THE APPLICATION OF HYPERTEXT TO ARCHIVES

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ABSTRACT

The thesis explores whether hypertext, a non-linear, associative way of structuring information using computer programs, could be implemented in an archival information system. It includes a summary of the development and nature of hypertext, a discussion of archival information systems and the needs of users regarding information retrieval, and a discussion of how the capacities of hypertext can be applied to archival retrieval systems and how a possible hypertext retrieval system could be structured. Additionally, aspects of a hypothetical hypertext information system are presented to illustrate how archival information could be organized using hypertext and how that information could be browsed and retrieved.

There are both benefits and disadvantages to implementing a hypertext archival retrieval system. The advantages of such a system include the following: the hierarchical structure of information about archives is well suited to being represented in hypertext; movement throughout the hierarchical structures is as simple as following links between the records; records could have multiple links to other records; information could be structured in multiple ways simultaneously; associative browsing of the information by following the links between the records could be possible; and a variety of search options are possible that would allow users to access the information in the hypertext in a variety of ways.

The disadvantages of implementing a hypertext archival information system are: it might be too time consuming to create the hypertext; movement throughout the hypertext

network would rely on links that were created by the archivist, so navigation would only be as good or bad as the established links; and the associational, non-linear structure of hypertext might not be the most effective or efficient way to retrieve archival information.

Despite some of the disadvantages and technical difficulties of hypertext, it could be successfully implemented in an archival retrieval system. The configuration and functions of such a system could vary widely, and would depend on the requirements of the archives.

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INTRODUCTION

In the 1940s, Vannevar Bush described a machine that could be used to associatively link disparate pieces of information, and the links could be saved and then later traversed at will. The machine was meant to revolutionize the way we view and retrieve information: movement from a piece of linked information, such as a passage of text or an illustration, to another linked piece of information, would be associative rather than being linear. While viewing one piece of information, the user would be able to jump to the attached piece of information. Bush believed this to be a superior way to organize and retrieve information because it was closer to the way we think.

Bush was unable to realize his "associative linking machine" because the technology of the time was not sufficiently advanced. Others were inspired by Bush's vision, though, and they worked to create a machine that could function as Bush had described. It was one of these early hypertext pioneers, Ted Nelson, who coined the term "hypertext."

Hypertext, as it has come to be understood, is a non-linear, associative way of representing information on computer. Information is broken down into individual components, often called nodes, which are then linked to one another. Movement between the information in the nodes is accomplished by activating a link embedded in the node and then travelling along the link to the attached information. The linked information can be in a variety of forms, including text, graphics, sound and moving images. The foundation of hypertext is associative and free movement throughout a network of linked information and the ability of a single piece of information to be linked to multiple pieces of information.

The purpose of this thesis is to explore whether hypertext could be implemented in an archival information system. It will begin with an exploration of the development and nature of hypertext, followed by a discussion of the nature of archival information systems and the needs of users regarding information retrieval, and finally, a description of how a hypertext archival information system could be structured and how it would function. To illuminate the particular concepts, a hypothetical hypertext archival information system is presented in the appendix.

The first chapter describes the nature and characteristics of hypertext. It includes a discussion of the origin of the concept of hypertext and how it has been realized in hardware and software, a description of the components of hypertext, the categories of hypertext systems, and the advantages and disadvantages of hypertext.

The second chapter discusses archival retrieval systems and access to information in such systems (with an emphasis on users and how they access information). The first part of the chapter includes a discussion of the archival principles upon which arrangement and description are founded, the elements of archival retrieval systems, and some of the methods to enhance the retrieval of archival information proposed by archivists. The second part of the chapter discusses the users of archives and their needs concerning information retrieval. This includes an identification of who are the users of archives, the type of questions they ask, how much time they have for searching and retrieval of information, and how the archivist acts as an intermediary between the information and the user.

The third chapter describes how hypertext could be implemented in an archival retrieval system. This is done with respect to the information presented in the first two chapters. It includes a description of the category of hypertext system best suited for archives; a discussion of the components of an archival hypertext; how the information in the archival hypertext could be linked; how the links could be indicated; what type of navigation aids could be used; what would happen when information was moved or deleted; how users would search and browse the hypertext; how the records could be printed out; and how and whether user links would be possible. Additionally, some of the issues concerning the implementation of a hypertext archival information system are discussed, including the time it would take to create links and nodes; how time consuming it would be to type all the structural elements in the hypertext so that they could be searchable; and whether the structure of archival information and the structure of hypertext would be a good match and if hypertext would lead to improved retrieval of information from archives.

Finally, the appendix presents a hypothetical hypertext system, and illustrates aspects of how a potential hypertext archival information system would function, in particular, how searching, browsing and guided tours would be accomplished.

CHAPTER 1
AN OVERVIEW OF HYPERTEXT

Introduction

Vannevar Bush (1890-1974), a distinguished American engineer, was the originator of hypertext. He developed hypertext because he was concerned about the rapid expansion of recorded information in the modern era and the concomitant difficulty of finding and remembering the location of records. He recognized that contemporary systems of indexing hindered the retrieval of records because they were not based on how the mind works.[1] As he commented:

> Our ineptitude in getting at the record is largely caused by the artificiality of systems of indexing. When data of any sort are placed in storage, they are filed alphabetically or numerically, and information is found (when it is) by tracing it down from subclass to subclass. It can be in only one place, unless duplicates are used; one has to have rules as to which path will locate it, and the rules are cumbersome. Having found one item, moreover, one has to emerge from the system and re-enter on a new path.
>
> The human mind does not operate that way. It operates by association. With one item in its grasp, it snaps instantly to the next that is suggested by the association of thoughts, in accordance with some intricate web of trails carried by the cells of the brain. It has other characteristics, of course; trails that are not frequently followed are prone to fade, items are not fully permanent, memory is transitory. Yet the speed of action, the intricacy of trails, the detail of mental pictures, is awe-inspiring beyond all else in nature.[2]

Taking into consideration the mind's associational nature, Bush was determined to improve information retrieval. He surveyed existing technology, and borrowed from the analytic devices of the time—such as photography, tube electronics, and mass production techniques—to come up with a solution.[3] His answer was memex, a machine that he first described in, "As We May Think," a visionary article he published in 1945. Memex was a machine that was designed to allow vast stores of information to be linked associatively. The machine could hold a thousand volumes of information on microfilm—such as books, documents, and communications—and two million pages of new material could be added each year.[4] The information would be displayed on the machine's dual screens, and by using special codes, the user could associatively link information from one screen to information in the other. When a particular item was viewed later, if another item had been linked to it, it could be recalled at the user's command. With memex, the user would be able to create and traverse trails of information. The trails would be permanently fixed in the machine, so the user would not have to rely on his or her memory to remember how information was linked. Also, the user would avoid having to travel up and down hierarchies of conventional indexing systems to find information.[5]

Memex was intended to extend human memory (memex is a portmanteau word combining memory and extension) and to help users find and link information. This associative linking machine was the first expression of hypertext. Memex was never created because the appropriate technology did not exist in 1945—computers had not yet been invented and there were no devices that could store and link vast amounts of information. Bush's ideas, however, inspired future scientists and information professionals to develop hypertext systems.

The two pioneers of early hypertext systems were Ted Nelson and Douglas Engelbart. Ted Nelson began working on hypertext at Harvard in 1960 as part of a term project for a graduate course on computers and the social sciences. His project, known as Xanadu, was a proposal to develop a revolutionary global hypertext information system that would allow for the creation, access and publishing of all the world's literature.[6] From 1967 to 1968, Nelson was part of a group of researchers at Brown University that developed one of the first hypertext-based text editing systems.[7] Similarly, Douglas Engelbart began exploring hypertext at Stanford Research Institute in 1963. He developed a hypertext-based text editing system, known as NLS (oNLine System).[8] When he demonstrated it at the 1968 Fall Joint Computer Conference, it astounded the audience and the demonstration became a landmark in the history of hypertext.[9] Engelbart has continued to work on hypertext and computer technology, especially exploring how machines can be used to augment human intellect.[10]

During the 1970s and 1980s, a number of working hypertext systems were developed. Most ran on mainframe computers or workstations, and were largely experimental prototypes that saw limited use outside the research environment. There were also a number of systems developed for personal computers. The aim during this period was to explore hypertext concepts and discover potential applications. At Brown University, Andries van Dam, after participating in the design of the original hypertext text editor, oversaw the development of a series of hypertext systems: the File Retrieval and Editing System (FRESS), the Electronic Document System, and finally Intermedia.[11] In 1983 the Institute for Research in Information and Scholarship (IRIS) was established at Brown with the mandate to study the "needs, requirements and impact of...technology on scholarly work," and its attention has been focused on the application of hypertext to education.[12] The development of Intermedia has been well documented by various members of IRIS, most notably Norman Meyrowitz and Nicole Yankelovich.[13] At Carnegie-Mellon University from 1976-84, the ZOG hypertext system was created under the direction of Robert M. Akscyn, Donald McCracken and Elise A. Yoder. Its first application was as an information management system for the U.S. Navy aircraft carrier, the USS *Carl Vinson*.[14] The Xerox

Palo Alto Research Center (PARC) has also played a prominent role in the development of hypertext in the 1980s. They developed NoteCards, a hypertext system described as "a computer environment designed to help people work with ideas."[15] It is a complex system mainly for use by members the research community. Prominent researchers in this group include Frank Halasz and Randall Trigg, who have written on the development of NoteCards and on issues relating to hypertext in general.[16] At the University of Maryland, a hypertext group under the direction of Ben Shneiderman developed the Hyperties hypertext system.[17]

The popularity of hypertext increased immensely during the late 1980s and early 1990s, because more hypertext programs were written for personal computers. Of note is HyperCard, probably the most popular hypertext application of this period. Although it is not a true hypertext system because of its limited linking ability, its widespread use helped make hypertext well-known. As the price of powerful computers falls and their capabilities increase, hypertext is becoming more accessible, and many people are beginning to examine it seriously to see how they can use it.

Many articles have been written about hypertext, covering a wide range of issues.[18] The best introductory surveys have been written by Jeff Conklin, Ben Shneiderman and Greg Kearsley, and Jakob Nielson.[19] In conjunction with other pertinent literature on hypertext, their surveys form the basis for the examination of hypertext that follows.

Elements of Hypertext

There are many different types of hypertext systems, but they all operate in much the same way.[20] A hypertext database contains a number of individual pieces of text that are joined into a complex network by explicit links established by the creator (or later editor) of the database. To move from one piece of text to another, the user selects an embedded link that is highlighted within that piece, and is instantly transported to the referenced piece(s). The user thus travels throughout the database in a process not unlike browsing. The user is aided by a number of mechanisms to make browsing easy and efficient—such as browsers, local maps, bookmarks, history lists, and overview diagrams. The user can also get to specific locations in the hypertext by conducting keyword and string searches. To understand hypertext, it is essential to understand its foundation: nodes and links.

Nodes

Nodes are the discrete units of information that make up a hypertext database. A node generally consists of a single idea or concept that is expressed in a concise manner. Nodes are treated as independent entities and are linked to other nodes in multiple ways. Depending on the concept or idea being expressed, and how the author or editor decides to modularize it, a node can be as small as a character or as large as a file. Problems can arise with modularizing ideas into nodes, because some information is difficult to separate into parts. In general, hypertext is best suited to information that can be easily broken down into discrete parts. However, if a node is defined too minutely or too independently, it may not be easily linked to others. The size of a node is also determined by the hypertext display software: if it displays a single window at a time and does not allow scrolling, ideas have to be expressed within the constraints of the frame (figure 1). To overcome this restriction, a series of frames can be used and the user notified that the text continues in the next frame. If it is a system with multiple windows that allows scrolling, there is no restriction on the amount of information that can be placed in a node. A final consideration on node size is that longer nodes are less efficient because they take longer to read and can therefore dissipate concentration on the referral and browsing process.

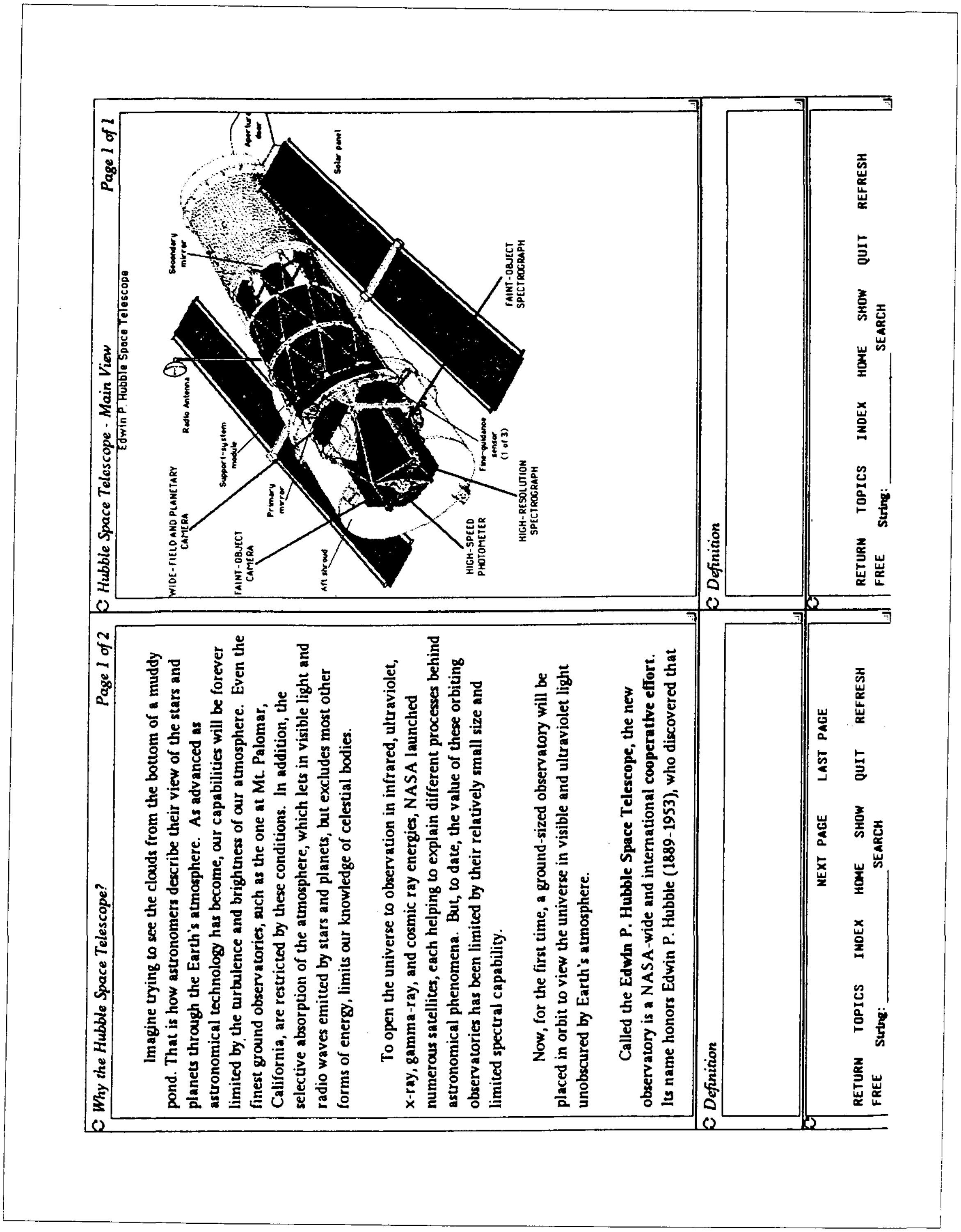

Fig. 1. A view of two windows in Hyperties. The the amount of information that can be placed in the windows is restricted by the boundaries of the frames. From Ben Shneiderman, "Reflections on Authoring, Editing, and Managing Hypertext," in *The Society of Text: Hypertext, Hypermedia, and the Social Construction of Information*, ed. Edward Barrett (Cambridge, Mass.: MIT Press, 1989), 120.

Types of Nodes

Hypertext systems can have either one type of node to perform all of the functions and hold all types of information, or they can have many different types of nodes each of which performs a specific function and holds a particular type of information. HyperCard and KMS, for instance, have only one type of node. It can contain any combination of text, graphics, or sounds, and can be used to invoke operations such as playing a CD-ROM drive or performing a calculation. NoteCards, Guide and gIBIS, on the other hand, are examples of systems that allow for different types of nodes, each used for a specific function or containing a defined class of information. NoteCards, for example, has "filebox cards" that are used to organize other nodes (figure 2) and guided tour nodes that provide tours of other nodes. In gIBIS, there are a variety of node types distinguished by their content and function, namely issue nodes, argument nodes, and position nodes (figure 3).[21]

Most nodes allow information to be placed in them in any arrangement the author desires. Some systems, however, have semi-structured nodes that limit how the information can be entered. These nodes have a fixed internal structure with "labelled fields and space for field values" that allows information to be entered into the node in a set way.[22] This structure helps ensure that complete information is entered into the node, which in turn helps the computer process the node. This structuring also makes certain that the nodes are represented in a similar fashion. gIBIS, for example, is based on semi-structured nodes. When a user wants to enter information into an issue, argument, or position node, the set structure has to be followed. The node has fixed fields for the date, subject, keywords, author, and text (figure 3). The difficulty with semi-structured nodes is that they may express more than a single concept or idea. This goes against the principle that a node should only contain a single concept or idea, and subsequently may cause problems when the node is to be represented graphically or when the node is to be linked to another node.

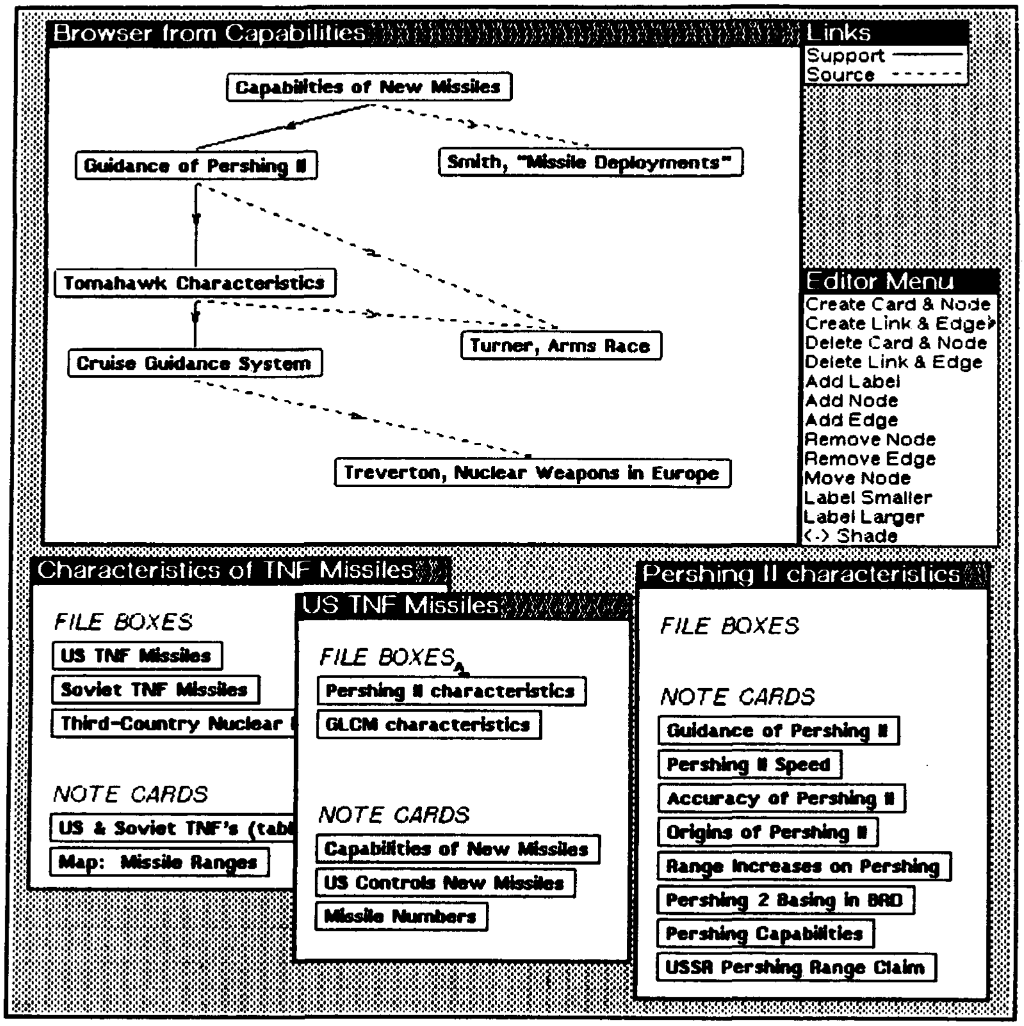

Fig. 2. A NoteCards screen showing the use of Filebox Cards (lower three nodes) to organize other fileboxes and notecards. From Frank G. Halasz, Thomas P. Moran, and Randall H. Trigg, "NoteCards in a Nutshell," in *Proceedings of the 1987 ACM Conference of Human Factors in Computer Systems (CHI+GI 87)*, ed. John M. Carrol and Peter Tanner. Toronto, Ontario, April 5-9, 1987: 47.

