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The International Conference on Small-Angle Scattering – past and future

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The International Conference on Small-Angle Scattering (SAS) is a periodic event that gathers scientists from many areas, including materials science, physics, chemistry and biology. They work on applications of X-ray and neutron small-angle scattering to a variety of nanostructured materials, such as alloys, polymers, glasses, proteins in solution, membranes, liquid crystals, porous solids and nanohybrid systems. Without any doubt, SAS is the most widely used technique for structural characterization of heterogeneous materials on the scale from 1 to 100 nm. At SAS conferences, besides the applications to a variety of materials, new developments of related instrumentation, theoretical analysis and data treatment are discussed. An increasing number of presentations in recent SAS conferences have also dealt with industrial applications.

In 1965, the first SAS conference was held in Syracuse in the State of New York in the USA. It was chaired by the late Professor Harry Brumberger. Since then, 12 conferences have been held in different countries, eight in Europe, three in North America, and one in South America. The XIIIth conference will be held in Himeji, Japan. The locations, dates and chairmen of the past 12 conferences, together with some information related to the published proceedings, are listed in Table 1. The proceedings of the first conference were published as a book, and eight of the others in archival scientific journals. Apart from the conferences held in 1987 and 1993, the proceedings of the five others were published in the *Journal of Applied Crystallography*. The numbers of communications presented at the different SAS conferences are plotted in Fig. 1. These numbers follow a monotonically growing function, except between the conferences held in Berlin and Hamburg in 1980 and 1984, respectively.

The purpose of this note is threefold: to begin with, it represents a modest contribution to the preservation of the history of the SAS conferences; secondly, it describes some features of its current organization; and thirdly, it is an attempt to explain the clear 'kink' or discontinuity in the function describing the number of communications between 1980 and 1984, and the high (exponential) growth rate from 1984 until now, both effects being clearly apparent in Fig. 1.

No formal scientific association has continuously participated in the organization of SAS conferences. In practice, the location of each event was selected among submitted proposals by the participants of the preceding conference, after a preliminary discussion among the members of the International Advisory Board. Complete responsibility for the practical organization pertains to the Chairman and the Local Organizing Committee. The International Advisory Board helps the local organizers to set up the scientific program. This rather informal style of organization is not ideal for maintaining an updated record of the events. In this respect, some coordination of the sequence of conferences by a formal and well-established scientific association would seem to be useful. On the other hand, the good quality of current SAS conferences is clearly appreciated by the community, as demonstrated by the fast increase in the number of participants from 1984 until now, and these positive aspects should be preserved. Many participants see the current SAS conferences as a very motivating forum for interesting and friendly discussions. This positive opinion of the SAS community is reflected in the vigorous growth of the number of communications over the past two decades (see Fig. 1). The current flexible organizational structure is desirable, as the program may thus be defined each time by a different group of scientists from different countries, taking into account a range of independent and usually complementary views. Since the local organizers are currently totally responsible for the event, they usually stress particular aspects of SAS science that may be of special interest to their own community. Indeed, that is precisely what happened with the Xth SAS conference organized in Campinas/Brazil in 1996. My Brazilian colleagues and I focused on the use of synchrotron radiation and the development of related instrumentation and industrial applications. This was a

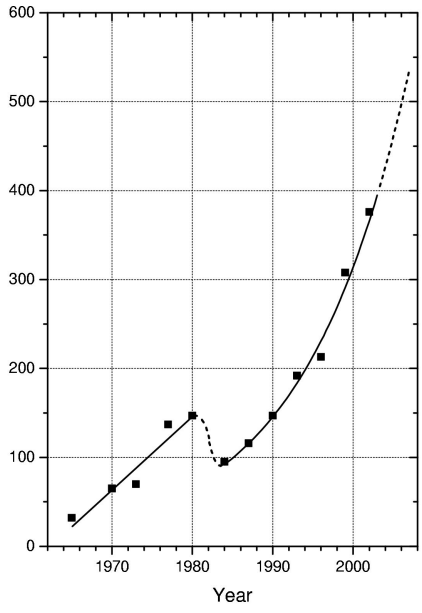

Figure 1
Number of communications at SAS conferences.

timely event for the Brazilian community because it was held when the construction of the synchrotron source of the Synchrotron National Laboratory (LNLS) was just completed, and the SAS beamline was nearly ready for its first operation.

Regarding one of the relevant features depicted by Fig. 1, namely the kink in the number of communications observed between 1980 and 1984, the conclusion of an informal discussion that took place during the Berlin conference (1980) seems to be pertinent. It was pointed out that SAS being just an experimental technique, periodic SAS conferences are only justified if, and only if, a significant number of new theoretical methods and instruments are under development. The general feeling in 1980 was that the relevant theory and instrumentation for SAS experiments were already established and well known. Therefore, the informal suggestion was to promote a stronger participation of SAS researchers in materials science and biology scientific events, and reduce the frequency of SAS conferences. Developments seemed to follow the mentioned predictions for a short period of time, since the number of communications presented at the VIth conference held in 1984 in Hamburg was actually 50% lower than at the preceding one.

The other relevant feature that can clearly be seen in Fig. 1 is the fast and persistent growth in the number of communications presented during the last seven SAS conferences. As discussed below, the fast growth starting in 1984 may be explained and directly correlated to (*a*) the strong and growing interest of the scientific community in the development and characterization of novel nanostructured materials and (*b*) the simultaneous and increasing availability of two important new tools, namely synchrotron X-ray sources and powerful computers.

Richard Feynman said in 1959 that 'when scientists have learned how to control the arrangement of matter at a very small scale, they will see materials take an enormously richer variety of properties'. This prediction soon became a reality. Scientists actually succeeded in the task of controlling

Table 1
Sequence of international SAS conferences.

