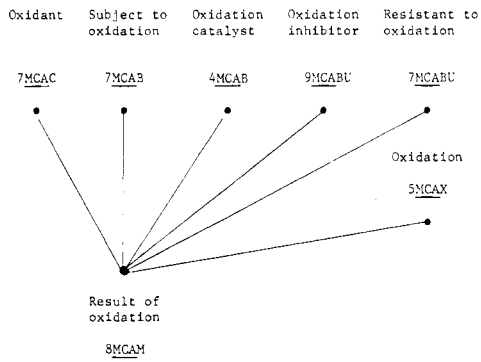

Figure 9. Notations for a family of relation indicators.

the functions of roles and links, and that they do this in a particularly efficient manner.

CONCLUSION

The POLIDCASYR system is another manifestation of the general philosophy of IDC, namely, to relieve the searcher from expending a large and continually increasing effort in scanning through myriads of irrelevant responses to the machine searches. Rather, the expenditure is shifted to a meticulous document analysis. Thus, the intellectual effort can be kept nearly constant in the course of time and also relatively low even if the system is used heavily.

Through the development of the POLIDCASYR system another goal was achieved, namely, to cover the entire field of organic chemistry with a *single* indexing language that is sufficiently general and effective. Admittedly, the full payoff of this approach will be realized only in the relatively distant future, and considerable far-sightedness is required to undertake such an investment in information science. We have, however, determined that such an approach is fully justified from an economic viewpoint, when it is concentrated on the literature of particular interest to a group of institutions, and when the input workload is shared by these institutions.

REFERENCES AND NOTES

(1) Suhr, C. "Neue Wege in der Dokumentation der Makromolekularchemie", *Chem.-Ztg.* **1972**, *96*, 342–347.
(2) Chemical Abstracts Service, Structure Input Manual, Chapter L (Polymers), Feb 27, 1975.
(3) DERWENT Publications Ltd.: Plasdoc Punch Code Manual 1975, Instructions for Coding and Searching.
(4) Fugmann, R. "The IDC- Systems". In "Chemical Information Systems", Ash, J. E.; Hyde, E., Eds., Ellis Horwood Lt., Chichester, England, 1975.
(5) Fugmann, R. "Representation of Concept Relations Using the TOSAR – System of the IDC", *J. Am. Soc. Inf. Sci.* **1974**, *25* 287–307.
(6) Skolnik, H. "A Multilingual Index Via the Multiterm System", *J. Chem. Doc.* **1972**, *12*, 128–132.
(7) Fugmann, R. "The Glamour and the Misery of the Thesaurus Approach", *Int. Classification* **1974**, *1*, 76–86.
(8) Fillmore, Ch. "The Case for Case". In Bach & Harms, "Universals in Linguistic Theory", Holt, Rinehart & Winston, New York, 1968; pp 1–88.
(9) Skolnik, H; Hays, J. T. "A New Notation System for Indexing Polymers", *J. Chem. Doc.* **1970**, *10*, 243–247.
(10) Dittmar, P. G.; Stobaugh, R. E.; Watson, C. E. "The Chemical Abstracts Service Registry System", *J. Chem. Inf. Comput. Sci.* **1976**, *16*, 111–121.
(11) Loening, K. L.; Metanomski, W.; Powell, W. H. "Indexing of Polymers in Chemical Abstracts", *J. Chem. Doc.* **1969**, *9*, 248–251.
(12) Hoffman, W. S. "An Integrated Chemical Structure Storage and Search System Operating at Du Pont", *J. Chem. Doc.* **1968**, *8*, 3–13.
(13) Duffey, M. M.; Klanberg, I. M.; Mahr, S. C., Meier, L. L.; Romstad, J. L. "Computer Indexing of Polymer Patents", *J. Chem. Doc.* **1968**, *8*, 85–88.