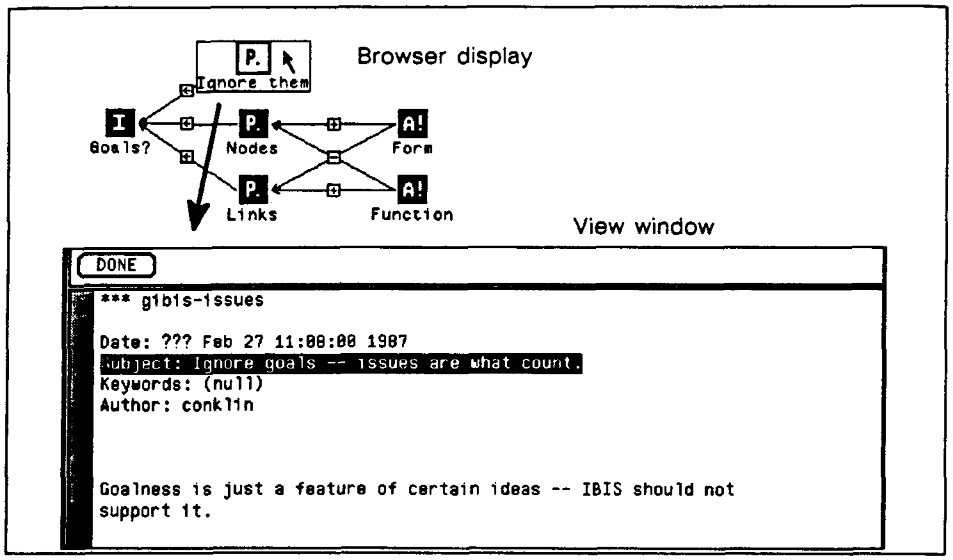

Fig. 3. A graphical representation of issue nodes, position nodes and argument nodes in gIBIS and the links between them (distinguished with positive and negative signs). Also, inset is a view window that is displaying the contents of a position node. From Jeff Conklin and Michael L. Begemen, "gIBIS: A Hypertext Tool for Exploratory Policy Discussion," *ACM Transactions on Office Information Systems*, 6 (October 1988): 318.

Nevertheless, semi-structured nodes are usually not separated into individual nodes because the relationships between its individual pieces of information would be lost.

Another variation on the standard node is the composite node. A composite node is created when many separate nodes are brought together and treated as a single node with its own name.[23] They unclutter the display by representing many nodes as a single node (figure

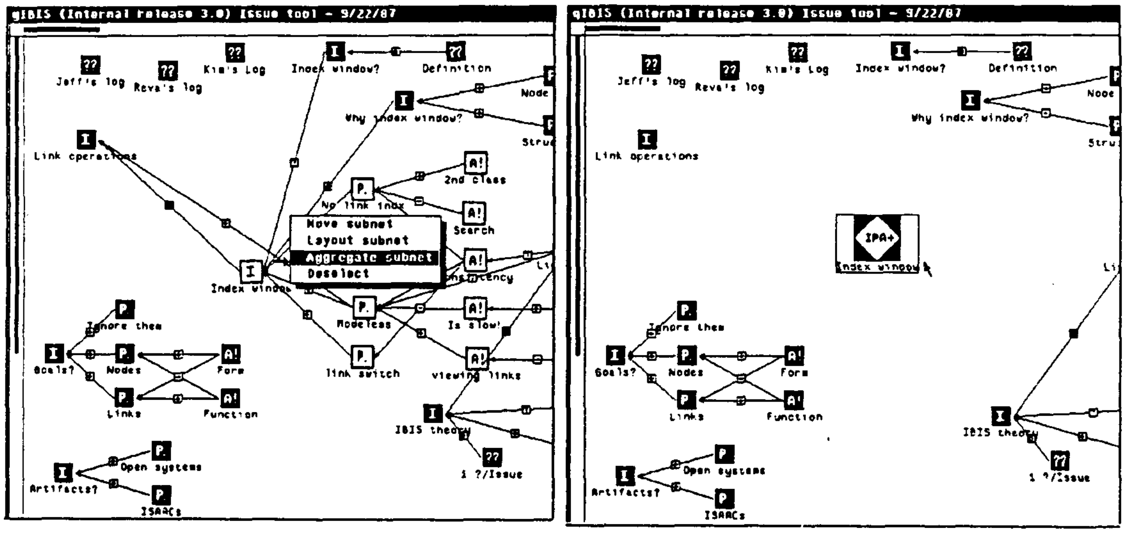

Fig. 4. The aggregation of a network of nodes in gIBIS (a) to form a single node (b); this effectively reduces the screen clutter for the viewer. From Jeff Conklin and Michael L. Begeman, "gIBIS: A Tool for All Reasons," *Bulletin of the American Society for Information Science* 15 (May 1989): 204.

4). Composite nodes are also dynamic—the subnodes can be rearranged, new ones can be added and old ones deleted. The problem with composite nodes, though, is that as nodes are added or deleted, the aggregation may change. The author of the hypertext has to be aware of this, and has to make sure that the title is an accurate reflection of its contents.

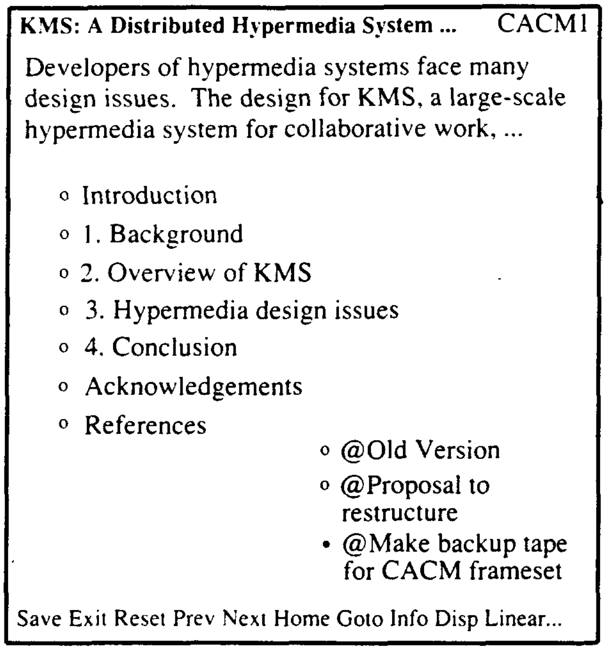

Fig. 5. A KMS frame with multiple links to other nodes. Links are indicated by a circle and dot preceding the text. From Robert M. Akscyn et al, "KMS: A Distributed Hypermedia System for Managing Knowledge in Organizations," *Communications of the ACM* 31 (July 1988): 882.

Links

The other central element of hypertext is links. Links connect text from one node to text in another node. A link has a starting point and a destination that is indicated as point or region in the text.[24] It can be indicated in a variety of ways, such as by using reverse color, color, icons, boldface or underlining. The link's name and type is usually suggested, and sometimes the destination is indicated as well (figure 5). The direction of travel along the link is unidirectional or bidirectional. With a bidirectional link, either end of the link can be a departure point. With unidirectional links, one end is the starting point and the nections," and it can be done "with the goal of discovering...an appropriate detailed document or even the pattern of connections between information in the [hypertext]."[32] Browsers can represent the information globally, showing all of the links and nodes in the network (within the limits of the screen), or they can show a local view, that illustrates the links and

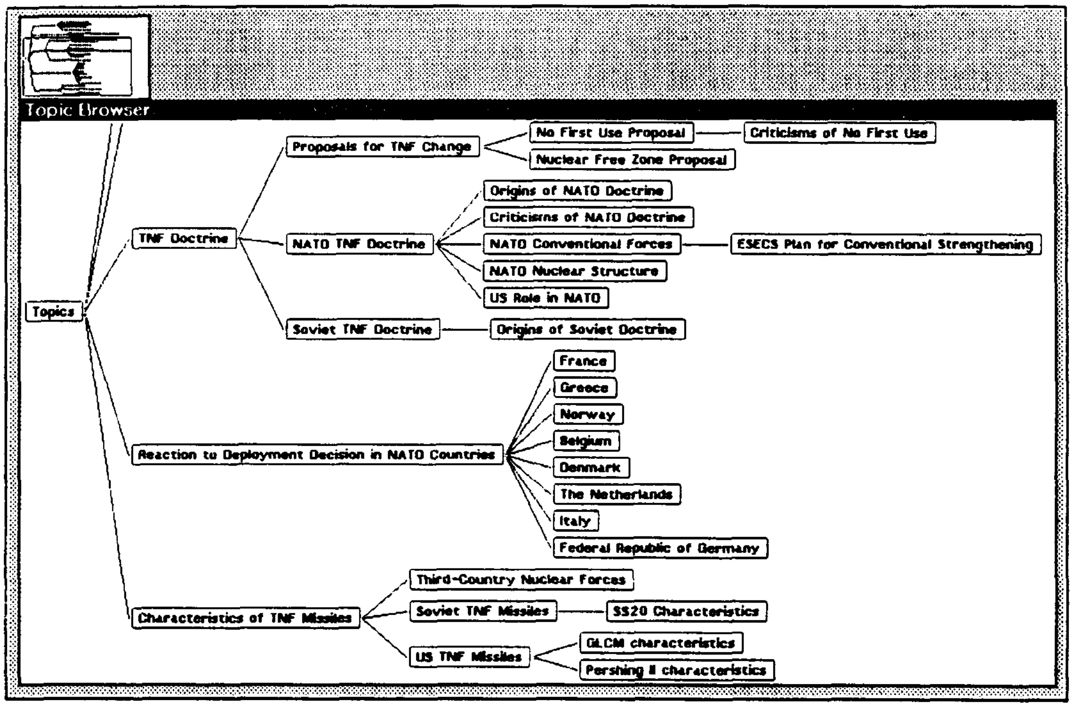

Fig. 6. A browser from NoteCards which shows the relationship between a number of nodes from a NoteCards filebox on the topic of NATO-Soviet missile deployment in Europe. From Frank G. Halasz, Thomas P. Moran, and Randall H. Trigg, "NoteCards in a Nutshell," in *Proceedings of the 1987 ACM Conference of Human Factors in Computer Systems (CHI+GI 87)*, ed. John M. Carrol and Peter Tanner. Toronto, Ontario, April 5-9, 1987: 49.

nodes emanating from the user's current location, as shown in figure 7. With regard to using global and local maps, Yankelovich offers the following suggestions:

> To get a general idea of how a body of information is structured, it is best not to display a detailed 'road map' when a 'globe' is all that is needed. To create global views, document systems must have facilities for summarizing, compacting, and extracting the essence of the stored material. However, once readers are in the midst of the web or already familiar with its overall structure, they will require

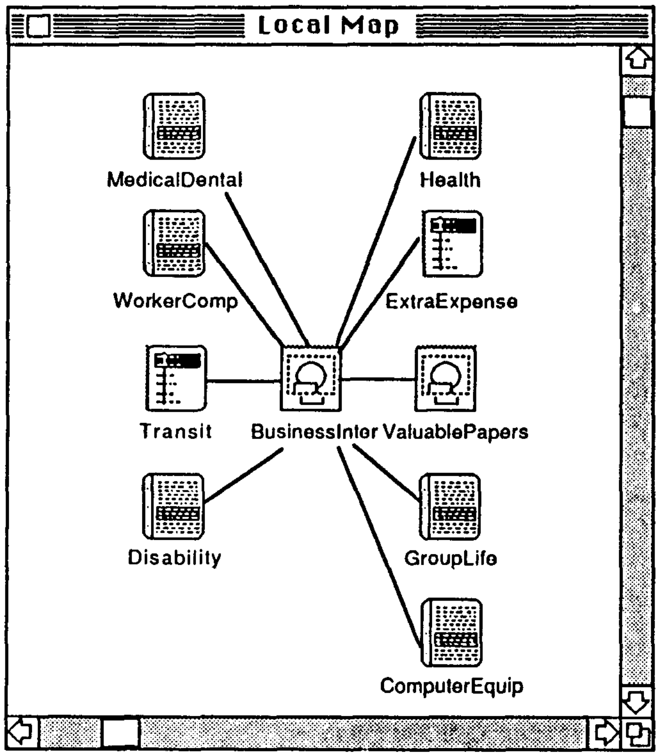

Fig. 7. A local tracking map in Intermedia, showing the network of links that emanate from the document "BusinessInter." From Kenneth Utting and Nicole Yankelovich, "Context and Orientation in Hypermedia Networks," *ACM Transactions on Information Systems* 7 (January 1989): 63.

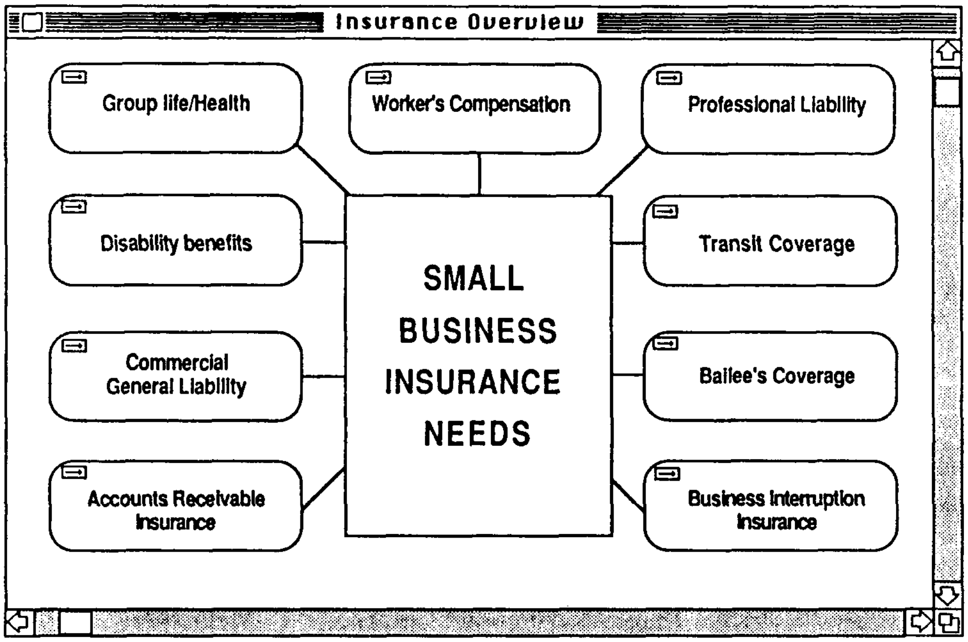

Fig. 8. An overview diagram in Intermedia. The theme "Small Business Insurance Needs" is represented in the center, and all of the related areas radiate from it. Clicking the link icon in any of the related areas would take the user to that node. From Kenneth Utting and Nicole Yankelovich, "Context and Orientation in Hypermedia Networks," *ACM Transactions on Information Systems* 7 (January 1989): 64.

the last node(s) visited. To return to a node, the user simply selects it and then is transported there.

Where the user is a novice and does not know where to begin browsing, the system can have overview diagrams somewhat like tables of contents. The user selects a topic or theme, and a graphical representation of that topic and related areas of information is displayed (figure 8). From there, the user simply selects the area that he or she wants to browse. Overview diagrams are effective because they are easy to use and they show the other is the destination. A unidirectional link cannot be accessed from its destination point. The main requirement of a hypertext link is that it should be able to move the user quickly from the departure node to the destination node with a minimum number of keystrokes. The movement from one node to another should take only a few seconds; if it takes any longer, the user might become frustrated, lose his or her train of thought, or decide not to explore the network.[25] If there is a delay, it should be indicated by the system.

Types of Links and their Functions

Hypertext is made up of a number of different types of links. Conklin has described referential, organizational, and keyword links,[26] Yankelovich has identified automatic links, conditional links, and action links,[27] and Aschuler has suggested direct and indirect links.[28] There is no standard for types of links nor is there an accepted vocabulary for describing them. Essentially, though, there are two kinds of linking: referential and organizational.[29] Referential linking connects points or regions of text in a non-hierarchical way. Organizational linking, on the other hand, is used to create hierarchical networks that connect parent nodes to their children. With referential linking, navigation can be difficult because most of the material is arranged associationally, which means there is no overall organizational structure to guide the user. Each node so linked is intended merely to expand on, exemplify, or illuminate the other. In comparison, hypertext created around organizational links is easier to navigate, because the organizational structure of the material is revealed by the links and the most that one can do is move up or down the hierarchy or "tree structure." The problem with hierarchical links, though, is that the links fix the information in a structure that may not be the most practical or logical way to present it to each potential user. Multi-hierarchical structures can also be created, and cross-hierarchical links can be added to allow the reader to jump laterally from hierarchy to hierarchy. Referential and organizational linking are often used together to create structures that are both hierarchical and extra-hierarchical at the same time.

Links can have many functions. As Conklin describes:

-They can connect a document reference to the document itself.
-They can connect a comment or annotation to the text about which it is written.
-They can provide organizational information (for instance, establish the relationship between two pieces of text or between a table of contents entry and its section).
-They can connect two successive pieces of text, or a piece of text and all of its immediate successors.
-They can connect entries in a table or figure to longer descriptions, or to other tables or figures.[30]

Shneiderman and Kearsley also suggest that links can:

-Transfer to a new topic.
-Display an illustration, schematic, photo, or video sequence.
-Display an index.
-Run another program.[31]

Overall, links are extremely versatile and can be used to perform many different functions, in addition to implementing a structural framework to the information.

