Pesticide Literature and Pesticide Research*

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Pesticides are chemicals which protect crops from destruction by other living things. Insecticides, herbicides, and fungicides are examples. Chemical variety is great, and pesticidal compounds are regularly being discovered in chemical classes not previously represented. Pesticide research and development involves biologists, chemists, engineers, and agricultural specialists. Key aspects are carried out by universities, government, and industry, often working together. Various stages in this work are:

Chemical Synthesis	Formulation
Biological Testing	Analysis
(a) Laboratory	Metabolism
(b) Field	Registration
Toxicology	Patent and Publication
Manufacturing	

In practice the process is a highly interwoven pattern of experimentation, evaluation, and communication. Furthermore, it is a highly competitive operation, participated in by most of the leading chemical companies throughout the world. In the face of such competition, researchers in the pesticide field must move quickly, seize early upon promising new leads, and proceed efficiently in their exploitation. The initial evaluation of a pesticide lead entails consideration of the following factors.

Factor	Source of information
Biological efficacy	Internal data
Mammalian toxicity	
Manufacturing cost	
Patentability	
Has the compound been made before?	Search
Has it been patented for this use?	
Has this use been described for homologs or close analogs?	
Does this compound show unexpected differences from its homologs and analogs?	Search and internal data

The useful properties of the material are ascertained experimentally. The important question of novelty and patentability can be answered only by searching the literature.

The intensity of effort which we see in this area at the present time arises in part from the fact that the pesticide field is a relatively young one. Pesticide research is in a "boom" period, such as often characterizes new scientific fields. Less than 25 years ago, synthetic organic chemicals had no place in the farmer's warfare against pests. Inorganic chemicals and a few organic compounds of plant origin were in use. During the late 1930's and early 1940's the birth of the chlorinated hydrocarbon and organophosphate insecticides took place, as well as the discovery of organic herbicides. This period marked the beginning of pesticide chemistry as we know it today and furthermore marks the beginning of a new pesticide literature.

Since 1940, the pesticide literature has expanded 400%. In 1962, *Chemical Abstracts* carried abstracts of more than 3000 journal articles and patents dealing with pesticides and plant growth regulants.

In speaking of the "pesticide literature" we do not wish to imply that pesticide chemists can divorce themselves from the body of scientific literature. For the most part, the pesticide researcher deals with the biological literature, encompassing the standard scientific texts and journals of entomology, plant physiology, and phytopathology; and the chemical literature embracing analytical, organic, inorganic, and physical chemistry. The answer to his analytical problem may be found in an article dealing with compounds bearing no resemblance whatever to any known pesticide. The method chosen by the synthesis chemist will probably have been devised by someone with little or no interest in pesticides. The laboratory scientist working in the pesticide area conducts his experiments in equipment and with techniques and attitudes to be found in laboratories everywhere. Yet, there are features which do allow one to describe a pesticide literature. It encompasses those areas peculiar to pesticide research alone, and in this respect it is a recognizable category of the general literature.

The forms of pesticide literature can be classified as:

a. Compendia of commercial pesticides
b. Books (testbooks, monographs, "review series")
c. Scientific journals
d. Government and university bulletins
e. Technical data sheets from industry
f. Confidential industrial files
g. Patents (U. S. and foreign)

The first three categories are useful to all of the scientists in this field. The first deals exclusively with commercial compounds, whereas the next two also contain considerable valuable information on compounds which do not achieve commercial stature. Searching of scientific journals is, of course, time consuming and is subject to the vagaries of nomenclature and a limited ability to search generically. Information in university and government

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reports is difficult to retrieve, as are industrial data sheets. Confidential files pose their own information retrieval problems—problems, naturally, not shared with the community at large.

Patents are the richest source of information on pesticidal compounds below the level of commercial practice. It is most important that scientists working in a discovery area have early access to these, and are able to search them rapidly. This represents a significant difference in the use of the literature by those involved in efforts to discover new pesticides compared with those involved in later stages of development. The analytical, formulation, and process chemists are concerned with compounds which have passed the initial evaluation. They will seek solutions for their problems in part from among analogous problems described in the literature for commerical compounds. The importance of the pesticide compendia is thus underscored; in addition, several magnificent reviews on pesticide analysis have been produced.

