Vision Information Center: A User-Oriented Data Base

A computerized information system offers instruction and retrieval of biomedical literature on the eye.

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The Weinberg report (*1*) focused national attention on the need to bring published scientific information to those engaged in teaching, research, or clinical practice. In response to this report, the National Institute of Neurological Disease and Stroke (formerly the National Institute of Neurological Diseases and Blindness, which was renamed in 1968 when the National Eye Institute was established) inaugurated a network of four information centers whose purpose it is to disseminate information on subjects within the institute's scope. The four centers are the Parkinson Information Center at Columbia University; the Brain Information Service at the University of California, Los Angeles; the Information Center for Hearing, Speech and Disorders of Human Communication at Johns Hopkins University; and the Vision Information Center (VIC) at Harvard University.

The Vision Information Center's mission is to serve physicians and scientists whose work is concerned with the eye and vision. Through our discussions with members of this community, we learned that they needed an information retrieval system which would provide rapid access to retrospective and current literature on specific topics within their subject area. Vision is a large, interdisciplinary subject; it includes ophthalmology, biological and psychological research on the eye and visual processes, physiological optics, and public health and environmental factors relevant to the eye or eye diseases. The large volume of literature led us to a decision to exclude, at least initially, visual psychology from the subject scope of the VIC because this area is adequately handled by *Psychological Abstracts*. Comprehensive coverage of the biomedical literature, however, requires the use of four major secondary services: *Chemical Abstracts, Biological Abstracts, Index Medicus,* and *Ophthalmic Literature*. These tools suffer from the disadvantages of insufficiently specific indexing, or a long time lag between primary and secondary publication, or both.

Although the VIC is a young institution and its information handling functions are still developing, we believe it is appropriate at this time to share our experiences. The methods and techniques we have developed can be applied to facilitate communication in any science. An information center plays an important integrative role in interdisciplinary or mission-oriented research.

VIC Thesaurus

We decided that VIC would concentrate its initial efforts on the development of a computerized information retrieval system which would be directly accessible to the scientist or physician via remote computer terminal. As originally conceived, the data base would comprise three parts: (i) computer assisted instruction (CAI); (ii) literature or bibliographic retrieval; and (iii) patient records. Only the first two have thus far been implemented. A prerequisite for such a system was a hierarchically structured thesaurus (*2*) of specific terminology—the point of entry to the data base. The overall scheme of the system is shown in Fig. 1. The thesaurus we have developed is compatible with *Medical Subject Headings* (*MeSH*) (*3*), the controlled vocabulary used for indexing the biomedical literature at the National Library of Medicine for its monthly *Index Medicus* and for MEDLARS (Medical Literature Analysis and Retrieval System).

Since scientists in the field of vision place a high priority on depth and specificity of indexing, the VIC thesaurus contains those terms that reflect current concepts in research and clinical practice. In fact, with the exception of terms indicating major categories (such as *vertebrates, eye diseases, enzymes*), which are used as they appear in *MeSH*, the VIC thesaurus has been created from terms actually used in indexing the 10,000 articles which constitute the VIC data base. We hoped that this method of constructing the thesaurus would both ensure the exclusion of unnecessary and archaic terms and tell a potential user that the data base contains at least one article on any subject which is in the thesaurus.

The thesaurus is printed by computer (*4*) in two forms, VICPRINT and PERMSORT. Relationships between terms are indicated by the seven levels of specificity of the hierarchical coding system, which is displayed in VICPRINT. The first level of specificity is indicated by a letter, and the remaining six levels are designated by six pairs of digits. Figure 2 illustrates a hierarchical tree of the thesaurus. The PERMSORT program prints every thesaurus term, in alphabetical order, under every significant word in the term. This printout resembles the familiar KWIC (keyword in context) index. An example of the PERMSORT printout is shown in Fig. 3.

Although the thesaurus contains vocabulary covering such diverse subjects as neuroanatomy and space science, most of the very specific descriptors are in the categories of the anatomy, physiology, and diseases of the eye, and of ophthalmic diagnosis and surgery. Of the 7000 terms in the most recent edition of the thesaurus, 40 percent are in these groups. The *Coding System for Disorders of the Eye* (*5*), prepared for the International Council of Ophthalmology, is the basis of the category for eye diseases in the VIC thesaurus. Incorporation of this coding system and of the International Union of Biochemistry's (*6*) nomenclature and code assignations for enzymes is a step in the direction of uniformity of terminology, which is so desirable in the scientific literature. The VIC thesaurus has been translated into French by scientists at the Institut Chibret, Clermont-Ferrand, France; such translations should facilitate its international usage.

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Computer Assisted Instruction

Our early work with programmed and computer assisted instruction convinced us that judicious use of such techniques would enhance the VIC information retrieval system. In the format of computer assisted instruction, one or more facts are presented in a sentence or two; this brief lesson is followed by a question which tests the student's comprehension of the material. Computer assisted instruction has three functions in the VIC system (*7*).