Browsers

Most hypertext systems have built-in maps called browsers that graphically illustrate the links and nodes, and indicate the user's position in the hypertext (figure 6). The links and nodes on the map can be distinguished by color, shape, pattern, and size. The browser facilitates exploration, helps orient users, and shows how the documents are connected. The browser only shows the relationships between the documents, though, not the contents of the documents. Some browsers can be used to travel throughout the network. Pointing to a node on the map can transport the user to that node and display its contents. In this way, "the map becomes a convenient way to move quickly through the [hypertext] via the conmore detailed road maps that show all of the links in a given subsection.[33]

Browsers are useful aids for orientation and navigation, but they can be difficult to implement. Sometimes the web of information can be too complex to represent, as Yankelovich indicates:

> As the number and quantity of information increases, so does the difficulty of generating maps of the entire information web. Since most readers cannot readily understand a diagram with hundreds of crisscrossing interconnections, the problem of distilling or summarizing the information must be addressed.[34]

Other problems with representing information in the browser is that the network may change frequently so the map may not always reflect the current situation; the map may be slow to respond to changes; there may be insufficient differentiation between nodes and links; and users may not be visually oriented so the browser may not be useful for them.[35] Nevertheless, the browser is a useful tool, and despite its difficulties, it is a standard element of most hypertext systems.

Browsing and Searching Hypertext

The main way of browsing hypertext is to travel through the records by selecting the links, usually with assistance of a navigational aid such as a browser or a map. Browsing is also aided by backtracking mechanisms: by invoking a command, the user returns to any record or frame that was previously viewed. One can usually backtrack all the way to the beginning if necessary. Backtracking is an important function of browsing, as it ensures that user's navigational errors can easily be corrected, and it encourages freer exploration without the worry of making irretrievable mistakes.[36]

There are also ways to represent nodes that have been previously viewed, so that the user can return to one of these if desired. Some systems have history lists that show the user which records have been visited, while others have previous node maps which show icons of reader the relationships between various groups of information.

Another way to help novice users is to program default paths or guided tours into the hypertext.[37] In a tour, "all link selections are done automatically and the system runs by itself."[38] A system can have a number of different tours; the user simply selects one he or she is interested in, and the computer automatically guides the user through the information. The user has the option of straying from the programmed path if there is an area that he or she wants to explore, with the knowledge that it is easy to return to the place in the tour where he or she left off.

For advanced users, the most efficient way to get to a known location in a hypertext database is to use search and query mechanisms. Most systems allow either keyword, Boolean, or full-string searches. Keyword and string searches can be used to find an occurrence of a word or a set of words. On completion of the search, the user is presented with a list of records that match the query, and he or she can view one or all of the records or conduct another search. Searches can also focus on the structural aspects of the hypertext: the user can search for the nodes created by a specific author, for all of the nodes created at a certain time or date, or for a type of node or link. Also, because nodes are semantically related to each other, searches can be made to exploit the semantic information of the hypertext structure. For example, a search can be conducted from the vantage point of a particular node, where the query would relate to the surrounding nodes, such as "find all argument nodes connected to the present node, each of which has outgoing links." This is an area that has yet to be explored, but it has many interesting possibilities.[39] Overall, searching can be focussed so as to allow the user to avoid browsing through many unimportant or unrelated nodes. Also, a search can take the user to a location from which the user can browse further.

Types of Hypertext Systems According to Application

Hypertext systems have a variety of applications. At the most basic level, hypertext can be used as a simple database management system that lets the user "connect screens of information using associative links," while at a more sophisticated level, hypertext can be considered as "a software environment for collaborative work, communication, and knowledge acquisition."[40] Consequently, hypertext systems have been used for a range of functions, such as online documentation, instruction, information retrieval, problem solving, software engineering, writing aids, authoring tools, and cognitive learning tools.[41] According to Conklin, there are four broad categories of hypertext systems, classified according to application: macro-literary systems, problem exploration systems, structured browsing systems, and general hypertext technology.[42]

Macro-Literary Systems

Macro-literary systems are those that integrate large volumes of information and make it available to the user using a consistent and simple interface. Many users can access the data, and the user can be a reader, editor, collaborator, or critic (by annotating documents).[43] The links are made between different documents or different versions of the same document. The most well-known macro-literary system is Nelson's Xanadu. When operational, it will provide for "the deposit, delivery, and continual revision of linked electronic documents, servicing hundreds of millions of simultaneous users with hypertext, graphics, audio, movies, and hypermedia."[44] Nelson has also developed complex ways to represent separate parts of a document, which is necessary for copyright and royalty purposes. Another macro-literary system is Textnet, developed by Randall Trigg. The system stores research papers and critiques of those documents. The pieces of text are connected with typed links to form a network. There are over eighty typed links that support literary criticism of the text, such as refutation and support links.[45]

Problem Exploration Systems

Problem exploration systems are designed to support brainstorming and unstructured thinking. They assist the user in creating, analyzing, and structuring ideas. They provide a number of components that assist the user in focusing and organizing information—such as typed nodes, labelled links, and filtering mechanisms. These elements are useful because they allow the user to structure information visually and they allow it to be easily manipulated.

Problem exploration systems have been used for software engineering, as writing aids, authoring tools, and as cognitive learning tools.[46] Some of the commercial and experimental systems that have been developed are gIBIS, SYNVIEW, and WE (Writing Environment).[47] gIBIS, as explained, is a visually based system for discussing and evaluating issues; it allows users to structure arguments collaboratively, and to see the semantic structure of their arguments. SYNVIEW is similar to gIBIS, but it has the added function of allowing users to assess the validity and relevance of ideas that have been posted. WE is a writing environment that is modelled after the associative way in which writers work; it encourages the creation of nodes and then allows them to be structured and linked in various ways, in the same way that a writer would structure and move ideas.[48]

Structured Browsing Systems

Structured browsing systems are similar to macro-literary systems, but they are smaller in scale. Ease of use and ease of learning is their primary consideration, and the user interface is designed to be easy to interact with and easy to comprehend.[49] Generally, these systems do not allow links or nodes to be altered by casual users—modification is restricted to those who have authorization. In general, browsing systems are used for teaching, reference, online documentation and public information. Because they are for use by the public, they should require only minimal training to become familiar with their features. Some examples of commercial browsing systems are HyperCard by Claris, SuperCard by Silicon Beach Software, Toolbook by Asymetrix, and Hyperties by Cognetics Corporation.[50] These systems generally offer similar functions. While structured browsing systems are noted for ease of use and learning, their range of application is limited in comparison to other more advanced hypertext systems. Nevertheless, some of these systems, such as HyperCard, have been extremely popular, and it has been through their widespread use and acceptance that hypertext technology has become known.

General Hypertext Technology

General hypertext technology includes those systems that are developed for experimentation and exploration of hypertext concepts. Generally, these systems have a broad range of applications, and could fit into a number of the previous categories. While most of these systems are experimental, some of them have later become commercially successful. Xerox's NoteCards, for example, was designed as an experimental "general purpose idea processing environment,"[51] but it has since been used for authoring, programming, personal information management, project management, legal research, and engineering design.[52] Similarly, Intermedia was also an experimental hypertext system, but it has since become an essential learning tool for courses at Brown University.[53]

Advantages of Hypertext

There are many advantages to using hypertext over conventional methods of representing information. Users can follow divergent paths through hypertext, pursuing whatever trails prove to be interesting or rewarding. Hypertext encourages the user to discover information through personal explorations, and it forces the user to be aware of the information because he or she has to make a decision about which path to follow. If a path does not appear to be yielding much, it is a simple operation for the user to retrace the path and return to the original node. This is different from traditional text, where the reader is encouraged to follow a rigid, linear path through the information. Database management systems also have the same limitations, as the records must be read in an fixed linear sequence.

Hypertext makes it easy to trace references because they are linked to the text. In a paper version of a document, there may be many citations linked to the text, but to find the original reference, the user has to go to the library and search for each one. This can be a time consuming process. Hypertext overcomes this, because an entire referenced work, not just its citation, can be linked to the text. This way, the reader can call up an article (or at least the relevant part of an article) and read it to see how the author formed his or her opinion. After a reference has been traced, it is easy to return to the original text where one left off.

Hypertext allows a single body of information to be organized in a number of different ways simultaneously. As Gluck explains, "linking can be used to generate various views of the same basic information, illuminating new relationships and interconnections not easily demonstrated by traditional methods."[54] With some hypertext systems, users are allowed to create their own structures of linked nodes, in addition to the structure that already exists. The structures that they create will not alter the links that already exist between the nodes. Hypertext can also be organized so that many different views are represented. For example, a set of nodes could be arranged so that it can be accessed thematically in one instance and chronologically in another. The flexibility of structuring is important, as it allows the user to link nodes based on his or her own needs, and to structure and relate information in a way that is personally relevant and useful. It also allows multiple views that can illuminate different aspects of the material. This multiple structuring of information is generally not possible with traditional textual materials. With database management systems, the records can be viewed in different arrangements, but the system has to restructure the material each time a different arrangement is required. In contrast, following different structures in hypertext is merely a matter of following a certain set of links.

Most hypertext systems allow personal annotations to be added to nodes without affecting the original information. They can be added naturally and easily to the text, and they can be kept visible or be hidden until activated by the user. Annotations can enhance the value of information in a record. For example, in an experimental use of Intermedia for a poetry class, the students were asked to add comments to an number of poems. The annotations were illuminating and they provided different interpretations of the information. It was discovered, as well, that students were more likely to comment on the material in this format than in a classroom situation. In a collaborative hypertext system, annotations can allow users to communicate with each other and to comment on one another's work. In comparison to hypertext, annotating traditional textual sources can be difficult, awkward, and even forbidden.

Information in hypertext systems can almost always be viewed in a map or an overview diagram.[55] This can help orient the user and provide an overall view of how the information is related. Browsers and overviews allow connections between ideas and concepts to be readily comprehended, and by seeing the information represented graphically, the reader can remember its structure and the relationship of its parts. Also, the interactive nature of these diagrams—such as the ability to click on a node and to be transported there—is a convenient way to move throughout the information.

The modularity of information makes it possible for nodes to be referenced to and from several different places. Thus, ideas can be expressed with less overlap and duplication.[56] A single idea or concept does not have to be repeated, as in a linear textual source, such as a book. Once the information is expressed, the reader can always be referred back to that original node. This saves the author from having to repeat the same information.

With hypertext, the consistency of information is improved. If a node or part of a node is moved, copied, deleted or merged with another node, the attached links are updated automatically. This means that information in hypertext can be kept accurate and up-to-date, because even with extensive changes, the link still provides access to the node.[57] This alleviates the problem encountered in computer databases where information can become isolated when it is moved, changed or updated.

Finally, hypertext can encourage collaborative work. Many hypertext systems have been developed with this intention.[58] With the system properly configured, multiple users can read, write and annotate one another's work. This is useful in projects where the sharing of ideas is mutually beneficial and where collaboration can result in better work. Although collaboration is common using traditional textual formats, hypertext offers a more interactive environment and has better tools for collaborative writing, editing and communication.

Disadvantages of Hypertext

Hypertext has both technical and intellectual problems that have to be addressed. The technical problems are likely to be solved as computer technology advances, but the intellectual problems, on the other hand, may not be as easy to solve because they are rooted in the nature of hypertext.

Technical Problems

The most obvious technical problem is slow performance of various operations. When the user activates a link, the system may take a long time to transfer the user to the referenced node, which makes the traversal of the links longer and it may discourage the user from exploring the network. Some hypertext developers have specifically addressed this problem by designing systems that can operate quickly, such as KMS, by Knowledge Systems Incorporated. In most cases, though, the slow link traversal is the result of slow computers, not the hypertext system. Accordingly, as technology improves, so should the speed.

Many hypertext systems have limitations placed on the nodes and links. This means that the size of nodes and the type of information that may be placed in them may be restricted, and that the types of links and kind of linking that can be performed may be limited too. For example, in the first release of HyperCard, the node size was fixed and it could only accept one font style. Other systems, such as KMS and Hyperties, only allow single hierarchical structures to be represented, which means that multiple structures cannot be represented. These restrictions on the choice of attributes for nodes and links can only be resolved by the developers of the hypertext systems.

No system has an easy-to-use graphical browser. This means that navigating can be difficult, and the user may not be able to understand clearly the network of nodes. This problem arises because of the difficulties of trying to represent all of the information in the system in a clear and concise way. The other difficulty is that there are no established or accepted ways of representing the information. As hypertext developers learn more about how to represent information and how people interact with it, then they should be able to develop more effective browsers.[59]

Intellectual Problems

The two major intellectual problems that have to be addressed are disorientation and cognitive overhead.[60] Disorientation involves losing one's sense of location and direction in the hypertext.[61] As Jonassen explains:

> Many hypertexts consist of hundreds and even thousands of nodes with a potentially confusing array of links connecting them. It has been well documented that in such systems, users can easily become lost, not knowing where they came from, where they should go next, or even how to exit the part of the program that they are currently in. Users are frustrated by this experience. Often they give up without acquiring any information from the hypertext.[62]

It is extremely easy to get confused and lost in the network, or trapped in a loop of irrelevant nodes, because hypertext offers so many choices and paths. When the user gets lost, often it becomes difficult to get back to the starting node. Disorientation also occurs "because users do not have enough information about their current location relative to the overall structure of the database. Most hypertext systems provide little in the way of location cues."[63] Unlike books or other traditional systems, users of hypertext do not have the same visual cues to orient themselves. When reading a book, the reader can tell whether he or she is near the beginning or the end, and can easily return to any previous location simply by turning the pages and looking for visual clues. In hypertext, on the other hand, users are are faced with orientating themselves in an environment that is generally non-linear and associational. There is no end or beginning to the hypertext, as in the traditional sense—there is only the path that has been followed. Of course, some systems try to overcome this problem by making the information rigidly hierarchical, but even hierarchies branch into multiple paths, which can be disorienting.

Disorientation can be be reduced by using browsers and search mechanisms, both of which have been described already. Browsers are very useful, but they do have their limitations: it is difficult to represent all of the links and nodes, only a small amount of the screen space is available to show all of the information, they can be awkward to use, and it can be difficult to interpret the information in them. Carolyn Foss has proposed a number of specialized browsers to overcome some of these limitations and to help users become oriented in hypertext.[64] She has proposed graphical history lists, history trees, summary boxes, and summary trees. Graphical history lists "record and display every neighbourhood of nodes the user has examined during a browsing session"; history trees display a hierarchical representation of the nodes that the user has visited; summary boxes are used to facilitate notetaking while browsing; and summary trees represent a user's historical path through a network.[65]

Mark Bernstein believes that maps are not completely effective in orienting users. He says that "the solution to orienting readers within complex hypertext networks lies not in computer assisted mapping tools, but rather in well-crafted hand tools which will help the authors to intelligently and sensitively instruct diverse audiences in the use of complex documents."[66] The tools that he proposes are simple orientation devices, such as book marks, thumb tabs, and "breadcrumbs."[67] Book marks allow the user to mark a node and then be able to return to that node, functioning as a normal book mark would. Thumb tabs are buttons at the bottom of the screen that can take the user to important parts of the document, such as a section, a table of contents, or an index. "Bread crumbs" are small markers that are placed on the node that allow the reader to remember which nodes have been visited.[68] Bernstein believes that these tools can assist users in getting oriented in hypertext networks.

Other methods of orienting users involve structuring the hypertext so that the user can become easily oriented. This can be accomplished by having overview documents and indexes that the user can consult frequently. The creators of KMS and Hyperties advocate this approach.

Cognitive Overhead

The other intellectual problem is cognitive overhead. Conklin defines cognitive overhead as the additional mental effort and concentration that is required to maintain several tasks or pursue several trails at the same time.[69] As the user traverses and explores the hypertext network, it can become difficult to keep track of the links and nodes. The system can make great demands on the user, by having him or her continually decide which link to follow and which node to choose. The human mind can only carry on so many tasks at once, and it can easily become overwhelmed with choices. Often the author of the hypertext can add to the cognitive overhead by structuring the information poorly. If the author does not label a link properly or have it tell the user enough about the attached node, decision making may become difficult. This means that the only way to learn about the attached node is to follow the link blindly, which may be time consuming and may add to the information that the user has to remember. Also, the continual offering of multiple paths may become very tiresome and frustrating for the user, especially when the choices are not always clear.

There are a number of ways to solve these problems. The system can have the referenced nodes appear very rapidly. This allows the user to preview the nodes quickly and to see whether it is useful to continue along the path. This way, if the trail that a user is following seems irrelevant, it is easy to get back to the original node. Another alternative is to provide a reference or an explanation that explains where a link leads. This way the user can decide whether or not to follow a link.

Hypertext Usability

For a hypertext system to be useful and usable, it should satisfy certain criteria. Primarily, it should be easy to learn. Users should be able to learn the basic structure of the hypertext from the first time they use the system and they should know how to look for and find information. Users should be able to "understand the most basic commands and navigation options and [use] them to locate wanted information."[70] Each node should be easy to read, and the users should be able to understand the hypertext and alter it (if this is permitted).

The system should be efficient to use. It should have a quick response time, allowing rapid movement from node to node. When a user arrives at a node, he or she should be oriented easily and should understand the meaning of the node.

The system should be built to minimize errors. If the user does make a mistake, there should be provisions to return the user to where he or she was before getting lost. This is especially useful if the user is following a path of inquiry and gets lost or decides that he or she wants to abandon the current path.

The system should be easy to remember. After the user has not used the system for some time, it should be easy to recall its basic structure and its landmark nodes, links, and anchors. Also, users should be able to "transfer their knowledge of the use and navigation of one information base to the use of another information base with the same engine."[71]

Finally, the user should feel in control and unconstrained by the hypertext system. If the user finds the hypertext difficult to use and prefers a paper version of the same information, then there is little reason to have a hypertext version of it.

Hypertext is a revolutionary way of representing information. It can be used like a database management system to organize information in a non-linear and associative way, or it can be used as a tool for collaborative work, communication, and knowledge acquisition. While it has some drawbacks, it has many advantages over the traditional ways of storing and managing information.

NOTES

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[4] Bush, "As We May Think," 107.

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[8] Nichole Yankelovich, Norman Meyrowitz, and Adries van Dam, "Reading and Writing the Electronic Book," *IEEE Computer* 18 (October 1985): 19. NLS was marketed commercially as Augment.

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[13] Nicole Yankelovich et al., "Intermedia: The Concept and Construction of a Seamless Information Environment," *Computer* 28 (January 1988): 81-96; Nicole Yankelovich et al. "Issues in Designing a Hypermedia Document System," in *Interactive Multimedia*, 33-85; Norman Meyrowitz, "The Missing Link: Why We are Doing Hypertext All Wrong," in *The Society of Text: Hypertext, Hypermedia, and the Social Construction of Information*, ed. Edward Barrett (Cambridge, Mass.: MIT Press, 1989), 107-14; Bernard J. Haan, Paul Kahn, and Victor A. Riley, "IRIS Hypermedia Services," *Communications of the*

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[20] A summary of current hypertext systems is provided in Myke Gluck, *HyperCard, Hypertext, and Hypermedia for Libraries and Media Centers* (Englewood, Colorado: Libraries Unlimited, Inc., 1989), 171-90; Conklin, 20-32; and Henry Fersko-Weiss, "3-D Reading with the Hypertext Edge," *PC Magazine* 10 (May 28, 1991): 241-82.