The chemical compounds in commercial use as pesticides at present number about 250, but these are few indeed compared to the total number of compounds which have been patented because of pesticidal interest. Each year several thousand specific compounds are patented for pesticidal uses. Some of these are new compounds; others are known compounds for which pesticidal activity has been newly discovered. Of course, in addition to disclosing specific compounds, most patents claim generic series of compounds. In this way the number of compounds effectively covered each year is in the hundreds of thousands. In order to be sure that he is not working on an idea already patented by someone else, the chemist seeking new pesticides must stay abreast of these developments.

The enormity of the problem is further indicated by some recent activities in Washington, D. C. In its investigations of machine searches among the first areas studied by the U. S. Patent Office, subsequent to steroids, were (a) organophosphorus compounds[1] and (b) pesticides.[2] Numerous and significant though they are, domestic patents are not usually the most satisfactory for early awareness.** Foreign patents—in some countries patent applications—are published sooner and are therefore more useful.

A rapid generic search is an invaluable research tool. The scientist is provided with the information he wants while he is still interested without excessive loss of his time from the bench. It minimizes both the chance that a good idea will be set aside on the mistaken assumption that it has been already disclosed, as well as the chance that experiments already disclosed will be unwittingly repeated. To provide this sort of search capability many scientists have established their own literature files into which they store information as they encounter it. In many laboratories such files are established and maintained by the library staff as a service to the researchers. To be at all useful, such files must be fairly complete. This is an attainable goal with patents. Coverage of the general literature would be considerably more complex and undoubtedly would seriously overextend the resources of a single research organization.

** About 1400 pesticide patents appear each year in a dozen of the most important countries. A number of these are the same patent issued in different countries: probably about 300 represent new subject matter.

No measure is available of the extent to which information services of this sort are being duplicated in industrial laboratories and universities, but one can safely assume that considerable duplication does exist. If some of the funds sponsoring this effort could be pooled, better service at less cost to each party should result. This could be done in a number of ways; *e.g.* (a) by subscriptions to independently sponsored services tailored to meet industry's needs, or (b) cooperative action among companies with each member responsible for some segment of the service.

In a recent panel discussion on pesticide information problems, two somewhat different proposals were set forth. Dr. D. MacDougall emphasized the involvement of pesticide research with chemistry in general and proposed an all inclusive system for coding the chemical literature, organized by the American Chemical Society, and contributed to by chemical industry and universities.[3] Dr. H. Skolnik proposed that the Pesticides Subdivision take the lead in discussing the industry's problems with all involved to increase the usefulness of the present information services, and beyond this to consider establishment of a central Pesticide Information Service modeled after the American Petroleum Institute's information service.[4]

Privately sponsored services could provide alternative solutions and bring these into being more rapidly than cooperative enterprises.

A recent development in the handling of the pharmaceutical patent literature provides a model for this. A company, long active in the patent information field, offered to the pharmaceutical industry a patent service which provides in part (a) a weekly alerting service covering patents issued in 15 countries including the United States, (b) copies of the issued patents with duplication from issuances in other countries eliminated, and (c) abstracts on cards designed for mechanical retrieval, coded by chemical structure and use.[5] This type of system would certainly have application in the pesticide area.

It is important to note that such a system puts the tools of the search in the hands of the user. Central searching bureaus will never be popular with industry. Requesting a search on a research idea reveals an interest which is of the most confidential nature. Services which permit searches—especially machine searches—to be carried out "in-house" are needed.

If a solution to the patent problem can be devised, some plan for dealing with the rest of the pesticide literature should be worked out. Here, too, an abstract system coded by structure for generic searching is needed. For some time to come, attention should be given to less ambitious schemes concerned with limited segments of pesticide research (analytical methods, formulation, toxicology). The pooled experience thus gained should provide guides to more comprehensive mechanization of literature searching.

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