1) Use of CAILAN, a programming language developed for CAI, makes possible a conversational mode of interaction between the user and the computer.

2) The user may request as much information as he needs on use of the computer terminal and of the VIC thesaurus; these directions, written in the CAI format, are typed out at the computer terminal. Thus it is possible for a novice user at a remote terminal to query the system without relying on the assistance of a librarian or information scientist.

3) CAI provides instruction on various aspects of ophthalmology. At present, there are four texts (*8*) of programmed instruction in the data base. The course material stored in the computer is supplemented by slides, which are projected on a small screen next to the computer terminal. The CAI user has three options: (i) he may take a basic course in ophthalmology; (ii) he may elect an advanced course in a narrow area of ophthalmology; or (iii) he may choose to receive a short sequence of instruction on a specific subject selected from the thesaurus.

Literature Retrieval Program

For best results in searching the VIC data base, an interested scientist should first familiarize himself with the thesaurus and the VIC indexing rules. As we mentioned above, instructions on the use of the thesaurus are displayed at the computer terminal. A detailed description of the thesaurus and an explanation of the indexing policies are included in a users' manual (*9*). In this article we briefly explain the indexing of a document, using a paper (*10*) published in *Science* as an example.

The title of the paper is "Organization of the visual pathways." After reviewing the anatomy of the retina and optic pathways, the author, Glickstein, presents recent findings on the function of several parts of the brain, especially the dorsal lateral geniculate nucleus, in the transformation of the retinal image into the complex neural processes which constitute vision. The following index terms and thesaurus code numbers were assigned to this article: retina (A1304-10000000), optic chiasm (A13060000-0000), splitting of optic chiasm (E0713-31010000), optic nerve fiber (A130501-000000), dorsal lateral geniculate nucleus (A080201040204), retinal images (G010830140300), visual pathways (G010817110200), visual field mapping (E0101080700000), visual evoked response (G010809110300), cats (B020-802010500), and tree shrews (B02080-2020600).

The last two terms indicate the species in which the research was done. The VIC indexers use specific rather than general terms whenever possible; thus, optic nerve fiber was chosen, rather than optic nerve (A1305-00000000), and dorsal lateral geniculate nucleus rather than brain (A08020100-0000). However, we used the term *retina* instead of enumerating all the retinal layers mentioned by Glickstein because the anatomy of the retina is not the main subject but is reviewed to orient the reader.

We can use the same article to describe a search of the VIC data base. The search strategy is so designed that the code number of any thesaurus term used to initiate a search will retrieve all articles indexed under that term as well as articles indexed under the narrower terms indented below the given term. Since the term *retinal images* is coded under the broad term *vision*, a search request for articles on vision would retrieve any references filed under *retinal images*. The flexibility of the search program allows the user to change his strategy as he proceeds. Let us say that a user of the system wants a bibliography on the role of the dorsal lateral geniculate nucleus in primate vision.

The first task is to locate the terms *dorsal lateral geniculate nucleus, primates*, and *vision* in the PERMSORT version of the thesaurus, and to note their code numbers. After the user has signed on to the system and typed his name and address, he is asked to type the thesaurus number of the subject of his search. He enters A080201040204, and the computer confirms the correctness of this number by typing "dorsal lateral geniculate nucleus." The computer states that there are x references on this subject, and asks the user if he wishes to continue with this term or change to another. At this point the user would select a narrower term if there were too many references, or a broader term if there were too few. However, our user is satisfied with the number of references and continues with his first term. He is asked if he wishes to get a list of references at this point, or to choose an additional term. He now types in B020802020000 (primates), and the computer replies that there are y references on primates, and that a citations are filed under the two terms he has entered. Again, the user continues with his two requests and enters a third number, G010830000000 (vision). The computer replies that there are z references on vision, and that the combination of his three request terms yields b citations. The user then types "list," and his bibliography is typed out at the computer terminal. If the bibliography contains more than 20 references,