[21] Jeff Conklin and Michael L. Begeman, "gIBIS: A Tool for All Reasons," *Bulletin of the American Society for Information Science* 15 (May 1989): 200-13.

[22] Conklin, 36.

[23] Ibid., 37.

[24] A link would not have a destination when the function of that link would be to perform an operation, such as running a program or performing a calculation.

[25] The movement between nodes should not be too fast, though. The creators of ZOG at Carnegie Mellon University developed special terminals that could change screens as fast as 0.05 seconds. They found that it was so fast that there was often trouble in discerning whether the screen had changed! Akscyn et al., 829-30.

[26] Conklin, 33-4.

[27] Automatic links would be generated spontaneously by the system when the user performed a specific action (e.g. a link that would be made between a word and a dictionary entry when it was searched); conditional links would be activated depending "on such factors as the user's level of expertise, the actual content of the source or destination anchors, or whether the user had previously taken the same path"; and an action link would cause "a certain operation or computation to be performed each time it was followed." Nicole Yankelovich et al., "Issues in Designing a Hypermedia Document System," in *Interactive Multimedia,* 67-8.

[28] Loira Aschuler, "Hand-Crafted Hypertext—Lessons from the ACM Experiment," in *The Society of Text*, 349.

[29] Conklin, 34-5.

[30] Ibid., 33.

[31] Shneiderman and Kearsley, 4.

[32] Yankelovich et al., *The Electronic Book*, 22.

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[37] Nick Hammond and Lesley Allison, "Travels Around a Learning Support Environment: Rambling, Orienteering, or Touring," *CHI '88: Proceedings of the Conference on Human Factors in Computing Systems* eds., Elliot Soloway, Douglas Fry, and Sylvia B. Sheppard (May 15-19, Washington, D.C., 1988), 269-73.

[38] Shneiderman and Kearsley, 14.

[39] Halasz, 842-43.

[40] Janet Fiderio, "A Grand Vision," *Byte* 13 (October 1988): 237.

[41] David H. Jonassen, *Hypertext/Hypermedia*, (Englewood Cliffs, New Jersey: Educational Technology Publications, 1989), 30.

[42] Conklin, 20.

[43] Gluck, 5.

[44] Nelson, "Managing Immense Storage," 225, and Nelson, *Literary Machines.*

[45] Conklin, 24. For a description of Textnet, see Randall Trigg and M. Weiser, "Textnet: A Network-Based Approach to Text Handling," *ACM Transactions of Office Information Systems* 4 (January

1986): 1-23.

46 Jonassen, 30.

47 Jeff Conklin and Michael L. Begemen, "gIBIS: A Hypertext Tool for Exploratory Policy Discussion," *ACM Transactions on Office Information Systems* 6 (October 1988): 303-31, and J.B. Smith et al., "WE: A Writing Environment for Professionals," *Technical Report 86-025, Department of Computer Science, University of North Carolina at Chapel Hill,* August 1986.

48 Conklin, 24.

49 Ibid., 26.

50 Danny Goodman, *The Complete Hypercard Handbook* (New York: Bantam, 1987); Gary Marchionini and Ben Shneiderman, "Finding Facts vs. Browsing Knowledge," 70-80.

51 Frank G. Halasz et al., 45.

52 Conklin, 27.

53 For the use of Intermedia in an educational environment, see George P. Landow, "Hypertext in Literary Education, Criticism, and Scholarship," *Computers and the Humanities* 23 (1989): 173-98.

54 Gluck, 14.

55 ZOG does not provide a global or local view of the information, but the creators insist that one is not necessary, because the user can move from frame to frame very quickly. They believe that the user can get to any node or return to any position faster or more effectively than using a browser. Hyperties also lacks a browser, but it provides overviews, table of contents and indexes to provide orientation.

56 Conklin, 38.

57 Gluck, 15.

58 Both gIBIS and Note-Cards were designed for collaborative work; for an elaboration see Jeff Conklin and Michael L. Begeman, "gIBIS: A Tool for All Reasons," 200-13, and F.G. Halasz, 848-50; and Akscyn, 831-2.

59 For a discussion of ways of representing information in browsers and maps, see Kenneth Utting and Nicole Yankelovich, "Context and Orientation in Hypermedia Networks," *ACM Transactions on Information Systems* 7 (January 1989): 58-84.

60 Conklin, 38.

61 Gluck, 16.

62 Jonassen, 41.

63 Shneiderman and Kearsley, 49.

[64] Carolyn L. Foss, "Tools for Reading and Browsing Hypertext," *Information Processing and Management* 25, 4 (1989): 409-11.

[65] Ibid., 412-6.

[66] Ibid., 44.

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[68] Ibid, 39-43.

[69] Conklin, 40.

[70] Ibid., 145.

[71] Ibid., 146.

CHAPTER 2

ARCHIVAL RETRIEVAL SYSTEMS AND ACCESS TO INFORMATION

Before describing how hypertext can be used in archival retrieval systems, it is necessary to establish what is the information in an archival retrieval system, and how it is structured and made accessible. It is also important to consider who are the users of archival information systems and how they retrieve information.

The discussion includes a summary of how descriptions are presented in archival retrieval systems, the type of relationships that exist between descriptions, and how descriptions are retrieved. As for users, various areas are explored, such as who are the users of archives, what types of questions they ask, how much time they have for locating information, and what they expect to retrieve when they conduct a search.

Archival Principles

Some of the archival concepts and principles that govern arrangement and description influence the way information is presented in archival retrieval systems. The concept of the fonds is the foundation of arrangement and the fonds constitutes the prime unit of description in archives. A fonds is "The whole of the records, regardless of form or medium, automatically and organically created and/or accumulated and used by a particular individual, family, or corporate body in the course of that creator's activities or functions."[1] Archival description aims to provide a representation of the fonds. The concept of provenance and the principle of respect des fonds ensure that the fonds is accurately represented. Provenance is "The person(s) or office(s) of origin of records, i.e., the person(s), family (families), or corporate body (bodies) that created and/or accumulated and used records in the course of the creator's activities or functions."[2] Respect des fonds (or principle of provenance) is "The principle that the records of a person, family or corporate body must be kept together in their original order, if it exists or has been maintained, and not be mixed with or combined with the records of another individual or corporate body."[3] Thus, outwardly applied, the principle of respect des fonds means that a fonds must not be mixed with other fonds, and inwardly applied, that the records in the fonds must be kept in their original order. As Terry Cook writes,

> By adhering to these principles, archivists are able to preserve the organic nature of archives as evidence of transactions. Through such adherence, the evidential character of archives is protected, whereby the records inherently reflect the functions, programmes, and activities of the person or institution that created them.[4]

According to the International Council on Archives, "The purpose of archival description is to identify and explain the context and content of archival material in order to promote accessibility."[5] The contextual (or external) information "identifies and explains the various administrative relationships governing the way organizations and persons conduct their business which in turn governs the way they create and maintain their archives," while the content (or internal) information identifies the documents and "the relationships among the documents as they were organized by the agent accumulating them."[6] In archival retrieval systems, external and internal information may be presented together in one description or the two types of information may be kept in separate descriptions to be linked as needed.

Archival Retrieval Systems

The most basic automated archival information system consists of a database of fonds descriptions and a retrieval mechanism to allow access to these descriptions. The external and internal information are presented together in the fonds description(s). The fonds can be described in a single description, or it can be represented as a whole and in its parts at various levels of description.[7] The parts are related hierarchically if the fonds description consists of a group of descriptions: the fonds description is related to the series description, the series description related to the file descriptions, and the file descriptions to the item descriptions, with the fonds description being the top or highest level of description.[8] Descriptive standards, such as *Rules for Archival Description (RAD)*, the *Manual of Archival Description (MAD)* and the *ISAD(G): General International Standard Archival Description*,[9] provide guidelines on how to present descriptions hierarchically at different levels and what information to provide at each level.[10] As Hugo Stibbe writes, "The concepts of provenance and original order demand that these hierarchical linkages be maintained in order to show how the context of the material being described relates to the whole."[11] When records are described according to this method (called "multilevel description") the user can view the fonds and its various parts. According to the concept of provenance and the principle of respect des fonds, the parts of the fonds—the subfonds, series, files, and items—can only be described as part of one fonds. Even if a part of a fonds, such as a series, was created by one agency and then was continued and added to by another agency, it can only be described as belonging to one fonds, that of the agency which last used it for its purposes.

Between descriptions, besides hierarchical relationships, there are also lateral or horizontal relationships. When a fonds, or part of a fonds, is related to another body of archival material, the relationship can be indicated. Usually the related material, such as another fonds or series, is mentioned in a note or in some similar way. However, there are no strict guidelines (according to *RAD* and the *ISAD(G)*, for example) that prescribe the indication of horizontal relationships.

Automated access to the descriptions is based on searching all or some of the information in the descriptions, or names or descriptors derived from the descriptions. In most cases, a "name, word or phrase placed at the head of the descriptive record" serves as a means by which to access the record.[12] In manual systems, this is called a "heading." Descriptions are filed alphanumerically according to these headings. They are assigned primary (principal) and secondary (added) headings. In automated systems, descriptions are retrieved by searching on access points. An access point is "A name, term, etc., under which a descriptive record may be searched and identified"[13] and is a synonym for any heading. The primary access point is the "access point under which the descriptive record for a fonds and all its parts can be searched and identified."[14] It "denotes the agent, i.e., the agency, institution, organization or individual that created, accumulated or maintained the records"; it identifies the provenance of the fonds.[15] Since a fonds can only be of a single provenance, there is only one primary access point, and only the fonds description may be assigned a primary access point.[16] Secondary (added) access points are those access points, along with the primary access point, under which a descriptive record may be searched and identified.[17] The secondary access points identify additional creators and custodians at the fonds level and as necessary at the series, file and item levels. Added access points may also include subject and non-subject (e.g., form, genre) terms.[18]

Access points are expressed in either a controlled or uncontrolled manner. If no control is exercised, a name or term is used as exactly as found in the description, or is reexpressed in terminology that has not been standardized. With a controlled vocabulary, a name or term is expressed in a formal syntax that has been standardized and is under vocabulary control, or authority control.[19] Authority control is a procedure that was developed by libraries and has subsequently been adopted by archives. It includes the creation of authority records, an authority record being defined as

> A record which shows a heading in the form established for use in a set of bibliographic records, cites the sources consulted in establishing the heading, indicates the references to be made to and from the heading, and notes information found in the sources as justification of the chosen form of heading and the specified references.[20]

The authority records are brought together to form an authority file. A complete authority file includes every name and term used as an access point. At its slimmest, an authority file may be only "a short list of exceptional or problematic names, or of only those names that require historical notes or complicated cross-references."[21] In a complete retrieval system, the authority file is linked to the file of archival descriptions. The maintenance and constant evaluation of the authority file and the system are essential to authority control.[22]

In retrieval systems that have linked authority and descriptive files, record descriptions are retrieved by searching for a name or term in the authority file, and then the system transfers to the descriptive record(s) in the descriptive file that have been indexed using that name or term.

According to the application of multilevel description rules (e.g., *ISAD(G), RAD*), the authority record of the creating body is linked only to the fonds description—it is not linked to descriptions below the fonds level. Access to descriptions below the level of the fonds is done indirectly by accessing the fonds, which serves as the umbrella description for all its parts. If there are additional creators or custodians for parts of a particular fonds, the appropriate name authority records are linked to the descriptions at whatever level they may occur.[23]

Provenance Authority Control

Some archivists have suggested that authority control should go beyond access management and that an authority record should contain detailed information about the agency or person (in the case of name authority records). This idea of separating external and internal information in an archival retrieval system was first presented by Peter Scott as the "series system" (later implemented by the Australian Archives as the Commonwealth Records System), and later by David Bearman and Richard Lytle as provenancial control, and by Max Evans as authority control.[24]

The name authority records in such systems have been described variously as agency or individual registration records, provenance authority records, or agency authority records. These records contain detailed information about the creator of the records, and they include, among other elements, the approved form of the name; administrative historical or biographical information (similar to that found in typical fonds descriptions); descriptions of the functions, activities and responsibilities of the corporate body or person; references to superior, subordinate, predecessor, and successor agencies; and for individuals or families, an indication of the relationships to other individuals or agencies. A complex network of relationships exists among the name authority records.

The documentary component in such systems includes descriptions of records without the usual administrative historical or biographical information. There are a number of different approaches to representing the fonds in such systems. Scott, Bearman and Lytle, and Evans, take a minimalist approach, making the series the highest level of description. There is no fonds level description because the fonds is considered as a conceptual entity that does not need to or cannot be accurately represented in description.[25] As Terry Cook has commented, the fonds is viewed "not as a physical entity, but as an abstract concept."[26] Another approach is to describe the fonds and its parts, as *RAD* and the *ISAD(G)* requires, but to exclude the provenancial information that would normally be contained in the descriptions.[27] As the footnote to rule 1.7B1 of *RAD* indicates:

> If the institution maintains an authority file containing authority records for persons, families and corporate bodies, etc., the biographical information or administrative history may be kept as part of the authority record for that person, family or corporate body and, therefore, does not have to be given in the description of the material.[28]

The aim in providing biographical and administrative historical information or external information in authority records with multiple references to other authority records is to preserve the context in which the records were created and to improve access to the descriptions. It is an attempt to overcome the vertical and fixed way in which biographical and administrative historical information has traditionally been represented. It has been suggested that the separation of internal and external information makes it easier to represent the archives of agencies whose administrative structures are more complex than the mono-hierarchical[29] structures of the past, and whose records reveal complex problems of creatorship and custody. It has also been suggested that separating internal and external information can be useful in representing the archives of individuals, especially when individuals have accumulated both personal and public records as a result of their various functions.[30]

The two groups of descriptive records—the name authority records on one hand, and the descriptive records on the other—are linked to each other. Where the linkages between the two sets of descriptive records are made depends on the level of description in the documentary hierarchy. If the series is the highest level of description, each series is linked to the authority record of the agency or individual that was responsible for creating or controlling the series. Multi-provenance series—those that have had more than one creating or controlling body over time—are linked to every creator that was responsible for the series. All the series created or controlled by that creator can be retrieved.

Multiprovenance series are listed with each creator. Each series description is "free" and is not included in any permanent organizational scheme. The fonds is conceptual and changes depending on which creator is used as the provenance. If the fonds is the highest level of description in the documentary hierarchy, the name authority record is linked to the fonds description. If there are additional creators or custodians for parts of a particular fonds, the appropriate name authority records are linked to the descriptions at whatever level different provenancial relationships may occur.[31]

Searching in authority control systems can begin with either the authority records or records descriptions. In the Australian Commonwealth Records System, for example, a search can begin with the agency or individual authority records, or with the series descriptions. Depending on the implementation, the name authority records can be accessed by name, topic, function, activity and so on, and the documentary records can be accessed by name, topic, form and so on.

An important aspect of systems where provenancial and documentary information has been separated is the ability to move throughout each hierarchy separately. Once a searcher gets to a description in either of the hierarchies as the result of a search, it is possible to move up, down or across the hierarchy to related descriptions. For instance, in the documents hierarchy, one is able to move down from a description of a fonds to that of a series, or up from a description of a file to the series. In the provenance hierarchy, one is able to move from a predecessor to a successor agency, from an agency to an individual, or from one agency to a related agency. Furthermore, if the searcher is in the documents hierarchy, he or she can move to the provenance hierarchy (or vice versa), if links between the two files have been made.

Movement throughout the network of provenancial and documentary descriptions is free and not dependent on knowing the structures beforehand: the searcher simply enters either of the hierarchies and follows the relationships that have been built between the descriptions. This approach has been advocated as an effective way to search for information. As Terry Eastwood has commented, archival retrieval systems should allow searchers to "move about the provenancial and documentary hierarchies represented by descriptions of records in the database as freely as possible." Searchers "need to be able to follow archival relationships as flexibly as possible, to work within the hierarchical structures without being dependent on knowing them beforehand." Further, searching should "teach them about the essential interrelationships upon which both provenancial and documentary hierarchies are organically built," about the context and composition of the records, and about how the information was created and in what circumstances it was created.[32]

Enhanced Authority Control

Recently, archivists such as David Bearman, Richard Lytle and Marion Matters have suggested that the authority component in archival retrieval systems should include more than provenance authority records. They have suggested that archival information systems should have "enhanced" authority records that describe occupations, functions, geographic coordinates, time periods, forms of material and so on.[33] These authority records would be reference files with scope notes. Users would be able to broaden or narrow their searches, and possibly search by facet,[34] if that type of thesaurus structure is supported.[35] These enhanced authority records would be linked to each other and to provenance authority records, as well as to archival description files. An important difference between provenance authority files and enhanced authority files is that enhanced authority files would be independent of archival description files.[36]

Bearman and Lytle have suggested that form and function authority records would be most useful, because they would provide unique avenues of access to records descriptions. In fact,

> functions are independent of organizational structures, more closely related to the significance of documentation than organizational structures, and both finite in number and linguistically simple. Because archival records are the consequences of activities defined by organizational functions, such a vocabulary can be a powerful indexing language to point to the content of archival holdings, without the need for actual examination of the materials themselves or for detailed subject indexing.[37]

Bearman and Peter Sigmond have also explored form authority files, and they have suggested that they could be useful, because they would allow researchers to locate forms of material (for example, diaries, minutes) with common informational attributes that have been created by many agencies.[38]

The goal of enhanced authority records is to improve access to records descriptions by offering more avenues of access. As Bearman has said, "the more terms applied to a document, the better the chances of it being retrieved."[39] These reference files are essentially an enhancement of subject and non-subject indexing; that is, they are authority records for names and descriptors with scope notes and relationships defined among each other. While these enhanced authority records are based on a sound principle, that is, that more avenues of access will likely improve retrieval, more study needs to be conducted on how the terms would be standardized, what type of relationships would exist among the terms, and how they would be linked to records descriptions.

A closer examination of the concept of function, for example, reveals many possible difficulties. The first is that "function" has not been adequately defined. In some instances, it has been identified with activity, and in other cases, activities have been defined as functions, as if there was no difference between the two.[40] Some talk about functions and subfunctions without defining what they are.[41] Other questions arise as well, such as: Does the nature of a particular function differ depending on its administrative context, and if so, how can it be characterized in an authority record divorced from an administrative context? Is there a difference between an administrative function and a documentary function?[42] Is function being used as a classification device, and would that make it different from other characterizations of function?[43] Besides specific types of enhanced authority records, such as function authority records, some broad questions can be asked about the validity and practicality of the whole procedure. Should archivists be creating reference files that are independent of archival description files and do they have the time to do this? Archivists would benefit if more research were done on the effectiveness and value of enhanced authority control before it is advocated as a means of retrieval in archival information systems.

To summarize, to improve access to information about archives, archivists have begun to move away from simple databases of fonds descriptions to more complex retrieval systems where provenancial, documentary and other information is separated into various components and then linked to one another. The elements of such systems have been described above. The aim has been to characterize only the descriptive aspects of retrieval systems and not the accessioning or records management components, because the latter are not relevant to the discussion of hypertext in the following chapter.

Users

Understanding who are the users of archives and how they retrieve information from archives is important in the design of archival retrieval systems. As Richard Lytle has commented:

> Archivists often operate as though they could construct archival access systems without reference to users. Identifying the users and potential users of archives and manuscript collections, and how these users approach collections, are the most important considerations in constructing [an]...information system.[44]

The design of archival information systems can benefit from answers to questions such as: Who are the users of archives? What type of questions do they ask? How much time do they have for locating information? What do they expect to retrieve when they conduct a search? and so on. Only a few comprehensive surveys have been done, so not much is known about users of archives and their typical behaviour.[45] From the surveys that have been done and from statistics that have been gathered by archives, some observations can be made.

