions were offered 10 shares out of 100 (10% of full ownership) (tom Dieck, 1996). A special place was given to national societies in *Chemistry*'s contents, most often on the occasion of the celebration of anniversaries: e.g. focus on Italian groups to celebrate one hundred years of the Italian Chemical Society in 2009, celebratory issue published on the occasion of the 150th anniversary of the German Chemical Society (GDCh) in 2017. Special issues are published in connec-

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[39] Available at: http://www.euchems.eu/wp-content/uploads/EuchemsMay2006_tcm23-52584.pdf (accessed: April 8, 2019).

tion with the EuChemS Chemistry Congresses that take place every two years. These publications, in particular editorials, afford an opportunity to highlight progress made, express concerns and "changing factors", and identify fears across the "imagined community", thus contributing to creating a European identity.

According its website,[40] EuChemS currently represents over 160,000 chemists from more than 40 member societies and other chemistry-related organizations. The chairpersons of the CPSE's journals are representative of the diversity of the countries involved. *Chemistry*'s editor-in-chief for 2018 pointed out that "the broad range of subjects has certainly always been one of the assets of the journal" (Ross 2018). Given the size of the organization today, there is also potential for fragmentation.

5. Concluding remarks

My investigations are not limited to Europe's policies and institutions. Instead, I have considered scientists as the main drivers of Europeanization.

Based on an historical analysis completed with fieldwork carried out from 2011 to and including 2013, I have focused the narrative on a group of chemists, illustrating how they embedded their networks, institutions and infrastructures with the aim of building a "European chemistry". Extending the idea developed in a recent exhibition, I suggest defining Strasbourg as a "laboratory of Europe".

I have given a special place to Lehn, who played the role of leader of an academic tribe and took advantage of the growing trend: the 1990s were the period during which Lehn's publications profile expanded internationally, thus contributing to strengthened his scientific credit. The circulation and appropriation of concepts and languages of the SMC were central in this development.

Chemistry remains a "science of the archive" (Daston 2012), in which exhaustive research through the accumulated achievements of the discipline is often a prerequisite for the acquisition of a new knowledge. Journals are part of the "international machinery" of chemical information (Hepler-Smith 2015). Far from considering them as archaic relics from the printing age, I suggest they could have contributed to creating an academic social order and, through the idea of a program, have acted as an instrument serving the discipline. The list of objects stemming from research in Strasbourg is multiple: crytands, helicates, multicompartmental nanocyl-

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[40] Available at: https://www.euchems.eu/ (accessed: April 8, 2019).

inders, "grid-type" entities, ordered polymetallic arrays, etc. In SMC, the effervescence of concepts and objects (and the ordering that was required to move forward) was also at the origin of the emphasis placed on the publication infrastructure.

There are many comparisons to the US world in the story told here. Conceptually, one of my assumptions is that a semantic 'battle' took place against the supremacy of the ("host-guest") chemistry of the English-speaking world.

My results also suggest that chemistry has a specific mode of European integration, which has been built in comparison, or even in opposition to the USA. The intellectual and political project of Strasbourg chemistry was that of a space (European chemistry) protected from other regional spaces. The intervention of Lehn, and to a lesser extent that of Sauvage in Stockholm, was directed towards staging the European cause. Research collaborations in SMC were numerous, even before 1987, and occurred largely within transnational networks. The case study reveals no risk whatsoever of fragmentation, but rather of disappearance of national scholarly societies. Publication infrastructures were articulated massively in a very short period of time, which also allowed them to be revitalized.

Further studies would be needed to refine our argument. Some avenues can be sought in the study of organizations (through the archives of EUChemSoc for example) or in a comparison with a journal that had European ambition but was a failure (*Nouveau Journal de Chimie)*.

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