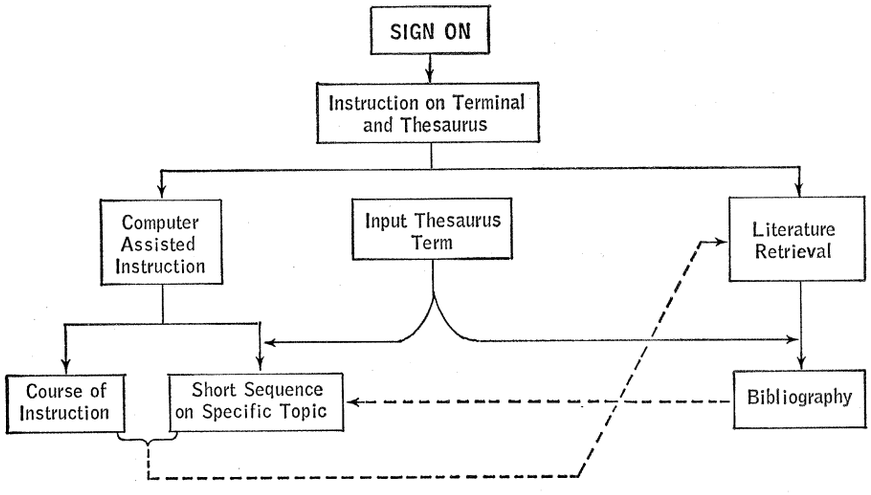

Fig. 1. Schematic diagram of the Vision Information Center data base. After the user signs on, he chooses computer assisted instruction or literature retrieval. At certain points in the program he may change from one mode to the other. The dashed lines indicate optional steps.

A00 00 00 00 00 00	Anatomical Terms
A13 00 00 00 00 00	Eye
A13 04 00 00 00 00	Eyeball
A13 04 10 00 00 00	Retina
A13 04 10 09 00 00	Retinal Photoreceptor Cells
A13 04 10 09 01 00	Retinal Rods
A13 04 10 09 01 02	Retinal Rod Outer Segment
A13 04 10 09 02 00	Retinal Cones
A13 04 10 19 02 01	Retinal Cone Outer Segment

Fig. 2. A hierarchical tree from the thesaurus.

only the first ten are typed on-line; the remainder are printed off-line and mailed to the user. In addition to searching by subject, it is possible to search (off-line) by author, journal, title, or date of entry of the citation into the system.

Until recently, the CAI courses were separate from the literature retrieval program. Now, however, a program which merges the two parts of the data base has been implemented; this allows the user to receive both instructions and a bibliography on a subject chosen from the thesaurus. For example, a student who begins by taking a course of instruction is given the option to request a bibliography. And if a user selects literature retrieval when he enters the system, the computer tells him whether or not instructional frames are available on the bibliographic subject. We think that this combination of CAI and literature retrieval will be especially helpful to a person who is entering an area of research new to him, or who needs information on a subject peripheral to his main interest. Imagine a physicist who wishes to investigate the optical properties of the crystalline lens of the eye. He would first need to learn a few facts about the anatomy of the lens. After he studies the appropriate instructional frames, he wants to know what research has been done on the optics of the ocular lens. A bibliographic request, in which the terms *crystalline lens* and *physiological optics* are combined, produces a list of references on his subject.

There are now 25 research groups who have access, on a time-sharing basis, to the VIC data base through computer terminals at their own institutions. These institutions include medical schools, teaching hospitals, research institutes, and federal laboratories. On-line demonstrations of the VIC system at several national meetings have introduced hundreds of prospective users to the availability of the service. Two aspects of the system have been especially well received: (i) the scientist can use it himself and revise his request as he proceeds through his literature search or course of instruction, and (ii) the specificity of indexing permits the retrieval of a small number of relevant citations, rather than a long bibliography from which the scientist must choose the documents which interest him. Favorable response has encouraged us to enlarge both the data base and the time-sharing capabilities of the system so that we can offer comprehensive coverage of the literature of vision and make the system available to more individuals whose work would benefit from it. Current developments in small, inexpensive computer terminals will ensure increased accessibility to the system in the near future.

	Anatomical Terms	A00 00 00 00 00 00
Retinal	Cone Outer Segment	A13 04 10 09 02 01
Retinal	Cones	A13 04 10 09 02 01
	Eye	A13 00 00 00 00 00
	Eyeball	A13 04 00 00 00 00
Retinal	Photoreceptor Cells	A13 04 10 09 00 00
	Retina	A13 04 10 00 00 00
	Retinal Cones	A13 04 10 09 02 00
	Retinal Rods	A13 04 10 09 01 00
Retinal	Rod Outer Segment	A13 04 10 09 01 02

Fig. 3. An abbreviated version of PERMSORT, constructed from the terms given in Fig. 2. The appearance of *retinal cones* under both *C* and *R* illustrates the method of listing each term alphabetically under every significant word in the term. To save space, here all other terms are listed only once.

Summary

In response to the information needs of scientists and physicians who work in the field of vision, we have developed a direct-access, on-line specialized information retrieval system which combines computer-assisted instruction and bibliographic retrieval. An essential feature of the system is its accessibility via remote computer terminal. The key to the data base is a thesaurus which contains specific terminology arranged in a hierarchical structure. The thesaurus is used both for indexing the literature and for retrieving the information stored in the computer. Courses of instruction on selected subjects in ophthalmology have been programmed and form part of the data base. A search of the literature retrieval system by single subject, or by a combination of several subjects chosen from the thesaurus, retrieves the appropriate bibliographic citations. The response to the service offered by the Vision Information Center indicates that the center should expand its facilities to satisfy the needs of its clients.

References and Notes

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