Who are Users of Archives

A number of surveys and statistics show that the typical user of archives varies depending on what kind of archives is used.[46] The main users have been categorized as the sponsor agency, scholars, archivists (accessing archival material on behalf of users), and genealogists.[47] In certain types of archives, one group may dominate over the other; for instance, in provincial archives, it has been found that the primary researchers are most likely genealogists, while in university archives, the main researchers are most likely scholars (faculty, graduates and undergraduates).[48] Each group of researchers varies in preparedness, sophistication and understanding of how the material is arranged and described in the archives. Researchers from sponsor agencies may be familiar with their records in the archives, and they may have a specific series or file in mind when they make a request; scholars may have done advanced preparation and have a good idea which fonds they want to access; genealogists, because of the nature of their research, may not have a fonds or particular type of record in mind. The needs of these various groups of researchers and of each researcher vary. As the trend seems to be towards an increased use by many different groups of users,[49] the best approach should be to design retrieval systems that can accommodate the different requirements of these various researchers.

Questions Users Ask

The types of questions that users ask are also significant in the design of archival retrieval systems. The Canadian Subject Indexing Working Group analyzed a number of user surveys and found that researchers asked both general and specific questions.[50] William Maher analyzed the reference correspondence file of the University of Illinois Archives and concluded that more than half of all requests had a specific record or group of records in mind, while only twenty percent of the questions were general.[51] Considering that questions vary from general to specific, it is important that the retrieval system accommodate this variation. If the question is specific, such as relating to a particular body of material or to a certain creator, the system should allow the researcher to arrive at the material directly. On the other hand, if the question is general, the system should allow the user to enter the system based on a general query, such as a form, function, or subject query, and then, once in the system, there should be the opportunity to broaden or narrow the search.

Time for Searching

Archivists assume that researchers are willing to do labour-intensive work to find appropriate records and that they have unlimited time to browse through a large number of descriptions.[52] This is reflected in archival retrieval systems that tend to favour high recall and low precision, that is, a search that will retrieve every possible concerned document, rather than just those documents that are most relevant to the query. This is in contrast to systems that favour low recall and high precision, which historically predominate in library practice. It has been suggested that researchers do not have time for the enforced browsing that high recall and low precision requires.[53] Researchers, many of whom are under time constraints, need greater precision in the retrieval of relevant descriptions. As the Bureau of Canadian Archivist's Subject Indexing Working Group has commented, researchers "need a retrieval system that will allow them to access records relevant to their research, efficiently and effectively."[54]

Present archival information systems rely heavily on the skills traditionally associated with the left side of the brain for retrieval, whereas involvement of the skills of the right side of the brain should be considered. As Hugh Taylor has described:

> What are at odds are the left and right hemispheres of the brain, where the left sets visual space in a hard edged frame with centres and fixed boundaries within which processes are logical, analytic and linear, as in the process of classification, indexing and the logical search for solutions; the right hand brain comprehends acoustic space without centres or margins, where perceptions are holistic, symbolic, intuitive and creative embracing abstract patterns and complex figures, the kinds which often come from browsing or simply daydreaming.
>
> Our retrieval systems, such as they are, have hitherto relied heavily on the skills developed by the left side of the brain, whereas we should try to allow increasingly the involvement of the right.[55]

Browsing, where one explores records descriptions on the basis of existing relationships, can be of value. This is not the same as the enforced browsing that is caused by low precision and high recall. It is creative and constructive browsing.[56] As Taylor has commented, it is browsing that "transcends the boundaries of classification and organic arrangement and allows vague and indistinct notions to interact with the sources."[57] Users may benefit if designers of archival retrieval systems explore the possibilities of allowing users to browse through the records based on the relationships that exist among the records. Browsing can also be used with other retrieval techniques to improve access to descriptions.

Archivist as Intermediary

The archivist frequently acts as the intermediary between the records and the researcher to help the researcher retrieve relevant descriptions.[58] As Mary Jo Pugh has commented,

> The archival system is predicated on interaction between the user and the archivist.... The archivist is assumed to be a subject specialist who introduces the user to the relevant records through the finding aids and continues to mediate between the user and the archival system throughout the user's research.[59]

What happens most frequently is that the archivist, through an inferential process, converts the researcher's subject request into terms of provenance. That is, the archivist associates subject queries with fonds that will likely satisfy those queries.[60] To rely on the archivist as the source of subject information, though, is not the best approach. As Pugh has observed:

> To depend on the subject knowledge of a particular archivist leaves too much to chance, since the quality of reference service may vary from day to day as individuals take leaves for illness, meetings, or vacations. Reference service may vary from year to year as archivists transfer or retire. In large organizations, seasonal variation or turnover may not be a major problem. In small organizations it can be devastating.[61]

It is also becoming difficult for archivists to serve as intermediaries because of other constraints such as the increase in the volume of material and the number of users that have to be served. As the Subject Indexing Working Group has concluded:

> ...the traditional approach to retrieval with the archivist as essential intermediary between the user and the records is no longer viable. Overall use of archives is increasing dramatically with the greatest increase being in non-traditional areas. Archivists increasingly must serve a heterogeneous clientele with diverse needs and expectations. The amount of time that users and archivists have to spend retrieving and examining documents is shrinking. Staff resources are simply too limited and the volume of records too large for archivists to continue to play a strongly interventionist role in retrieval.[62]

What is needed instead is a retrieval system that can assume part of the role played by the archivist. Bearman and Lytle describe a possible solution—a retrieval system that has as one of its main components a "provenance inference engine" that can convert researchers' subject requests into terms of provenance.[63] The provenance inference engine would replace the archivist as intermediary. Archival retrieval systems designed to be more "comprehensive, comprehensible and self-explanatory"[64] and to operate independently of the archivist would greatly improve the retrieval of information from archives.

Those mentioned above are some of the important issues concerning users that must be considered in the design and implementation of archival retrieval systems. To summarize, the design of the system should be based on a knowledge of who are the typical users of archives; the system should be able to accommodate the type of queries that researchers typically pose; the time that the users have to go through the information that has been retrieved as the result of a search should be considered; and retrieval systems should be developed that assume some of the functions traditionally assumed by archivists, such as acting as an intermediary between the records and researchers.

This chapter has discussed first, the issues relating to what is the information in an archival retrieval system, and how is it structured, portrayed, and made accessible; and second, who are the users of archival information systems and how they retrieve information. On the basis of this discussion, the next chapter will consider how hypertext can be implemented in archival retrieval systems.

NOTES

[1] Bureau of Canadian Archivists, Planning Committee on Descriptive Standards, *Rules for Archival Description* (Ottawa: Bureau of Canadian Archivists, 1990), D-3.

[2] Ibid., D-4.

[3] Ibid., D-5.

[4] Terry Cook, "The Concept of the Archival Fonds: Theory, Description, and Provenance in the Post-Custodial Era," in Bureau of Canadian Archivists, Planning Committee on Descriptive Standards, *The Archival Fonds: From Theory to Practice*, Terry Eastwood, ed. (Ottawa: Bureau of Canadian Archivists, 1992), 35.

[5] International Council on Archives, "Statement of Principles Regarding Archival Description," *Archivaria* 34 (Summer 1992): 13.

[6] Terry Eastwood, "General Introduction" in Bureau of Canadian Archivists, *The Archival Fonds: From Theory to Practice*, 4. He characterizes contextual information as "the external structure of provenance" and content information as "the internal structure of provenance."

[7] International Council on Archives, "Statement of Principles," 14.

[8] There can also be intervening levels, such as subfonds, subseries, and so on.

[9] *Rules for Archival Description*; Michael Cook and Margaret Procter, *Manual of Archival Description*, 2nd ed. (Aldershot, 1989); International Council on Archives, "ISAD(G): General International Standard Archival Description," *Archivaria* 34 (Summer 1992): 17-32.

[10] Although Henson's *Archives, Personal Papers and Manuscripts* (Washington: Library of Congress, 1983) suggests that hierarchical relationships between descriptions should be indicated, the rules do not prescribe what information should be given at each level of description and how the parts should be related to one another. See Heather MacNeil's response to Steven Hensen, Letters to the Editor, *Archivaria* 31 (Winter 1990-91): 5-9.

[11] Hugo Stibbe, "Implementing the Concept of Fonds: Primary Access Point, Multilevel Description and Authority Control," *Archivaria* 34 (Summer 1992): 115.

[12] *Rules for Archival Description*, D-3.

[13] Ibid., D-1.

[14] Ibid., D-4.

[15] Stibbe, 116.

[16] If at the time of description, all that is in hand is a series, the series is considered the fonds and it is given a primary access point. If another series from the same fonds is acquired later, then a fonds description is created that includes the series descriptions, and the primary access point migrates up to the fonds description. For a more detailed explanation of this procedure, see the discussion in Stibbe, 124. The point of view that only a fonds, but none of its parts, can have a primary access point belongs in the multilevel description rules in *RAD* and the *ISAD(G)*. Other descriptive standards, such as *Archives, Personal Papers and Manuscripts*, that do not have multilevel description rules, allow a description at any level to have a primary access point.

[17] *Rules for Archival Description*, D-5.

[18] Form, etc. added access points identify what the material "is" (e.g., correspondence, daguerreotype, diary) rather than what it is "about."

[19] Stibbe, 113.

[20] Heartsill Young, ed., *The ALA Glossary of Library and Information Science* (Chicago: American Library Association, 1983), 16, quoted in Elizabeth Black, *Authority Control: A Manual for Archivists*, (Ottawa: Bureau of Canadian Archivists, 1991), 2.

[21] Ibid., 4.

[22] Robert H. Burger, *Authority Work; the Creation, Use, Maintenance and Evaluation of Authority Records and Files* (Littleton, Colorado: Libraries Unlimited Inc., 1985), 10, quoted in Louise Gagnon-Arguin, *An Introduction to Authority Control for Archivists*, (Ottawa: Bureau of Canadian Archivists, 1989), 11.

[23] For a more detailed description of this approach, see the discussion in Stibbe, cited above.

[24] Peter Scott et al., "Archives and Administrative Change: Some Methods and Approaches [Parts 1-5]," *Archives and Manuscripts* 7 (August 1978): 115-27; 7 (April 1979): 151-65; 8 (June 1980): 41-54; (December 1980): 51-69; and 9 (September 1981): 3-18; Australian Archives, Records Information Section, *CRS Manual*, Vol. 1-3, (Australian Archives, 1990); David Bearman and Richard Lytle, "The Power of the Principle of Provenance," *Archivaria* 21 (Winter 1985-86): 14-27; and Max J. Evans, "Authority Control: An Alternative to the Record Group Concept," *American Archivist* 49 (Summer 1986): 249-61.

[25] Terry Cook goes into what he considers to be some of the main difficulties in representing the fonds, and into why he advocates the method of provenancial authority control instead of describing the fonds in a single aggregate description. See Cook, "The Concept of the Archival Fonds," 52-64.

[26] Terry Cook, 65.

[27] Stibbe, 120.

[28] *Rules for Archival Description*, Rule 1.7B1.

[29] Bearman and Lytle define mono-hierarchical structures as those in which "a given bureaucratic unit is directly subordinate to no more than one hierarchical unit." Bearman and Lytle, 17.

[30] Bearman and Lytle, Evans, and Scott all focus on agencies in their descriptions of provenance authority control systems. The implementation of the series system by the Australian Archives also addresses the description of records created by individuals and families.

[31] For a more detailed description of this approach, see the discussion in Stibbe, cited above.

[32] Eastwood, "Access to Information," 10.

[33] David Bearman and Richard Szary, "Beyond Authorized Headings: Authorities as Reference Files in a Multi-Disciplinary Setting," in *Authority Control Symposium, 14th Annual ARLIS/NA Conference, New York, NY, February 10, 1986*, Karen Miller, ed. (New York: Art Libraries Society of North America, 1987): 69-78; David Bearman, "Authority Control Issues and Prospects," *American Archivist* 52 (Summer 1989): 286-99; Marion Matters, "Authority Work for Transitional Catalogs," *Cataloguing and Classification Quarterly* 11, 3/4 (1990): 91-115.

[34] Some thesauri, such as the *Art and Architecture Thesaurus*, are organized into facets. A facet, as defined in the *AAT* is "A Homogeneous category of terms whose members share characteristics that distinguish them from members of another facet." Within each facet, the terms are arranged into hierarchies that show genus-species or broader-narrower relationships between the terms. Toni Peterson, dir., *Art and Architecture Thesaurus* (New York: Oxford University Press, 1990), 45.

[35] Bearman, "Authority Control Issues," 295.

[36] Matters, 92.

[37] Bearman and Lytle, 22.

[38] For an exploration of form-of-material authority files, see David Bearman and Peter Sigmond, "Explorations of Form of Material Authority Files by Dutch Archivists," *American Archivist* 50 (Spring 1987): 249-53.

[39] Bearman, "Authority Control Issues," 289.

[40] In the manual for indexing function in the RLG Seven States Project, they say that function terms from the *Art and Architecture Thesaurus* can be used to characterize functions or activities. Terry Eastwood also explores some of the difficulties of the *AAT* functions vocabularies in "Provenance, Structure, and Content in Archival Information Retrieval," cited above in this chapter.

[41] Heather MacNeil, "The Context Is All: Describing a Fonds and Its Parts in Accordance with the Rules for Archival Description," in Bureau of Canadian Archivists, *The Archival Fonds: From Theory to Practice*, 208.

[42] The differences between administrative and documentary functions is mentioned in Terry Eastwood, "Provenance, Structure, and Content," 1-18.

[43] The Australian Commonwealth Records System classifies all of the agencies according to broad functions, such as health, defence, etc.

[44] Richard H. Lytle, "A National Information System for Archives and Manuscript Collections," American Archivist 43 (Summer 1980): 424.

[45] The most prominent surveys of archival users are: Jacqueline Goggin, "The Indirect Approach: A Study of Scholarly Users of Black and Women's Organizational Records in the Library of Congress Manuscript Division," *Midwestern Archivist* 11 (1986): 57-67; Elsie T. Freeman, "In the Eye of the Beholder: Archives Administration from the Users Point of View," *American Archivist* 47 (Spring 1984): 111-23; Diane L. Beattie,

"An Archival User Study: Researchers in the Field of Women's History," *Archivaria* 29 (Winter 1989-90): 33-50; William L. Joyce, "Archivists and Research Use," *American Archivist* 47 (Spring 1984): 124-33; Mary N. Speakman, "The User Talks Back," *American Archivist* 47 (Spring 1984): 164-71; Mary Jo Pugh, "The Illusion of Omniscience: Subject Access and the Reference Archivist," *American Archivist* 45 (Winter 1982): 33-44; Paul Conway, "Research in Presidential Libraries: A User Survey," *Midwestern Archivist* 11 (1986): 35-56.

46 Bureau of Canadian Archivists, Planning Committee on Descriptive Standards, *Subject Indexing for Archives*, (Ottawa: Bureau of Canadian Archivists, 1992), 20-21.

47 Ibid., 20-21.

48 Ibid., 20; and, a survey conducted in 1991 at the University of British Columbia Archives by Blair Taylor for ARST 654 (Research Methods).

49 William J. Maher, "The Use of User Studies," *Midwestern Archivist* 11 (1986): 19.

50 Bureau of Canadian Archivists, *Subject Indexing for Archives*, 21.

51 Maher, 20-21.

52 Freeman, 113.

53 Ibid., 113.

54 Bureau of Canadian Archivists, *Subject Indexing for Archives*, 21.

55 Hugh Taylor, *Archival Services and the Concept of the User: A RAMP Study*, (Paris: United Nations Educational, Scientific and Cultural Organization, 1984), 15.

56 Ibid., 71.

57 Ibid., 25.

58 Bureau of Canadian Archivists, *Subject Indexing for Archives*, 22-3.

59 Pugh, 36.

60 Ibid., 38.

61 Ibid., 39.

62 Bureau of Canadian Archivists, *Subject Indexing for Archives*, 22-3.

63 Bearman and Lytle, 14-27. They describe their inference engine as a "software system that executes the provenance-inference process in place of the reference archivist." They say that it would "have the ability to make inferences from user's questions to provenance information and hence to the desired documentation or information." p. 26.

[64] Bureau of Canadian Archivists, *Subject Indexing for Archives*, 23.

CHAPTER 3

HYPERTEXT AND ARCHIVAL INFORMATION RETRIEVAL

The aim of this chapter is to illustrate how hypertext could be implemented in an archival retrieval system. The intention is not to advocate a specific hypertext information retrieval system, but rather to generalize on the components and functions of such a system. Various aspects of a hypertext archival information system are discussed, including: what type of records could comprise an archival hypertext, how the records could be linked, how access could be gained to the records, and how users could move throughout the network of linked records. The emphasis is on the elements of archival information retrieval described in the previous chapter, such as the separation of information into provenancial, documentary, and other components and then linking that information to one another; the flexible movement throughout the hierarchies of provenancial and documentary descriptions without relying on a knowledge of the structures beforehand; the efficient and effective access to descriptions gained through general and specific queries and through browsing; the flexibility of the system to address the needs of a variety of users; and the design of the system so that it is comprehensive and self-explanatory. The potential advantages and disadvantages of a hypertext archival information system will also be summarized.

System Category

The type of hypertext system most suitable for archives, based on the categories mentioned in the first chapter, would be a structured browsing system. This type of hypertext system is most suitable for public use. It integrates large volumes of information and makes it available to the user using a consistent and simple interface, the data are provided in a read-only form (modification of links and nodes is not permitted by casual users), and it is easy to use and learn.

Nodes and Links

An archival hypertext would most likely consist of records information and authority data. This type of information satisfies Ben Shneiderman's "Golden Rules" of hypertext:

- there is a large body of information organized into numerous fragments,
- the fragments relate to each other, and
- the user only needs a small fraction at any time.[1]

The records and authority information would be easy to separate into discrete parts that could be contained in individual nodes. Once separated into individual nodes, they would be free to be linked to other nodes in multiple ways.