Some Problems Encountered in Interdisciplinary Searches of the Polymer Literature†

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In a number of areas of polymer science (particularly those of a nontraditional nature), the handling of polymer information needs reassessment, redefinition, or definition. Some problem situations are the interfaces between (1) polymers and medicine and (2) polymer science and engineering as well as subfields within polymer science. Actual examples of problems encountered when attempting to retrieve information are cited, and the relationship of these problem situations to potential or pending solutions is discussed. Specific topics include polymeric drugs and other biomedical uses of polymers, polymer blends, polymer characterization, and inorganic polymers among others.

In order to make use of accumulated knowledge on such a vast scale as that collected in modern chemistry, ever more sophisticated indexing and abstracting systems have been developed and continue to develop. Apace with the development of these has been the construction of nomenclature systems. The accomplishments in indexing and abstracting have more or less taken the route of utilizing the nomenclatures of the various subdisciplines within chemistry. Divergencies exist in the nomenclature, and one of the most striking lies in comparison of the organic and the inorganic nomenclatures. The former is substitutive and the latter additive. That is to say that in devising a name for an organic compound, one does so by adding to a parent name (more often than not that of a hydrocarbon, but not completely so) the name of an atom or group of atoms taking the place of a hydrogen atom present in the parent, e.g., 2-chloropropane, chlorobenzene, etc. In an additive system one devises the name in the same fashion by which many German verbs and nouns are constructed, that is, by stringing together the names (or a close facsimile thereof) of the component parts of the compound, e.g., lead chloride, hexaamminecobalt(3+) chloride, etc. This type of nomenclature works well particularly when applied within the pertinent subdiscipline. However, when one moves into an interdisciplinary subdiscipline, such as polymer science, difficulties are encountered in devising nomenclature systems since we must take into account the fact that there are, for example, both inorganic and organic polymers and even semiinorganic or semiorganic polymers. Polymer charac-

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MOLECULAR WEIGHT DISTRIBUTION
MWD
DISPERSITY
POLYDISPERSITY
POLYDISPERSITY INDEX
PDI
PI
$\bar{M}_W/\bar{M}_N$

Figure 1.

terization employs the nomenclature of not only the organic and inorganic subdisciplines but also that of the analytical chemist, the physical chemist, and the physicist. In addition, there are some newly emerging areas of polymer science which require that the jargon, argot, or nomenclature (as you will) of medicine, agriculture, and electrical engineering be thrown into the already formidable nomenclature list generated by the traditional chemistry subdisciplines relative to polymer science.

Polymer science is a "Johnny-come-lately" in the nomenclature field, but great strides have been and continue to be made even though, nomenclature-wise, polymer science is in a distinctly catch-up situation in relation to indexing and abstracting needs.

Now, let us descend to a lower level of abstraction and look at a few specific problems which it is hoped will illuminate some of the more generalized philosophical problems alluded to previously.

As discussed above, the characterization of polymers often involves the techniques of a number of different subdisciplines. Figure 1 lists the names currently in vogue for describing molecular weight distribution. These range from the use of phrases such as "molecular weight distribution" (genesis most likely by polymer scientists via physical chemistry and biology) and "polydispersity index" (a term used by colloid and surface scientists) to the use of only single constituent words of these phrases as well as the use of not-quite-acronyms derived from the first letters of the words in the phrases. This may seem to be an isolated trivial problem, but evidently it is serious enough because the Polymer Division Nomenclature Committee has been asked by several sources to develop a uniform designation for molecular weight distribution. On this score, I can attest to personal difficulties in this regard because until I became a faculty member at Clarkson College and began associating with colloid and surface scientists, I did not recognize that polydispersity index meant the same thing as molecular weight distribution, and would not have reacted accordingly in a literature search. Returning to a higher rung on the ladder of abstraction to put the interdisciplinary character of nomenclature needs concerning polymer characterization hopefully into a proper perspective, let me say that relative to viscosity, light scattering, other molecular weight methods, and other characterization techniques used by polymer scientists, and hence by abstractors and indexers, there is no agreed-upon nomenclature. Further, some presumably officially defined characterization standards have been in conflict with those actually in common use (e.g., inherent viscosity). Some real progress in a few of these areas has been made by the IUPAC nomenclature commission on Colloid and Surface Science. The ACS Polymer Division Nomenclature Committee also is looking into these matters. A key element in developing this area of nomenclature will be coordination of effort among those nomenclature groups working on common problems.

