

LETTERS TO THE EDITOR

The diffusion of knowledge about glycoconjugates through reviews, monographs, textbooks and symposia

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Glycobiology is a well consolidated discipline [1, 2]. In addition, other emerging areas related to glycobiology are those of glycopathology [1, 3], glycotherapeutics [3, 4] and glycobotechnology [1]. Several current journals are devoted exclusively to these topics, *Glycoconjugate J* being the oldest.

The following questions have arisen concerning the progress achieved from the end of the XIXth century in the field of glycobiology. (i) Were the data on glycoconjugates rapidly diffused among specialists? (ii) How was this diffusion carried out: did it run at a constant rate or was it discontinuous? (iii) Which were the main 'media' used for this diffusion? (iv) How important was the impact of this knowledge on other related areas?

An answer to some of these questions may be found, at least partially, in the following.

The first **review article** on modern aspects of glycoconjugates appeared in **Ann Rev Biochem** in 1937, and referred to glycolipids. However, after 1948 references to glycoproteins were frequent and abundant, and after 1965 the number of pages devoted to glycoproteins, lectins and glycolipids increased dramatically.

From 1962, **monographic works** on glycoproteins have been more abundant than those on glycolipids. In addition, from 1957, several monographs and books have been devoted to the detailed **description of techniques** for determining the structures of glycoconjugates and 'neoglycoconjugates' (for references see [1, 5, 6]).

The old French **textbooks** of Wurtz (year 1884) and Lambling (1911 and 1921) included relatively abundant data on both glycoproteins and glycolipids. From 1959, other French (Montreuil, Polonovski, Louisot, Courtois, Weil) and German (Karlson) treatises/textbooks have

included a large number of pages dealing with glycoconjugates. Later, American classical **treatises** on biological chemistry/biochemistry have followed this trend, although initially not in such depth. In parallel, problems concerning the nomenclatures used to refer to glycoconjugates have also been a matter of discussion; details can be found elsewhere [1].

In 1964, a **symposium** was held at Boston-Swampscott, USA, under the heading of "International Symposium on Glycosaminoglycans, Glycoproteins and Glycolipids".

Some years later, in 1973, J. Montreuil invited all biochemists interested in research on certain 'complex carbohydrates' (then probably named for the first time 'glycoconjués' = glycoconjugates) to participate at a meeting at Villeneuve d'Ascq (near Lille, France). There, it was decided that future symposia on glycoconjugates should thereafter be held as biennial events.

The Swampscott meeting was considered as number I, and that of Villeneuve d'Ascq number II. Later on, the following meetings were held: III, at Brighton, England (1975) (R.C. Hughes); IV, at Woods Hole, USA (1977) (R.W. Jeanloz); V, at Kiel-Damp, Germany (1979) (R. Schauer); VI, at Tokyo, Japan (1981) (T. Yamakawa); VII, at Lund-Ronneby, Sweden (1983) (B. Lindberg); VIII, at Houston, USA (1985) (E.A. Davidson); IX, at Lille, France (1987) (J. Montreuil); X, at Jerusalem, Israel (1989) (N. Sharon); XI, at Toronto, Canada (1991) (H. Schachter); XII, at Kraków, Poland (1993) (J. Kościelak); and XIII, at Seattle, USA (1995) (S. Hakomori).

All symposia were enthusiastically and efficiently organized by renowned specialists in the area of glycoconjugates.

On the occasion of the Kraków meeting, J. Kościelak

reminded the attendants that an "International Symposium on Biologically Active Mucoids" had been held in Warsaw, Poland, on October 1-3, 1959, with the participation of at least a dozen relevant specialists in the field of glycoconjugates from France, Germany, Hungary, Poland, the United Kingdom and the USA. Therefore, this meeting should be considered as a preliminary symposium on glycoconjugates, if the present numbering of subsequent meetings is to be retained.

Figure 1 shows how the number of participants (= registered active members), authors, and lectures + communications has evolved since the meeting in 1973. Attendance at such meetings has been subject to circumstances such as the site of the symposium, the closeness (in space and time) to other related or general meetings (both international and national meetings), etc.