No.	Location	Country	Date	Chairmen	Proceedings	Editor(s)
I	Syracuse	USA	24–26 June 1965	H. Brumberger	*Small-Angle Scattering* (1967), 509 pp. London: Gordon and Breach.	H. Brumberger
II	Graz	Austria	26–29 August 1970	O. Kratky	*J. Appl. Cryst.* (1971), **4**, 405–426 (abstracts only)	
III	Grenoble	France	4–8 September 1973	A. Guinier	*J. Appl. Cryst.* (1974), **7**, 95–239	R. A. Young
IV	Gatlinburg	USA	3–7 October 1977	R. W. Hendricks	*J. Appl. Cryst.* (1978), **11**, 295–657	R. H. Hendricks and R. A. Young
V	Berlin	Germany	6–10 October 1980	R. Hosemann		
VI	Hamburg	Germany	20–23 August 1984	H. Stuhrmann		
VII	Prague	Czechoslovakia	13–16 July 1987	J. Baldrian	*Macromol. Chem. Macromol. Symp.* (1988), **15**, 1–372	B. Sedlacek
VIII	Leuven	Belgium	6–9 August 1990	H. Reynaers	*J. Appl. Cryst.* (1991), **24**, 413–877	H. Reynaers and G. Kostorz
IX	Saclay	France	27–30 April 1993	J. Teixeira and J. P. Cotton	*J. Phys. (France)* (1993), **C8–C3**, 1–526	A. Brûlet, J. P. Cotton and J. Teixeira
X	Campinas	Brazil	21–25 July 1996	A. Craievich	*J. Appl. Cryst.* (1997), **30**, 569–888	A. Craievich, G. Kostorz and J. Teixeira
XI	Brookhaven	USA	17–20 May 1999	D. Schneider and S. H. Chen	*J. Appl. Cryst.* (2000), **33**, 421–866	D. Schneider, S. H. Chen, M. S. Capel, B. Hsiao, G. Kostorz, J. S. Pedersen, P. Timmins and G. D. Wignall
XII	Venice	Italy	25–29 August 2002	A. Benedetti	*J. Appl. Cryst.* (2003), **36**, 373–868 (this issue)	A. Benedetti, T. Hashimoto, G. Kostorz, F. Rustichelli and G. D. Wignall
XIII	Himeji	Japan				

arrangements of matter at a nanometric scale and have developed a large variety of useful materials during the past two decades. They also realized that the properties of the new nanomaterials not only obviously depend on the structure on the atomic scale, but also depend strongly on the shape, size and spatial correlation of the nanometric building blocks. In the past, many material investigations dealt only with homogeneous systems that needed to be structurally characterized at an atomic level, mainly using wide-angle X-ray scattering techniques. The new world of nanostructured materials opened during the past two decades brought a huge number of exciting opportunities to scientists that use SAS techniques.

Along with the increasing availability of neutron scattering facilities, synchrotron radiation began to be widely used in the 1980s, making a number of novel SAS experiments possible, such as those involving surface and very thin layer materials, time-resolved measurements, anomalous scattering, and the use of coherence effects. These new issues induced the development of new instrumentation, namely fast one- and two-dimensional detectors, control systems, setups for grazing-incidence small-angle X-ray scattering, and special cells for measurements under extreme (temperature, pressure) conditions. At the same time, computers became more and more powerful and more widely accessible, thereby allowing the application of novel theoretical developments, such as the use of Monte Carlo methods for the statistical description of nanoscale phase separation, the geometrical concept of fractal structures, and more recently, *ab initio* calculations of macromolecular envelopes from SAS curves and new numerical data treatments that provide useful structural insight into polydisperse and concentrated particle systems.

The 'novelties' described above, concerning the opening of the new world of tailored nanostructures, the progress made in theory and instrumentation, and the new applications arising from the increasing availability of synchrotron sources and powerful computers, are just a few selected reasons that, together with others have affected the dynamics of the SAS conferences. As a consequence, the skeptical visions of the 1980s about the future of SAS conferences changed dramatically a few years later. Since 1984, the SAS conferences seem to have gained new momentum and appear now to have a very bright future.

The overall trend of the curve plotted in Fig. 1 tells us that the SAS conferences are still today in the stage of rapid growth that started in the early 1980s. This long growth period may be understood as a 'second youth' of the SAS conferences, the first having lasted until the end of the 1970s. Will this trend continue over the next few years? Probably yes, because up to now, we do not notice any significant saturation in the growth trend. What may we foresee for the forthcoming SAS conference at Himeji? If this 'second youth' of the SAS conferences persists, the number of communications might well be around 500.

At the beginning of the 1980s, the late Paul W. Schmidt published an interesting short history on the SAS technique [*Crystallography in North-America* (1983), ch. 13, American Crystallographic Association]. He was aware at this early time of the new possibilities opened by the then recent advent of new synchrotron and neutron sources, computers, position-sensitive detectors and commercial cameras for small-angle X-ray scattering. He said 'I won't risk making very detailed predictions about the future of SAS . . . ', but anyway he guessed '. . . I certainly do not expect SAS to wither away. When interest in one application declines, other uses will be discovered, and with new techniques and equipment which are now available, as well as with the further advances which can be expected, SAS should continue to be useful for many years.' All of us can confirm now, 20 years later, that Paul's predictions were perfectly right.

The international SAS conferences are today a vigorously growing series of events that reflect a flourishing and dynamic scientific field. We may find the reasons for the current success of SAS conferences in the high quality of the scientific communications presented, the variety of subjects covered, the dedication of all those involved in their organization, and in the very motivating and relaxed atmosphere that prevails at these meetings.

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