The various inputs to these decisions will be the user reaction to the subjournal through subscription changeovers, etc., and the results of an experiment to determine customer interest generated in reports announced in each of the three announcement media. We feel this continuing effort is necessary in order to meet the growing plethora of research and development reports available to the technology-conscious public of today.

LITERATURE CITED

(1) Urbach, P. F., "User Reaction as a System Design Tool at CFSTI," 4th Annual National Colloquium on Information Retrieval, Philadelphia, Pa., May 3, 1967.
(2) Luginbyhl, T. T., *et al.*, "The Poor Man's SDI," *Proc. Am. Soc. Inform. Sci.* **5**, 1968.
(3) Bjorge, S. E., *et al.*, "An Experiment to Determine the Effectiveness of Various Announcement Media on CFSTI Sales," *Proc. Am. Soc. Inform. Sci.* **5**, 1968.

Macromolecular Nomenclature: General Background and Perspective*

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The history of the preparation, approval, and publication of IUPAC reports dealing with macromolecular nomenclature is reviewed. Certain problems recently considered include modifications of the previously approved structure-based system for representing polymers by names and formulas. Other problems that should be considered soon are concerned with ladder, crosslinked, sheet, network, coordination, and purely inorganic polymers. A plea is made against approval of definitions or rules of nomenclature by any national or subnational organization without prior submission to, and consideration by, the appropriate international body.

Nomenclature rules and definitions were proposed, approved, and used long before chemists realized the importance of macromolecular compounds and began treating them as chemical substances. As macromolecules became more important chemically, industrially, and otherwise, the rules and definitions devised for substances of low molecular weight could, to a considerable extent, also be applied to those of high molecular weight. Some modifications and extensions were, however, necessary.

When it became realized that the use of different terms and different definitions for the same things by different people in different places was causing confusion and misunderstanding, organizations such as IUPAC's International Commission on Macromolecules and its liaison organization in this country—the Committee on Macromolecular Chemistry of the National Research Council—decided that something should be done about it. At the instigation of Herman Mark, the chairman of the NRC Committee, and with the help and collaboration of many people and organizations in this country and abroad, a Report on Nomenclature in the Field of Macromolecules was prepared, approved by the NRC Committee, and in 1951, with modifications, by the IUPAC Commission. It was published[1] the following year.

That report dealt with two types of problems: ideas, concepts, and definitions peculiar to the macromolecular field, and a system for representing linear polymers, by name and formula, on the basis of their composition and structure, rather than on the basis of the monomers from which they were, or might be, derived. In the first category were included special terms and definitions needed because high polymers and other macromolecular substances are usually mixtures of many different molecular species, differing with regard to molecular weight, composition, and structure. Also included were terms related to methods commonly used for polymer characterization—for example, methods for obtaining molecular weight averages by measurement of solution viscosities.

In dealing with the second category, a system of naming polymers and representing them by formulas on the basis of the name and formula of the biradical that is the smallest repeating unit, disregarding conformational differences, was devised and recommended for use. To avoid confusion between the structure-based names and the usual source-based names, it was proposed that the former always have the termination "-amer." Thus, the recommended structure-based name for a linear polyethylene was "polymethamer" and that for polyoxymethylene was "polymethoxamer."

After approval of this report, the Nomenclature Committees of the NRC Committee on Macromolecular Chemistry and the IUPAC Commission on Macromolecules were dismissed. A few years later the IUPAC Commission appointed another committee to deal specifically with

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nomenclature problems related to stereoregularity in macromolecules. A tentative report was approved and, in 1961, published.[2] A revised version was given final approval in 1963, and the committee was disbanded. Regrettably, publication of the revised report was delayed, by circumstances beyond the control of the committee, until 1966.[3]

Most of the recommendations in these reports have received general approval, but those concerned with a structure-based system of naming linear polymers have not been widely used. There are several obvious reasons: There was considerable delay in publication of the reports. Since the nomenclature committees responsible for the reports were immediately dissolved, no effort was made by any group to encourage use of the new, unfamiliar system. The "-amer" endings of the names, being unfamiliar to scientists already working in the field, may have reacted against their use. Editors of scientific journals, abstract journals, handbooks, and textbooks did nothing to encourage their use. Perhaps most important was the fact that, for nearly all purposes, the source-based system, already in general use, seemed satisfactory.

In the last few years it has become increasingly evident that further consideration must be given to macromolecular nomenclature problems. As macromolecular science and industry have developed, some of the previous definitions require modification and some new terms and definitions are needed. Realizing this situation, the International Commission on Macromolecules again, in 1966, established a Nomenclature Committee under my chairmanship. That committee, meeting in Brussels in 1967, considered some proposals, submitted by the Nomenclature Committee of the Polymer Division of the American Chemical Society, with regard to modifications of the IUPAC-approved system of structure-based nomenclature. These proposals are dealt with in some detail by other speakers in this symposium. The major changes proposed were the elimination of the "-amer" endings in the names and changes in the names of the unit biradicals to make them conform to terminology approved by IUPAC committees of chemists concerned with low-molecular organic chemistry since the preparation of the 1951 Macromolecular Nomenclature Report. These changes received tentative approval by the IUPAC Committee. A few new and altered definitions were also tentatively approved. This IUPAC Committee's report has been published in the Journal of Polymer Science[4] and in a number of journals in other countries.

The International Commission on Macromolecules has recently been upgraded. It is now the Macromolecular Division of IUPAC. The Nomenclature Committee of the old Commission has been replaced by a Commission on Nomenclature, headed by Kurt Loening of Chemical Abstracts Service. That commission must decide whether or not the tentative recommendations of the IUPAC Nomenclature Committee, which it succeeds, are to receive final approval. It must also consider other problems, such as the representation, by names and formulas, of ladder, crosslinked, sheet, network, coordination, and purely inorganic polymers and nonpolymeric macromolecules. The commission should make sure that terminology adopted for linear organic polymers is capable of logical extension to these other types of macromolecules.

I feel very strongly that no new proposals in the field of macromolecular nomenclature should be approved and recommended for use by the American Chemical Society, its Polymer Division, or any other national or subnational body, without prior submission to, and consideration by, the appropriate international body. That body is Dr. Loening's commission. Consideration by that commission is especially important if the new proposals are in conflict with definitions or rules that have previously been approved internationally.

LITERATURE CITED

(1) International Union of Pure and Applied Chemistry, *J. Polymer Sci.* **8**, 257 (1952).
(2) Huggins, M. L., Natta, G., Desreux, V., and Mark, H., *J. Polymer Sci.* **56**, 153 (1962).
(3) Huggins, M. L., Natta, G., Desreux, V., and Mark, H., *Pure Appl. Chem.* **12**, 645 (1966).
(4) Huggins, M. L., Corradini, P., Desreux, V., Kratky, O., and Mark, H., *J. Polymer Sci.* **B6**, 257 (1968).