Turning our attention to a subdiscipline of polymer science, namely, that of inorganic polymers and seminorganic polymers, let us again try to outline the scope of the nomenclature problem by looking at a few specific examples. Also, let me

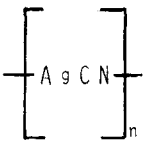

Figure 2.

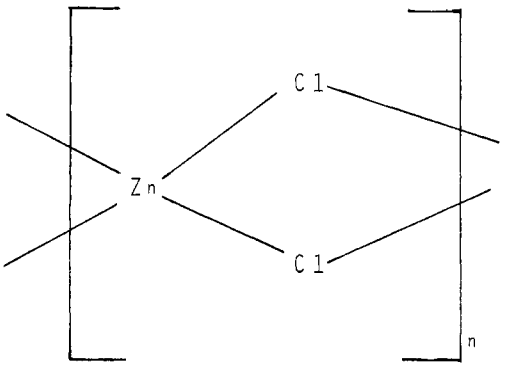

Figure 3.

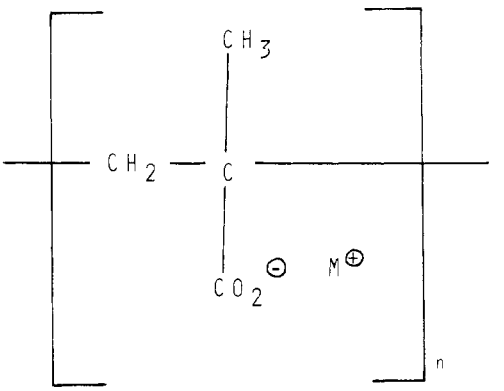

Figure 4.

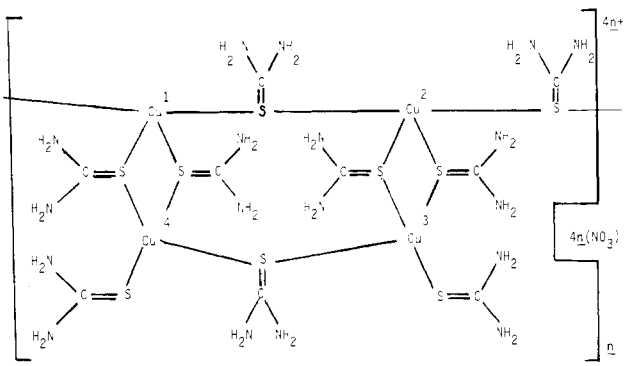

Figure 5.

say that presently there is no real nomenclature system available for inorganic or semiinorganic polymers, although significant progress toward this end has been made by the Polymer Division Nomenclature Committee and the IUPAC Macromolecular Commission on Nomenclature. To define somewhat the magnitude of the problem further let it also be said that no definition exists which clearly distinguishes a strictly inorganic polymer from a semiinorganic polymer or the latter from an organic polymer.

It is interesting to note that we do not think of silver cyanide (Figure 2) and zinc chloride (Figure 3) as being polymers, yet they are. It is obvious that both are inorganic polymers. However, it is not clearly defined that the structures shown in Figures 4–6 should be called organic or semiorganic, or semiinorganic. If the methacrylate salt (Figure 4) is that of

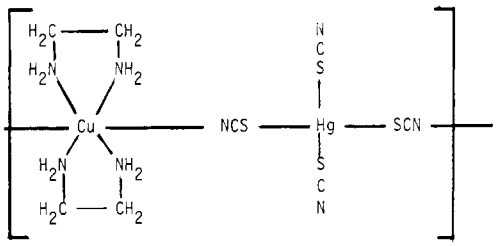

Figure 6.