At each symposium, efforts were directed towards focusing special attention on certain aspects of the current very broad and very heterogeneous field of glycoconjugates.

These ranged from methods for the study of glycoconjugates, a matter dealt with in depth in the 1973 symposium, to the "chemistry, biochemistry (including, pathological aspects), molecular biology and biotechnology of glycoconjugates" addressed in the 1987 symposium – both symposia organized by J. Montreuil. Since the inception of these meetings much has been done in this field of science: the role of glycans in cellular differentiation (including cancer and metastasis); the glycoconjugates not only of mammalian origin but also from parasites, plants and viruses; the genetics and evolution of glycoconjugates and their biotechnology; the interaction between glycoconjugates and lectins; proteoglycans; the role of lipid intermediates in glycoprotein biosynthesis; the organic synthesis of glycoconjugates; and the immunology and immunochemistry of glycoconjugates. These issues remain topics of current interest.

As expected, the number of topics on glycoconjugates addressed in the most recent symposia has increased dramatically. Thus, there were 36 topics classified as

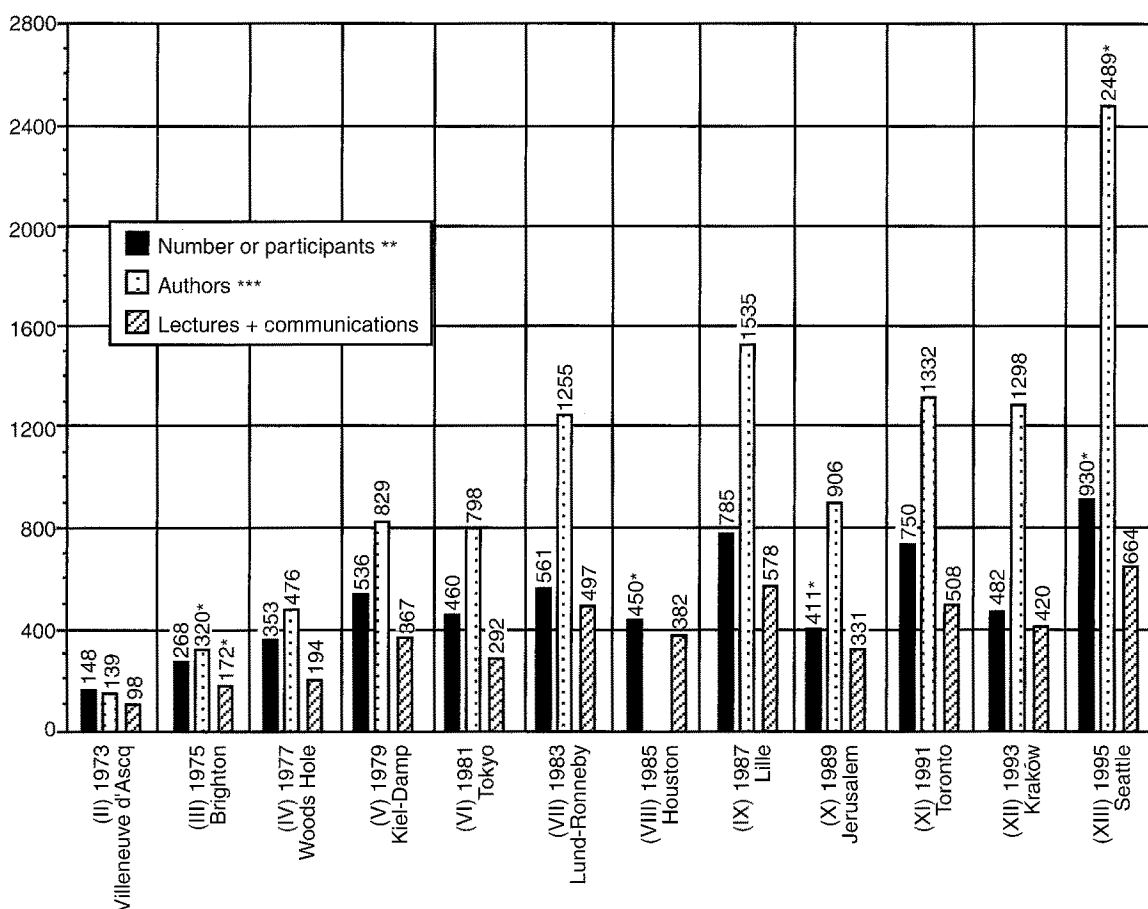


Figure 1. Number of participants, authors/coauthors and lectures + communications corresponding to the II-XIII Glycoconjugate Symposia.

*Approximate number.

**Participants = registered active members.

***When the same author/coauthor appears in more than one abstract, he/she is listed only once.

'mini-symposium sessions' at the Seattle meeting held in 1995.

As Turner and Schachter have recently pointed out [7], the pathological features of glycoconjugate research ("Glycosylation and Disease") are a matter of growing interest. This trend was confirmed in the last two meetings, in which research into cancer or inflammation related to glycoconjugates was particularly addressed.

An analysis of Fig. 1 suggests that the number of authors has greatly increased; more so than those of participants and lectures + communications. Accordingly, it may be deduced that more people have collaborated in experimental work on glycoconjugates than in previous meetings. Furthermore, in contrast to earlier symposia, in which European participants predominated, more and more American and Japanese scientists have been registered members and authors in recent symposia.

Growing commercial interest in glycoconjugate research may also be deduced from the collaboration between 'pure' scientists and several industrial laboratories or biotechnological enterprises, as shown in the abstracts volumes of recent meetings.