The hypertext could have specific nodes to contain the record and authority information. Record nodes would provide textual descriptions of fonds. If the hypertext consisted of multilevel fonds descriptions, the description of each of the parts of the fonds—the fonds, series, file and item descriptions—would be contained in an individual node. An example of a fonds description (one that includes both internal and external data in the description) and a series description belonging to the same fonds could appear as in figure 9. The individual record nodes would be connected to each other with hierarchical and associational links (both are organizational links). There would be hierarchical and associational links among the records of a fonds and with record descriptions of other fonds (figure 10). The links among the record nodes would be made based on rules found in standards such as *Rules for Archival Description*, which indicate how descriptions of parts of

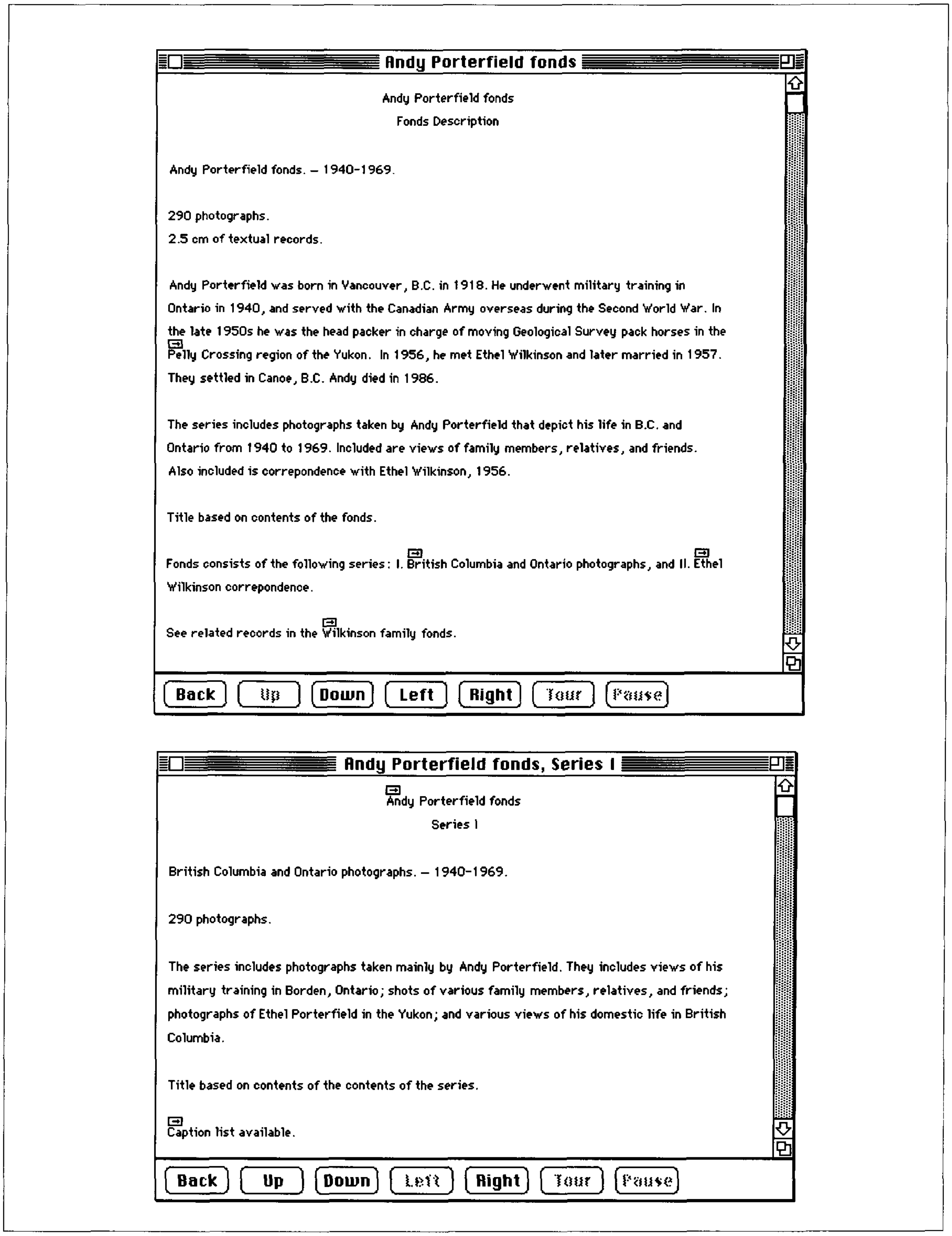

Fig. 9. The Andy Porterfield fonds node, shown at the top, is the first of the record nodes that make up the Andy Porterfield fonds description. The node on the bottom is the Series I node that would be on the next hierarchically lower level.

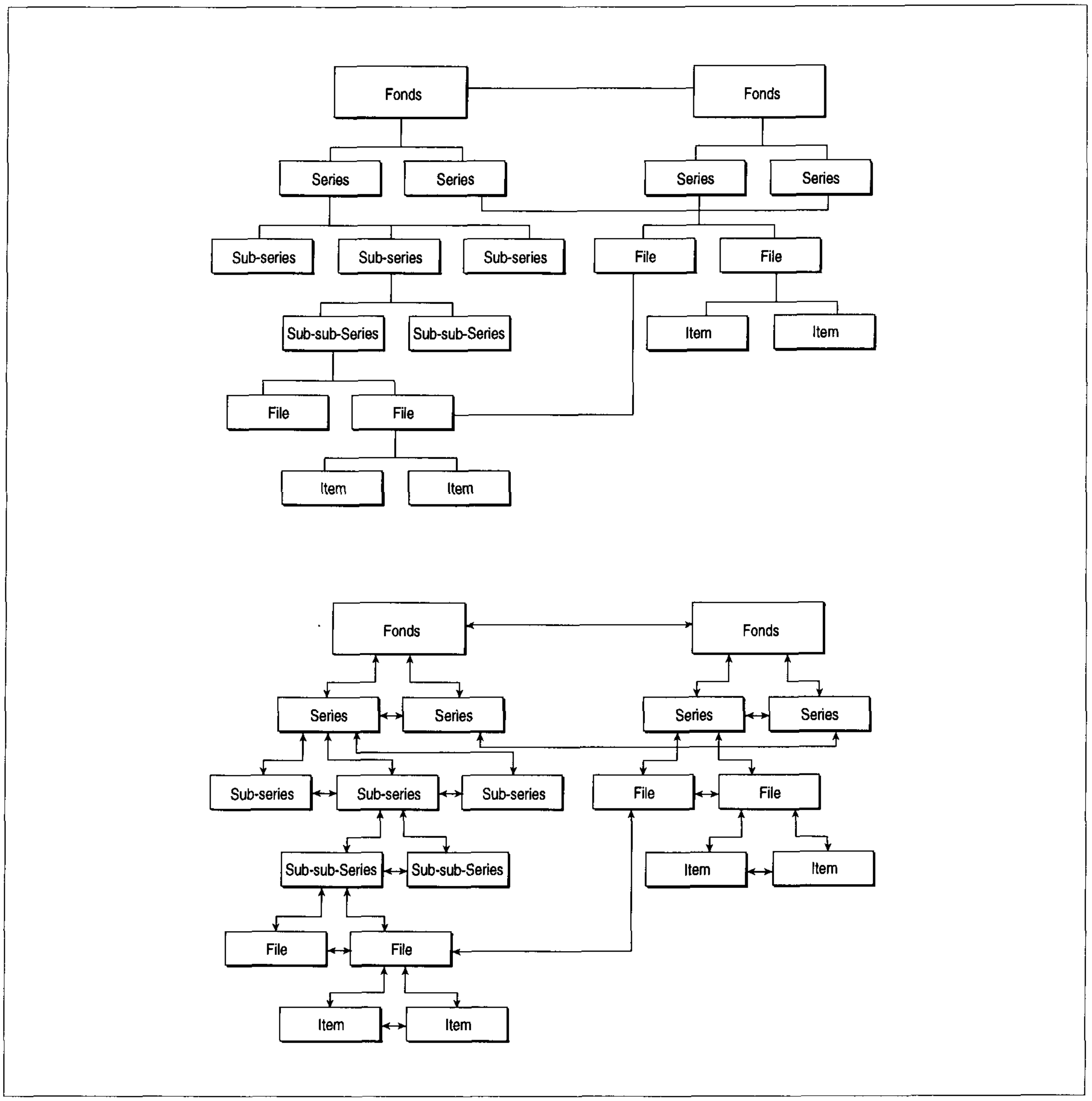

Fig. 10. The diagram on the top illustrates the relationships among the descriptions that comprise a fonds. The diagram on the bottom indicates how the descriptions would be related in hypertext. Each box represents a node and each line with arrows represents a hypertext link.

a fonds should be related.

Authority nodes would consist of authority data, that is, the information typically found in authority records. They would provide authorized and unauthorized forms of names and terms, including personal names, corporate names, geographic names, topics,

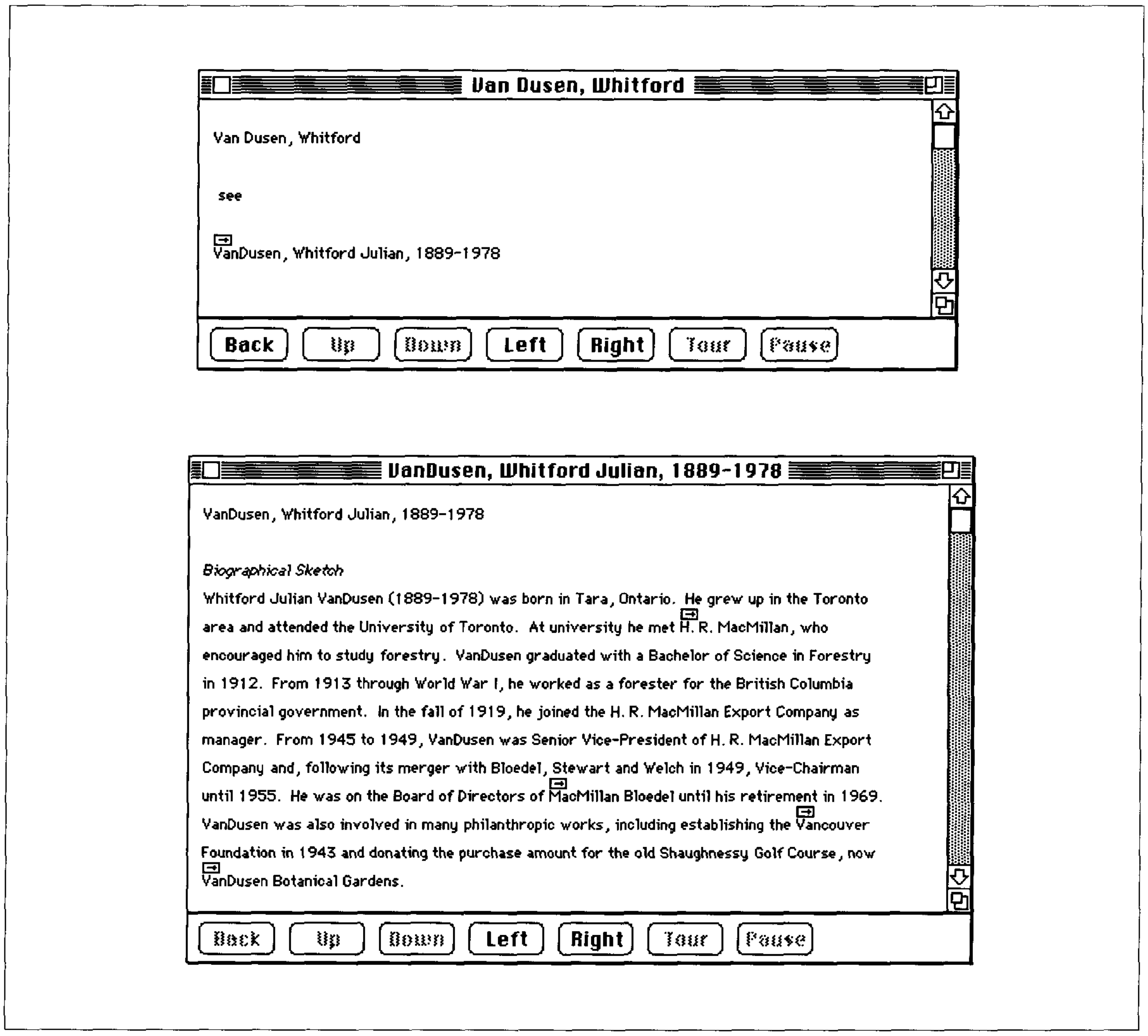

Fig. 11. An authority node containing typical authority data at the top, and on the bottom, an authority node containing enhanced authority data. The enhanced authority node includes detailed biographical information on the person named in the record.

form terms, and genre terms. Each authority node would contain the heading in its established form at the top of the record, followed by the tracings, references and notes relating to the heading. Figure 11 illustrates how authority nodes (one with normal authority data, the other with enhanced authority data) could appear in an archival hypertext. The authority nodes would be linked to other related authority nodes. The links that connect the nodes

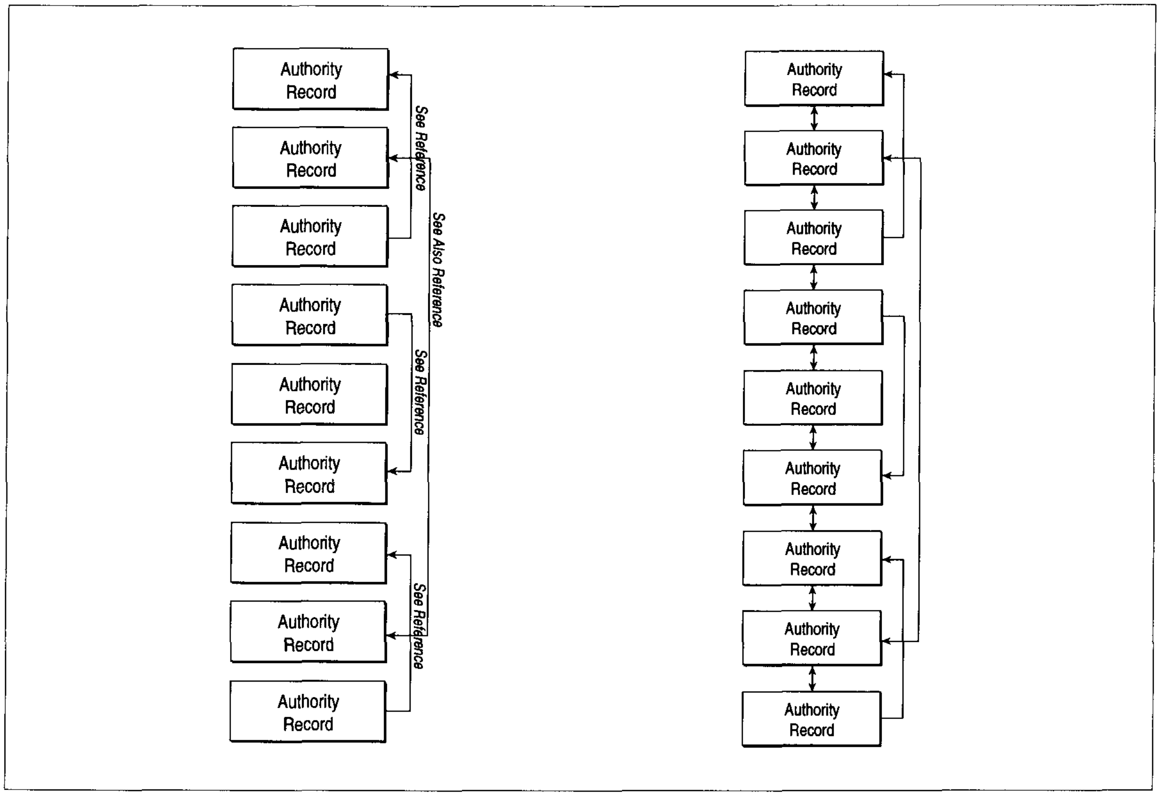

Fig. 12. The diagram on the left illustrates the relationships between authority records. The illustration on the right is a graphical representation how authority record nodes would be linked in an archival hypertext. The boxes represent the nodes and the lines represent the links between the nodes. Unidirectional movement between the nodes is indicated by a line with a single arrow, while bidirectional movement is indicated by a line with double arrows.

could be either associational or hierarchical. Where there is a *see* or *see also* reference to another heading, there would be a link to the node that contains the authorized form of the name or term. If the authority node contains enhanced authority data, there could be links to function authority records, name authority records for predecessor and successor bodies or superior and subordinate corporate bodies, name authority records for related individuals, and so on. The links between the information in the authority nodes would be made based on the rules found in standards such as the *Anglo-American Cataloguing Rules* and *Rules for Archival Description*, which indicate how and when references should be made to names or terms in other records. The relationships between the authority nodes containing typical authority data (not enhanced authority data) in an archival hypertext would be as illustrated in figure 12.

An additional type of information that an archival hypertext could include would be reference information. Reference information would include a wide variety of information that was related to the information in the record and authority nodes, and other reference nodes. The purpose of the information in the reference nodes would be to augment or illuminate the information contained in other nodes.

The reference nodes could contain information in a variety of forms, including text, sound, graphics, and moving images. For instance, a reference node could contain a graphical representation of the structure of a corporate body (linked to the name authority record for the corporate body); a scanned image of an item, such as a photograph (linked to the description of the item); or a segment from a sound recording (linked to the description of the sound recording). A typical reference node is illustrated in figure 13. Reference nodes would be linked by reference links. These types of links are in contrast to the organizational links (hierarchical and associational) that connect authority and record nodes. Reference nodes would be free to be linked to any other node; how and where the links were made would be determined by the archivist ad hoc or by institutional policy.

Reference information is not an essential component of an archival hypertext. It is included as a component of a possible hypertext archival information system mainly to illustrate how easy it is to integrate information in a variety of forms. Whether an archival information system should include extraneous information is not addressed here. However, the concerns that archivists might have concerning this type of information would have to be answered at the outset. The questions that would need to be resolved include: Should archivists add this type of information to an archival database? Would archivists have time to add this type of information? Would archivists be creating an information database rather

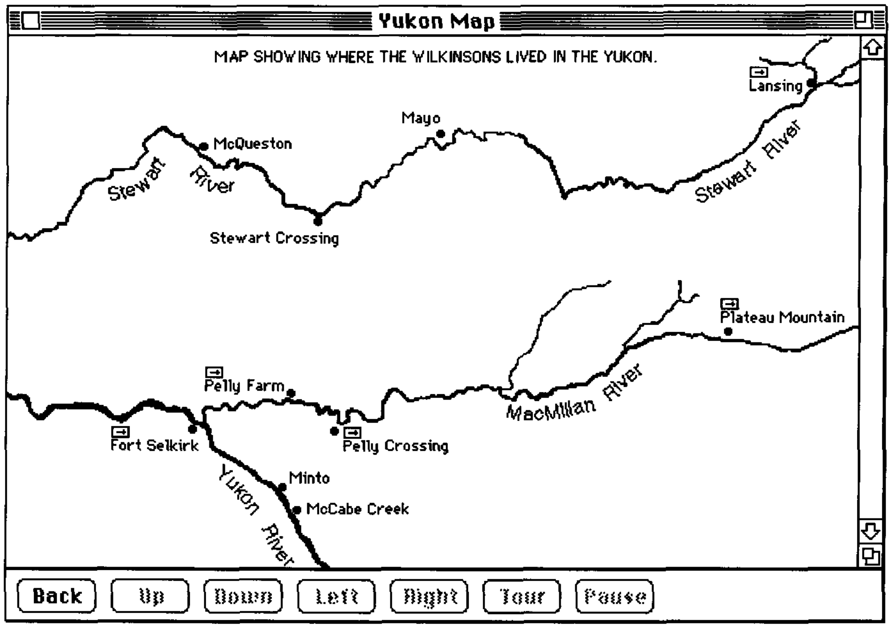

Fig. 13. A reference node providing graphical information that is supplementary to the information in the fonds description.

than an archival database? and Would this type of information be a distraction to users and hinder them in their task of locating information about archives?