a sample common monovalent ion, we would tend to call it organic. If, on the other hand, the ion is multivalent, particularly a transition metal, then because in some cases coordination phenomena arise should we call it semiorganic or semiinorganic? The complex structures in Figures 5 and 6 illustrate the quandry further. All of this, along with the fact that presently there is no nomenclature system for inorganic, semiinorganic, or semiorganic polymers makes it difficult to carry out literature searches. As one who has been carrying out research in this area for over 20 years, I can testify to the difficulty of information retrieval in this area. In fact, the only information retrieval method which I have found to recover such information with what might be called semicertainty is to scan each macromolecular abstract singly, to write letters, and to talk to people working in the area. This is not to say that some progress has not been made in abstracting and indexing because the actual fact is that a nomenclature system has been devised albeit not officially sanctioned and some provision has been made by *Chemical Abstracts* for naming coordination polymers.[1,2]

Turning to another topic, a recent review[3] drew as one of its prime conclusions that information retrieval systems at the interface between polymers, biology, and medicine are quite inadequate. This interdisciplinary area is one which is new and growing fast. The problem here is an odd one in that many of the polymeric species being investigated are not normally thought of or referred to as polymers. For example, it is, to an extent, easy to find information related to jalap, an emetic or purgative, but difficult or almost impossible to find in the context of a macromolecular species. Yet, jalap is a drug whose use stretches back to antiquity. This applies not only to jalap, but to many substances with which we deal today. A list of these is shown in Table I.[3] This table contains only a few of the possible entries. The materials listed and many others are not often thought of as macromolecules, and it can be difficult to obtain all the information available relative to their macromolecular status. Likewise, many materials which we would readily identify as polymers have been found to have biological activity of some sort, and this is equally difficult information to retrieve. In fact, this type of information is so difficult to retrieve that until April 1978,[4] the only way to do it with any effectiveness was by personal contact.

Finally, it might be well to call attention to one other area. Materials such as blends, interpenetrating polymer networks,

Table I

common name of substance	macromolecular identity	remarks
anaflex	urea-formaldehyde copolymer	in use as antibacterial
interferon	protein	antineoplastic-antiviral
glucans	polysaccharides	plasma expanders
dextrans	polysaccharides	plasma expanders
levin	polysaccharides	plasma expander
pectin	polysaccharides	plasma expander
controlled release fungicide	cellulose	fungicide
controlled release herbicide	cellulose	herbicide
IC complex	polynucleic acid	antineoplast
antidiarrhea resins	polyacrylates	
dermatological resins	ion exchanger salts	poison ivy-oak drugs

AB cross-linked copolymers, and many other combinations have no existing systematic nomenclature. The situation is further complicated by the fact that the time sequence of polymerization, grafting, and/or cross-linking each produce materials possessing different morphologies, and often widely different mechanical or physical properties. An examination of the patent literature reveals complex combinations of up to five polymers. An exact description of each requires a long exposition and the identification of the isomeric possibilities presents a serious challenge even to the expert. The need for a more comprehensive nomenclature in this area is becoming more imperative. However, work on this matter is in progress.[5]

It is hoped the presentation of this material has made clear the fact that to provide easy access to information in polymer science we need improvement both in nomenclature as well as indexing and abstracting. Presently, to do accurate literature searches in many areas of polymer science it is cumbersome at best in contrast to the relative ease of information retrieval concerning the classic subdisciplines (organic, inorganic, analytical, and physical) of chemistry. Moreover, in making needed improvements, we need to bear in mind the nature of modern data-processing equipment as we proceed to develop new nomenclature, indexing, and abstracting systems.

REFERENCES AND NOTES

(1) A Structure-Based Nomenclature for Polymers. II. One Dimensional Inorganic and Semi-organic Polymers. A draft of a proposed nomenclature system by the American Chemical Society Polymer Division Nomenclature Committee.
(2) *Chemical Abstracts*, Vol. 76. Index Guide, Section IV, 215.
(3) L. G. Donaruma, "Progress in Polymer Science", Vol. 4, A. D. Jenkins, Ed., Pergamon, London, 1974, p 1.
(4) L. G. Donaruma and O. Vogl, "Polymeric Drugs", Academic Press, New York, 1978.
(5) A Generalized Nomenclature Scheme for Multipolymer and Multimonomer Systems. A draft of a proposed nomenclature system by the American Chemical Society Polymer Division Nomenclature Committee.