The creation of an **International Glycoconjugate Organization (IGO)**, with representatives from a dozen nations, was decided and ratified at the Ronneby meeting, held in 1983. The IGO Steering Committee has set as its main aims the fostering of research into glycoconjugates, the coordination of its scientific and administrative activities with other related organizations (IUBMB, etc), and the preparation of future glycoconjugate symposia. The IGO is now open to membership from other countries where research on glycoconjugates is sufficiently advanced but which are not yet represented.

Independently of the IGO symposia, **other meetings/conferences** have been held, several years ago and more recently, dealing **with limited topics related to glycoconjugates**. For instance, in 1974, a symposium on 'neuraminidase' (= sialidase) was held in Marburg-Marbach (Germany) supported by the Behringwerke AG industry. A symposium on 'sialidases and sialidoses' was held in Genoa (Italy) in 1981 (G. Tettamanti, P. Durand and S. DiDonato). A 'Philippe Laudat conference' on the 'role of sialic acids and sialidases in molecular recognition phenomena' was held in Bischensberg (near Strasbourg, France) in 1991 (A.P. Corfield, C.R. Lambré, J.C. Michalski and R. Schauer). A 'Japanese-German symposium on sialic acids' was held in Berlin in 1988 (R. Schauer and T. Yamakawa). In 1994 an international conference on 'biology and chemistry of sialic acids' was held in Moscow (Russia) (N.V. Bovin *et al.*), the Second International Conference on 'International Perspectives in Glycobiology' was held in Oxford (UK) and the Second Annual Conference on 'Glycotechnology' was held in San Diego (California, USA). Additionally, in 1995 the

Third International Glycobiology Symposium on 'Current Analytical Methods' was held at Loews, Coronado Bay. Furthermore, the First Electronic Glycoscience Conference was held using the Internet from 15 September to 20 October 1995. This conference was organized by B. Hardy (Oxford, UK) and I. Wilson (Vienna, Austria) and 529 registered members participated. Other related meetings were those of the European Carbohydrate Organization (eight held to the present date).

In **summary**, our present knowledge on glycoconjugates has come from the efforts of scientists mainly from European, American and Japanese laboratories. It was diffused:

1) From the fifties by means of original papers published in general journals on biochemistry, and later in specialized journals (*Glycoconjugate J* from the eighties, and at least three other journals starting in the nineties).