Multiple links would be made between nodes in the hypertext based on the relationships between the information in the nodes. Authority nodes would be linked to record nodes, record nodes would be linked to authority nodes, and reference nodes would be linked to all other nodes. The nodes could also have multiple links to other nodes: a series node could be linked to all the authority nodes that contained the name of the creator responsible for the records; a fonds node could be linked to all its related series nodes; an authority node could be linked to all the record nodes that use the heading in the authority

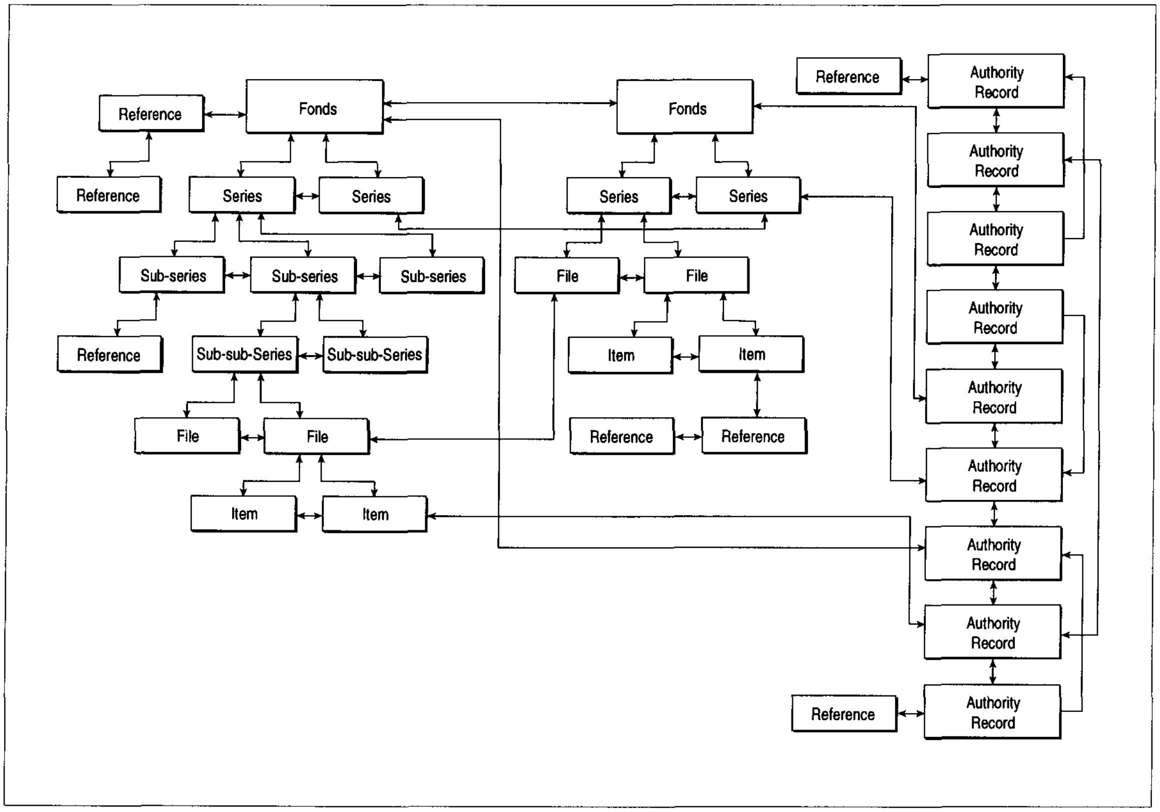

Fig. 14. A graphical view of the complex web of relationships in an archival hypertext. The diagram illustrates links between descriptive, authority, reference nodes in part of an archival hypertext.

record as an access point. The result of all the linking would be a complex hypertext network, primarily hierarchical in nature, similar to the one illustrated in figure 14 (which only shows a fraction of a possible archival hypertext).

The type of links described so far have been structural links that connect nodes or information found in nodes. Other types of links could be possible, such as those that perform a function when activated. For instance, a link from a node could be connected to a CD-ROM player or videodisk player. When the link is activated it would search the contents of the CD-ROM disc or videodisk and present the results of the search to the user.

This would be useful, for example, if the contents of the fonds, such as photographs or images of documents, were contained on a CD-ROM or videodisk. The primary type of links in an archival hypertext, though, would be structural rather than functional.

While all the nodes in an archival hypertext would be linked into one large network, subnetworks of nodes could exist. That is, besides the main hierarchical, referential, and associational links, secondary networks of linked nodes could be created based on other criteria, such as provenance, theme or subject. The subnetworks would coexist with the original hypertext network. The subnetworks could be isolated for various purposes, such searching. In this way, the same set of information in the hypertext could be organized in many different ways for a variety of different purposes.

Physical Linking of Nodes

The links between the nodes could be made in a variety of ways. Links could be from node to node (the entire contents of the node would be linked to the entire contents of another node), from a piece of information in a node to an entire node, or from a piece of information in a node to another piece of information in the same or a different node. If the link was attached to a piece of information, that information could be a sentence, a character string, a single word, or a graphic. Information that could not support a link anchor could not be linked.

To link two nodes, the nodes are selected and then a command to link them is given. For instance, two series description nodes from the same fonds could be selected and linked. To link a piece of information in a node to an entire node, the information in question is selected, such as a section of text or a graphic, the command to start the link is issued, the destination node selected and the command to complete the link is given. To link two pieces of information within the same node or between nodes, the source information is selected, the command to make a link is issued, and then the destination information is highlighted and the command to complete the link is given. For example, if the archivist wants to make a link between a series title in a fonds description to a the series description itself, the information that serves as the anchor in the first node, such as the series title, is selected, the command to start the link is issued, then the information in the second node is selected, and the command to complete the link is given (figure 15).

Linking can be either manual or automatic. With automatic linking, the system links the node in question to other nodes based on the criteria specified by the archivist. For example, if a new authority node is added to the hypertext, it can automatically be linked to the preceding and succeeding authority nodes based on the heading in the node, or if a new fonds description node is added, it can be linked to preceding and succeeding fonds description nodes based on the title of the fonds. In other cases the linking is manual: the archivist would highlight the information to be linked and then select the source information or source node as the link destination (as illustrated in figure 15).

For the most part, node-to-node linking can be automated, but links that involve selecting a piece of information within a node to serve as the link anchor must be done manually, because the archivist needs to specify the extent of the information used as the link anchor and the placement of the link marker.

Researcher Created Links

Structured browsing systems, as a rule, do not allow casual users to alter records or to add new links to the hypertext. They are intended as public, read-only information retrieval systems. It might be useful, though, if a hypertext archival information system allowed researchers to add their own links that would be specific to them and that would not effect the existing links established by the archivist. The user-supplied links could be used to preserve relationships between information discovered by the researcher. For exam-

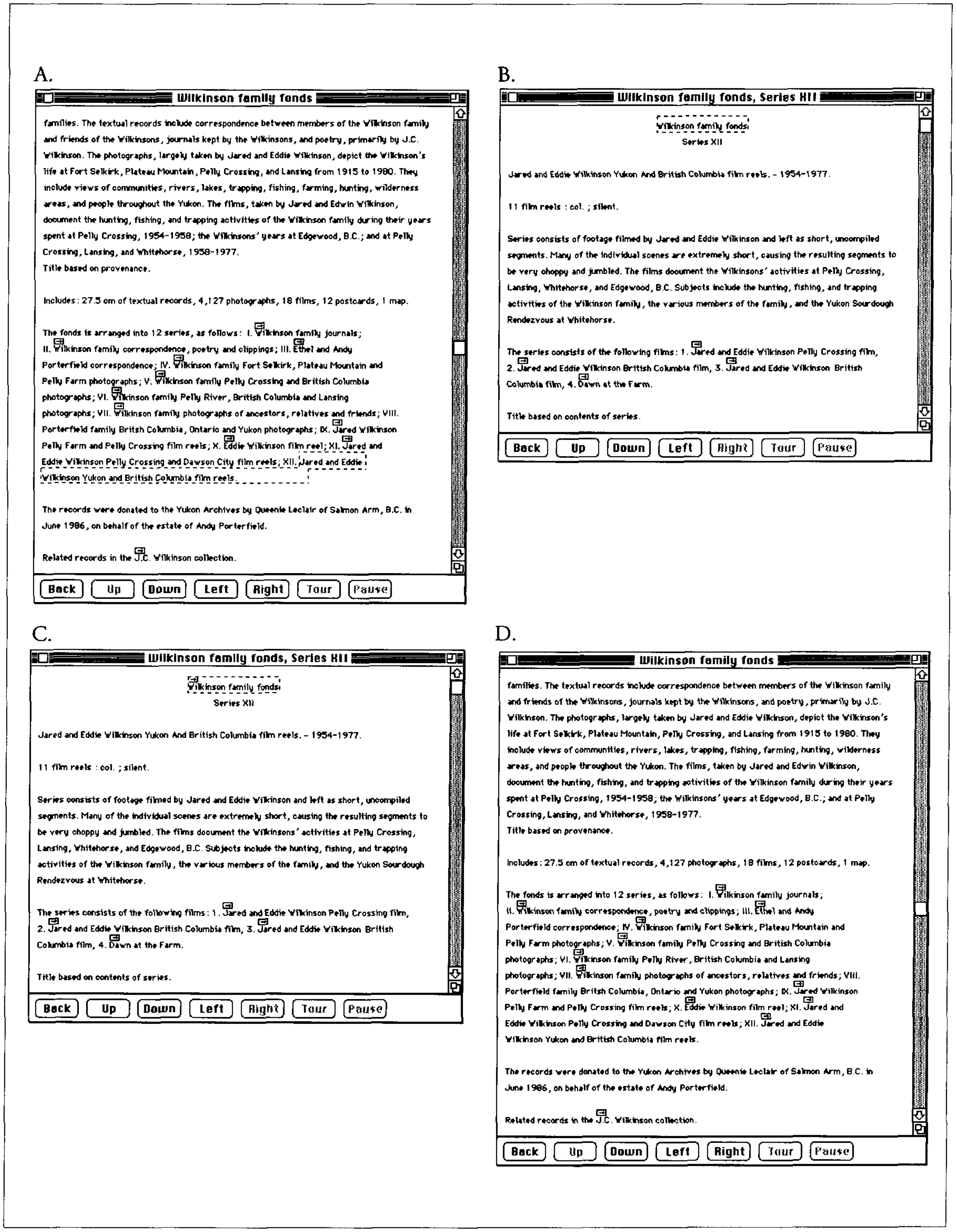

Fig. 15. Creating a link between two pieces of information. *A.* the first piece of information is highlighted (the title for Series XII in the arrangement note of the Wilkinson family fonds node) and the command to start the link is given; *B.* the destination information is selected (the title of the fonds in the series description node); *C.* the command to complete the link is given, and a link marker (the small box with the arrow "⊟") appears above the text in the series description, and *D.* above the text in the fonds description.

ple, if a researcher was conducting a search on the history of the arts in Saskatchewan, he or she might connect the Saskatchewan Arts Board authority node with the authority node for the Saskatchewan Crafts Council—a related agency that might not have been linked by the archivist. Or the researcher might link a group of fonds nodes that were of interest that had not been linked by the archivist. These personal links, which would be temporary, could be useful as they could preserve relationships that the researcher thought were significant.[2] While conducting research, the user could create a network of information with personal significance, later to be used as a reference.

Movement Along Links

Movement from node to node is accomplished by activating a link and then following the link to the attached information. If two pieces of information were linked and each piece of information had a link marker, movement along the link would be bidirectional. The user would activate the link in the first piece of information and would travel along the link to the attached information. From that piece of information, the user could travel back along the same link to the original information. For example, figure 16 illustrates how a user could travel between two authority records connected with a bidirectional link. If the destination information or node does not have a link marker, then travel along the link is unidirectional.

A link anchor can have multiple links to different pieces of information or nodes. For example, the heading in an authority node could be linked to many different record nodes. When a link marker on such a link anchor is activated, the user must choose the link destination.

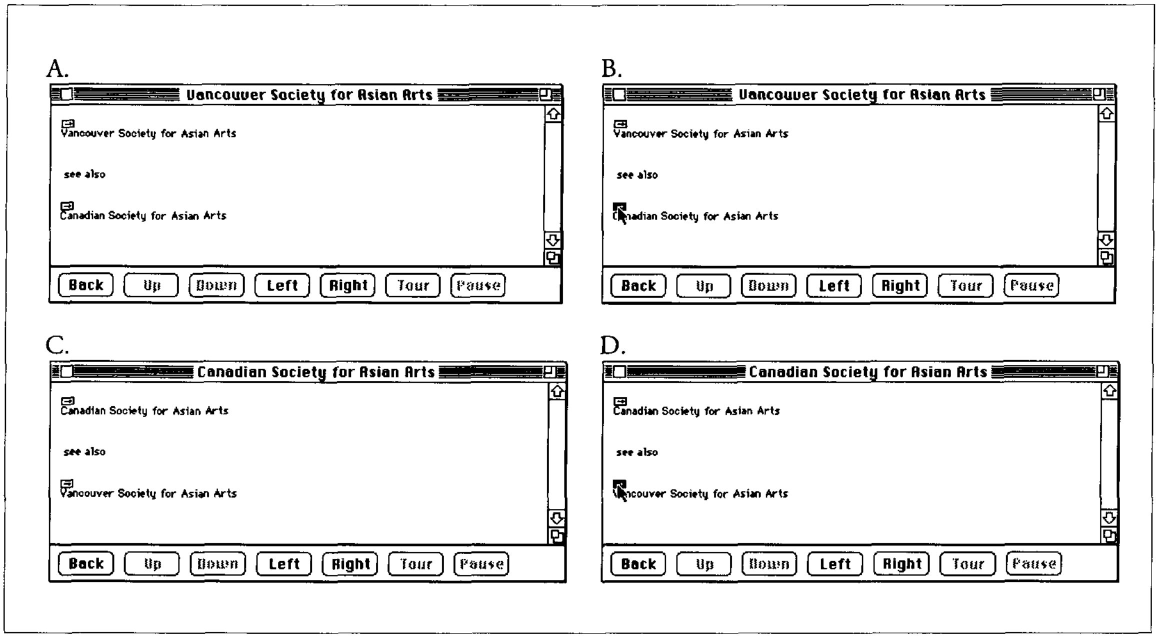

Fig. 16. Movement between two authority nodes connected with a bidirectional link. *A.* The Vancouver Society for Asian Arts authority record node has a *see also* reference to the Canadian Society for Asian Arts authority record node. *B.* Clicking on the link marker above "Canadian Society for Asian Arts", takes the user to *C.* the Canadian Society for Asian Arts authority node. *D.* To return to the Vancouver Society of Asian Arts authority node, the user would click on the link marker above "Vancouver Society of Asian Arts." Movement along any bidirectional link would be in this fashion.

Navigational Aids

Navigating through the records in an archival hypertext would be straightforward—movement up, down, and across the hierarchies of nodes would be as simple as following the embedded links. However, rapid movement through the network, combined with the non-linear, associational nature of the hypertext, makes it easy for the user to become lost or disoriented. This, as previously mentioned, is one of the major intellectual problems of hypertext. To help overcome this problem, a hypertext archival information system could have a number of navigational aids, the most useful being a backtracking mechanism, a path history indicator, and a browser.

Backtracking Mechanism

A backtracking mechanism would keep track of which nodes had been visited and would allow the user to return to the last node visited. Researchers would be able to retrace their path through the hypertext one node at a time—all the way back to the beginning, if necessary. For example, if the user was at the Wilkinson fonds description node, and decided to return to the previously viewed Wilkinson family authority node, this could be done by issuing the "Back" command, which would take the user back one node at a time, until the desired node was reached.

Browser

Along with backtracking, the system can visually document the researcher's path through the hypertext by presenting a chronological list of the nodes that have been visited. To return to a previous node, the researcher would simply select the icon that represents the node and is then taken to it. The same mechanism can also provide a visual representation of the links emanating from the current node. A possible path history/browser mechanism (modeled after Intermedia's Web View) is illustrated in figure 17. The browser can include visual identifiers to help users tell at a glance what type of information is linked to the current node. Again, clicking on the representation of a node in the browser takes the user to that node. In the browser shown in figure 17, the authority nodes, record nodes, and reference nodes are indicated by different icons: "▤" indicates a record node, "☐" indicates an authority node, and "▣" indicates a reference node. Additional visual cues can be implemented as well, such as having the different nodes represented in different colors, having the various link types indicated differently, and so on.

A browser lets users know where they have been and where they can go. It helps

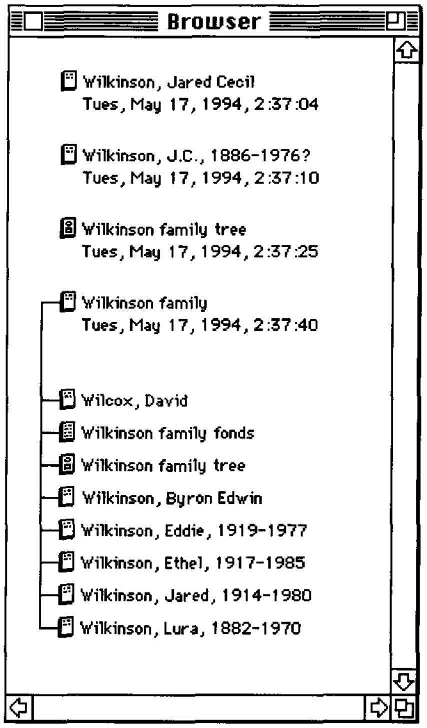

Fig. 17. The path history/browser would provide a chronological list of the nodes visited (the top half of the window), and an indication of the nodes linked to the current node (the bottom half of the window). This would help keep the user oriented in the hypertext. Modeled after Intermedia's Web View.

orient them to their current location in the hypertext and it provides a way to travel to different parts of the network. The visual cues and view of the information in the browser offer a unique view of the relationships between the records—a view perhaps not offered by other types of information retrieval systems. The browser might also be useful as it can help researchers understand the relationships between the records in the hypertext.

Other mechanisms to aid travel throughout the hypertext could be implemented as required.

Moving or Deleting Links and Nodes

When a piece of information or a node is moved or deleted, the information in the hypertext would be updated to reflect those changes. If a piece of information is moved, the attached links automatically move as well. For instance, if a selection of text in the biographical sketch area of a fonds description node that contains a number of links is moved to the biographical sketch area in a series description node, the links would move with the information.

A piece of information or node could also be unlinked and then linked to a new destination. For instance, a sub-series node belonging to one fonds structure could be unlinked and then relinked to a new fonds structure (figure 18). The links to the series description node and sub-series description nodes would be broken, and then similar links made to the nodes in the new fonds structure. The hierarchically subordinate nodes attached to sub-series description could remain unchanged. The links that were broken between the original sub-series description would also have to be updated to reflect the changes. When nodes are moved around the hypertext in such a way, the text in the individual nodes must also be changed to reflect the new organizational position of the nodes in the hypertext.