2) Through review articles appearing very early on (in the thirties) in *Annu Rev Biochem*, and also later in general and review journals on biochemistry.

3) Through monographs mainly addressing glycoproteins, but also glycolipids and lectins. These have appeared regularly from the fifties and, more recently, have included detailed descriptions of techniques.

4) Through textbooks/treatises featuring (very early on in the case of French books) pages devoted to the structural features, cellular localization, and metabolism of what are now known as glycoconjugates.

5) Through specialized symposia which have contributed to expanding and delving more deeply into research on glycoconjugates: (a) by exposition and discussion of the main topics; and (b) by favouring contact between scientists and encouraging mutual collaborations.

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Second Electronic Glycoscience Conference

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The Second Electronic Glycoscience Conference (EGC-2) will be held on the Internet (the Net) and World Wide Web (the Web) from 9–20 September 1996 and follows the same pattern as the first such conference, EGC-1, held in 1995.

EGC-2 will be a fully international event open to all members of our scientific community and will cover a broad range of disciplines related to carbohydrate and glycoconjugate molecules including chemical, physical, biological and medical areas using theoretical, experimental and computational approaches.

Conference subject areas are: Biological Function of Protein-Linked Glycans; Carbohydrate Biotechnology; Crystallography; General Glycobiology; Glycanalysis; Glycoimmunology; Glycolipids; Glycomedicine; Glycosynthesis; Glycosyltransferases; Lectins; Mass Spectrometry; Molecular Modelling, Design and Informatics; NMR; Polysaccharides and Cellulose; Proteoglycans and Glycosaminoglycans; and Perspectives in the Glycosciences. Each subject area has a section convener who will screen abstracts sent by authors for suitability. The names and addresses of section conveners can be obtained at the URL: <http://bellatrix.pcl.ox.ac.uk/egc2/>

Authors can opt to have their presentation in the following categories;

- (i) non-permanent presentation like a normal conference poster
- (ii) refereed presentation which will be considered for inclusion on a CD
- (iii) refereed presentation which will be considered for publication as a Letter to the Editor in a special issue of *Glycoconjugate Journal* in 1997.
- (iv) refereed presentation which will be considered for publication as a full paper in a special issue of *Glycoconjugate Journal* in 1997.

Referees will be appointed by the section conveners and the reports will be handled via the Special Editor for *Glycoconjugate Journal*, in consultation with Harry

Schachter and Graham Turner, editors of *Glycoconjugate Journal*.

Presentations must be prepared in Hypertext Markup Language (HTML) with figures in GIF, Rasmol or other web-compatible formats so that participants can view the papers via the World Wide Web. Aid and consultation will be provided to participants during summer 1996 to help them with their presentation. Further details are given in the authors' guide accessible via the URL: <http://bellatrix.pcl.ox.ac.uk/egc2/>

During the conference, discussions will take place via the Internet in real-time using a virtual conference centre based on a MOO (Multiple-user domain, object oriented) and via Internet-accessible electronic mailing lists. Trial sessions for those not familiar with MOO will be held before the conference. During the conference, a timetable for MOO discussion sessions of each section will be posted. Since these real-time discussions are an integral part of the conference, authors will be expected to attend one for their subject; the right is reserved not to referee submissions by authors who do not attend one of these sessions.

The Conference will feature a Virtual Trade Center where commercial vendors, consultants, manufacturers, and contractors will be able to display their goods and services in return for exhibition fees to support conference activities. Any potential advertisers should contact the conference organisers.

Deadlines and dates

Subscribing to the Glycoscience Network mailing list

Conference-related news and announcements will be posted regularly to the Glycoscience Network (TGN) mailing list (<http://bellatrix.pcl.ox.ac.uk/hypermail/tgn/index.html>) and the *bionet.glycosci* newsgroup (news:bionet.glycosci or <http://www.bio.net:80/hypermail/GLYCOSCI/>).