If a piece of information or an entire node is deleted, the hypertext would be updated to reflect the changes. If a piece of information containing a link is deleted, both the information and the link would be deleted. The link marker on the destination information would be deleted as well (but not the information). For example, if a related material note containing a link to a related material note in another node is deleted, the text in the originating node, the link markers in both nodes, and the link between the nodes would be removed. If an entire node was deleted, all outgoing links would be deleted, as well as any link markers in attached nodes. When deleting part of a node or an entire node, the effect

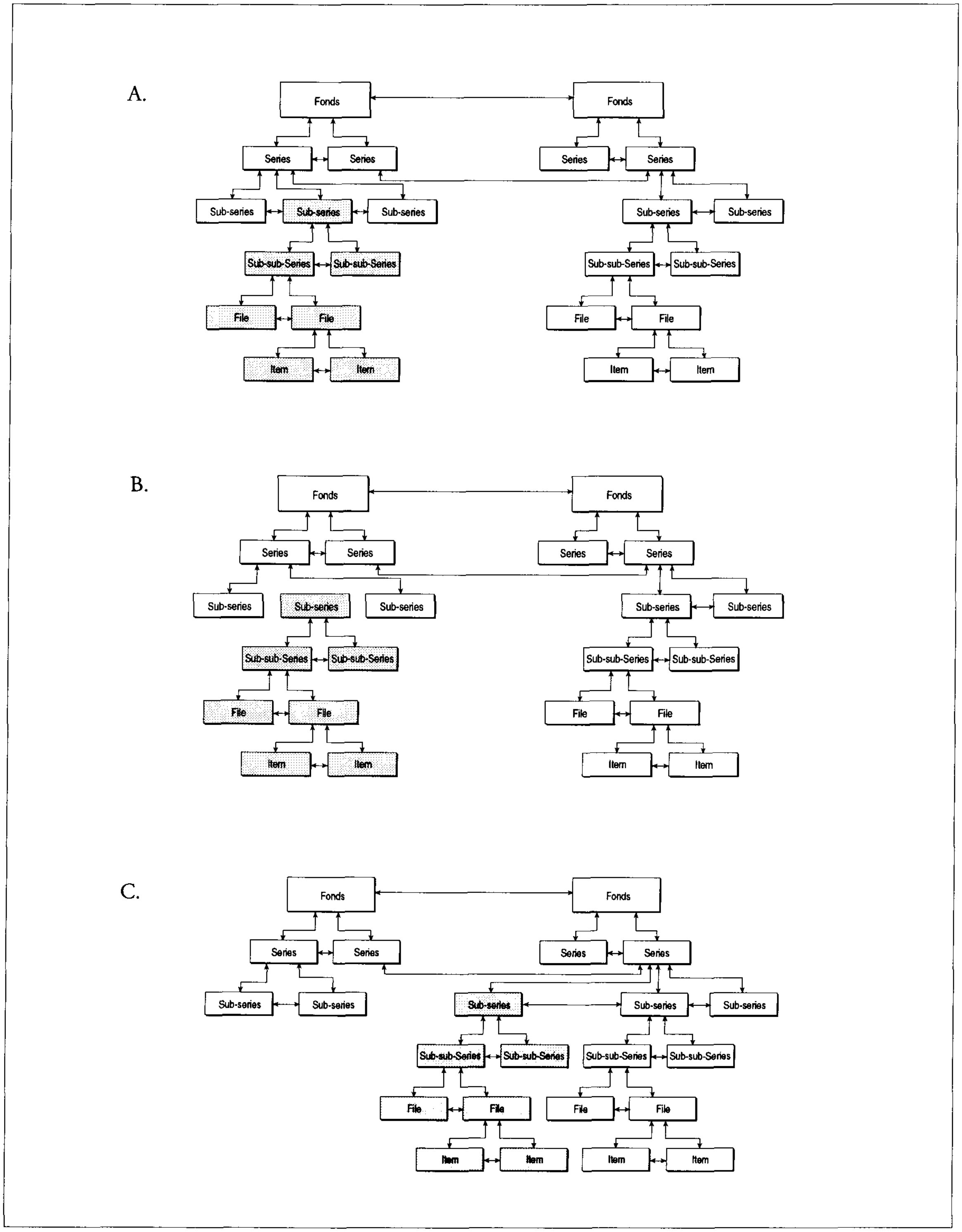

Fig. 18. A graphical representation of a sub-series node being unlinked and then linked to a new fonds structure. *A.* The links from the sub-series to the series and other sub-series descriptions are broken; *B.* the links to the hierarchically subordinate descriptions are retained; *C.* the sub-series node is linked to a series and sub-series description in another fonds structure. The links to the original fonds structure are updated.

on the attached nodes must be considered. No node should be left behind as an unattached orphan, because it would be inaccessible through browsing. For example, if a series description node is deleted, then the hierarchically subordinate file and item descriptions should be deleted as well (figure 19), unless a new series description node is created and attached to those nodes. As archivists would constantly be adding information to the archival hypertext, it is crucial that the information in the links and nodes be updated as soon as nodes or information in the nodes are changed or altered. A mechanism that could automatically check the hypertext for orphaned nodes or nodes that need to be linked would be useful.

Entering the Hypertext

Entering the archival hypertext to view the information in the nodes could be done in a number of ways. The researcher could conduct a search to get to a specific node, and then from that node, begin browsing (or conduct further searches from the vantage point of that node); the user could take a guided tour through a set of nodes where the path would be predefined and link selections would be made automatically; or the user could browse through a predefined subnetwork of linked nodes. (The appendix presents a hypothetical hypertext archival information system where the methods of viewing the information in an archival hypertext are illustrated.)

The variety of search options offer many avenues of approach to the information in an archival hypertext. This would accommodate the differing needs of users: a researcher could conduct a precise search on the access points derived from a description and then be taken to the node that satisfied that query; a researcher could have an indistinct notion which records were required, enter the hypertext, and through browsing, find relevant records; or the researcher could combine elements of both searching and browsing to find relevant information.

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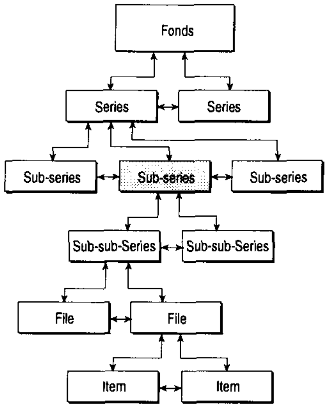
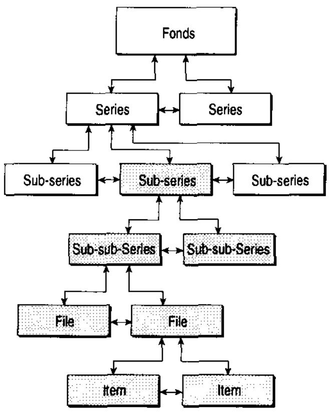


B.



C.

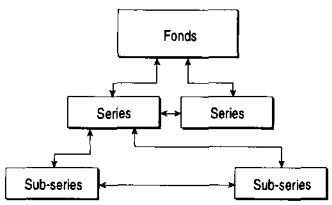


Fig. 19. A sub-series description node and the hierarchically subordinate descriptions is deleted from a fonds structure in the archival hypertext. *A.* The sub-series is selected; *B.* the subordinate nodes are included in the selection; and *C.* the nodes are deleted from the hypertext. The hypertext would be updated to reflect the changes (the remaining sub-series would be linked).

Structure and Content Searches

Both the contents of the nodes and structural aspects of the links and nodes could be searchable. A content search would examine the entire text of the node or selected text in the node. A search on the entire text would examine all the uncontrolled vocabulary in the node to find a match; it would be similar to a keyword search in a typical information retrieval system. If the nodes were semi-structured and the text in the nodes was separated into fields, the search could be limited to information contained in a particular field or fields. For instance, a search could be limited to the scope and contents field in the record nodes.

A more precise contents search would be limited to the words or terms that were under vocabulary control. For instance, the search could be on the controlled vocabulary in the authority nodes or the record nodes, including topic, genre, form, function, and occupation terms, or names (geographic, personal, corporate). Contents searches could be refined by using Boolean operators (and, or, not). For non-textual information, such as graphics or moving images, to be retrieved as part of a contents search, the information would have to be identified or characterized so that it could be searched. For instance, an illustration could be given a title that could be searchable. As the result of a successful search, the user could be presented with a list of authority nodes or records nodes that matched the search parameters.

The structural components of the hypertext—the links and nodes—could also be searched, if they had been characterized so that the system could identify them. A search could be limited to record nodes, authority nodes, or reference nodes. A search could also be conducted on the properties of the links, such as whether the link was dominant or subordinate (hierarchical links only), associational, or referential. From a record node, a search could be conducted for all the nodes connected by hierarchically subordinate links, or all the nodes connected by associational links. A search could also be delimited by specifying that the search only extend a certain number of links or nodes from the present node. For example, from a particular series description node, the search could be limited to record and reference nodes, connected by specific links a fixed distance away. Structural searching could also limit a search to a defined subnetwork of records. For example, the search could be restricted to a subnetwork of thematically related records or nodes of a related provenance. Other structural aspects that could serve as search parameters include the date the node was created and the creator of the node.

Contents and structural searches could be conducted separately, or aspects of both could be combined into a single search. For instance, a search could be limited to record nodes that were created by a particular archivist; or a search could be conducted for reference and record nodes a certain distance from the search node containing a particular search term. Combined structure and content searching would offer a variety of ways to retrieve information in the hypertext.

Browsing

Once the user arrived at a particular node in the archival hypertext as the result of a search, further searches could be conducted from the vantage point of that node, or the user could browse the linked nodes starting from that node.

Browsing would be a useful way to investigate the information in the hypertext because researchers would be able to associatively navigate through organizational structures (represented by authority nodes or reference nodes) or records hierarchies to find information, without having prior knowledge of the structures or the records related to those structures.[3] Browsing through a hypertext version of an archives' holdings would reveal relationships between agencies and individuals and the records they created. Browsing would also allow researchers to discover material and make associations that might otherwise not occur; this is contrast to systems where information can only be retrieved by phrasing the request in terms of a query.[4] Researchers would also have the opportunity to discover supplementary information about agencies and individuals by viewing the information in the reference nodes (these nodes might not be accessible through regular content searches).

Associative browsing offers a unique way to navigate through the hypertext. It would be based on the user following his or her vague and indistinct notions to move from node to node, which would then lead to chance discovery of material. It would not be as precise as query based searching, but for a researcher who does not have a specific group of records in mind (as is often the case), it may be an effective means to discovering information. Especially considering that archival researchers cannot browse the archival records themselves, as they would for instance, browse books in a library, browsing representations of archival records in an archival hypertext provides a means of access not hitherto offered.

A possible weakness of browsing is that it would be based on following the links established by the archivist. The user's ability to browse the information can only be as good as the links that were made. If the archivist neglected to make the required links or linked material inconsistently, it might be difficult or even impossible for the researcher to find specific information.

Guided Tours

Another means of viewing the information in an archival hypertext would be to take a guided tour through a predefined path of authority, record, or reference nodes, where all link selections would be made automatically and the system would run by itself.[5] The user would select a tour and then follow a path through the hypertext that has been programmed by the archivist. The system would automatically move from node to node, or the user could manually advance the nodes (the link selections would still be made by the system).

A variety of tours could be made available, such as a tour through the records of a single fonds, a tour through a group of thematically related records, a tour of a number of related fonds, a tour of fonds of similar form, or a general tour that familiarized users with various aspects of the archival hypertext.

A tour of a fonds description would take the user through the record nodes, one at a time, beginning with the fonds description and working down through the hierarchy of descriptions. A thematic tour would take the user automatically through a group of thematically related nodes. This type of tour would be useful in circumstances where the archivist knew what type of information users might be interested in or would most likely be requested. For instance, if researchers frequently requested records relating to a specific theme, then a guided tour that brought those records together could be created and made available to users. In this way, the tour is similar to a thematic guide, the difference being that the researcher is lead through the records descriptions, and instead of only providing citations to the fonds or collections, the entire set of descriptions that made up the fonds or collection would be available. Also, as new records were added to the hypertext, the tour could be updated to include those records; this is in contrast to printed guides, that are fixed and often out of date soon after they are printed. Another use for guided tours would be to orient users to the structure and information in the archival hypertext before they started browsing it on their own. This would offer a user-friendly approach to orienting researchers to the hypertext.

Once in a guided tour, the user would have the option of straying from the tour. If the researcher wanted to follow a link, the tour could be paused, and nodes outside of the parameters of the tour could be explored. This exploration could be done with the confidence that it would be easy to return to the tour—a command could return the user to the departure node, and the tour could be resumed.

The advantage of a guided tour is that it could free the reference archivist from having to answer the same questions and of having to direct researchers to the same records descriptions. In response to a query, the archivist could instruct the user to take a guided tour through the records related to the query. The tour would provide consistent information, which would not be dependent on the knowledge of the reference archivist, who might not be familiar with the material or who might not always direct the user to the best sources. For guided tours to be successful, it would be necessary for achivists to find out more specifically who are the users of archives so that they could design tours for them.

Applications

A hypertext archival information system would be useful in either a single archives setting or a multi archives setting. In a single archives setting, the archival hypertext could be distributed across a number of computers, and archivists could create, edit and link information simultaneously. To avoid conflicts, the system would not allow two people to edit or link the same node at the same time. In a multi archives setting, many archives could contribute to the hypertext, and again, the information could be created, edited, and linked simultaneously. In a multi archives setting, the multiple linking and referencing of information would reduce repetition in the creation of records.

Printing Records

An archival hypertext would be a non-linear database of records that have multiple relationships to other records. At any time, though, a fixed, linear version of the records in hypertext could be printed out. The archivist or researcher could select nodes, determine an order, and then print them out in that order.

Nature of System

A hypertext archival information system could perform many functions that are currently accomplished by different systems. For instance, the retrieval system would be similar to typical archival retrieval systems; subnetworks of thematically linked records would be similar to thematic guides; a linked subnetwork of descriptions that comprise a fonds would be similar to an inventory; and reference information would be similar to information typically found in a subject search file. A hypertext system could combine all these various systems into one. This could be useful, as researchers would be able to retrieve a variety of information all in one location. The disadvantage may be that the system could be trying to accomplish too many different purposes. Combining all this information into the hypertext could also potentially overwhelm the researcher.

Designing an Archival Hypertext

Designing an archival hypertext would be similar to the design of any retrieval system. It would involve conducting a general needs analysis, determining the structure of the data, determining how the data elements would be controlled, deciding how the information would be linked, and choosing software and the hardware. In the system design phase, many of the functions exclusive to hypertext could be considered for implementation.

Issues Relating to an Archival Hypertext

There are a number of issues regarding the implementation of an archival hypertext that need to be addressed. These include: the time it would take to create and maintain an archival hypertext; the time it would take to type structural elements, such as links and nodes, so that they could be searchable; which information and which nodes would be linked; and whether hypertext would be an effective way to represent information about archives.

Creating links and nodes

A major concern with an archival hypertext would be the amount of time it would take to create and maintain the hypertext, including the creation of nodes, the linking of nodes, and keeping the hypertext up-to-date when nodes and links were altered.

Creating nodes may be time consuming, especially if separate nodes had to be created for each record. In current retrieval systems, a variety of records can be generated from a single set of data. For example, from a single set of authority data, records for preferred and non-preferred terms can be generated. In a hypertext system, separate nodes would have to be manually created for each record. Unless there was a way to automate the creation of nodes, it may be too time consuming to be practical. Similarly, extensive manual linking of information might prove to be too time consuming for archivists. For instance, it could be very labour intensive to manually link all the descriptions of a large fonds that included series, sub-series, file, and item descriptions. Unless the linking was automated, it might prove to be impractical.

Maintaining the hypertext might also be time consuming, especially if descriptions were being added, removed or deleted on a regular basis, as would most likely be the case with an archival hypertext. As mentioned previously, whenever a description was altered or deleted, the hypertext would have to be updated and there would have to be a means to ensure that there were no orphaned nodes. Unless this aspect of the hypertext could be automated, maintaining the hypertext may be too time consuming.

Another area of concern would be how records were linked. Rules or guidelines as to how and what information should be linked would have to be established so that researchers could expect consistent linking from node to node. As researchers would continually be offered multiple paths, it would be important that the paths available and choices were clear (to help alleviate cognitive dissonance). If the placement of link anchors and the type of information that was linked was standardized or at least consistent, researchers could expect link anchors to be in the same location from node to node, and consistent results when the links were activated. If not, researchers could easily become confused and frustrated. Consistency and standards would also be very important in an environment where a number of different archivists were adding and linking information in a collective hypertext.

The number of links that archivists made would also be a concern. The user's ability to explore the hypertext based on the links between the nodes would only be as good as the links that have been made. If the archivist neglected to make the required links, then the user would not be able to find the records through browsing. The ability to associatively traverse the structures and find information would be seriously weakened as a result.

Typing Structural Elements

While searching on the structural elements of the hypertext would offer a unique way to get at the information in the hypertext, it may be too time consuming to type the structural elements so that they could be searchable. If each time information was added to the hypertext, a specific node type had to be selected or defined, such as a reference node, record node, or authority node, or if each time a link was made, a particular link type had to be selected, such as a hierarchical link, referential link or associational link, it could end up being too complicated and time consuming. It would have to be decided whether structural elements would be typed for searching at all, and if so, how finely the elements would be distinguished. For example, would just links and nodes be identified, or would the various types of links and nodes be identified? Having multiple structural elements typed could also increase the chances that an error could be made during the creation of the hypertext. If the archivist linked a node with the wrong type of link, a search on the link properties would not produce the expected results.

Overall, the benefits of having the structural elements typed and searchable would have to be examined to see if it improved the retrieval of information from the hypertext. If it did not improve retrieval then there would be little advantage to having it. And even if it did improve retrieval of information from archives, then the time it would take to type the elements would have to be considered.

Retrieval of Information

The main concern is whether a hypertext representation of information about archives would improve the retrieval of information from archives. The structure of information about archives, especially records information, is primarily hierarchical. Hypertext is well suited to representing hierarchical information and allowing easy movement among such information.

Hypertext may also suit the way people typically retrieve information. Most often, researchers find information through a combination of structured queries and associative browsing. For instance, in a library setting, researchers use a retrieval system to find a particular source, and then once they get to the book stacks, they often browse the related material on the shelf. An archives cannot make its holdings available to the public in the same way a library can, but a hypertext archival information system, where related items would be linked and browsing of the items would be possible, could come close to replicating this process for archives. The user would enter the hypertext by posing a query, and then once in the network of records, the user could browse the associated linked material.

Overall, a hypertext archival information system would address some of the issues raised by archivists regarding efficient retrieval of information. Provenancial, documentary and other information could be separated into various components and then linked to one another; movement throughout the linked network of records would be flexible, and not dependent on the researcher knowing the structures beforehand; the varying needs of researchers would be addressed in the variety of avenues of information retrieval offered: researchers could conduct a search and be taken to a specific node, they could browse throughout the network of linked nodes, they could take a guided tour of selected nodes, or they could search a subnetwork of linked nodes; the system could accommodate general and specific queries, and the queries could be related to the contents of the records or to the structure of the hypertext; and the system could be designed to be comprehensive, comprehensible and self-explanatory and to operate with minimal intervention from the archivist.

The purpose of the chapter has been to illustrate how hypertext could be implemented in an archival retrieval system. A variety of systems could be developed, and as technology advances, so will the capacities and functions of hypertext. Also, the type of hypertext retrieval system developed by archives would depend on the specific requirements of the archives.

NOTES

[1] Ben Shneiderman, "Reflections on Authoring, Editing and Managing Hypertext," in *The Society of Text: Hypertext, Hypermedia, and the Social Construction of Information*, ed. Edward Barrett (Cambridge, Mass.: MIT Press, 1989), 115.

[2] Most multiuser hypertext systems that are for educational purposes or collaborative writing allow users to add their own links, such as Intermedia and NoteCards. When hypertext systems are for informational purposes and are accessible by the public, the option of added links is usually suppressed.

[3] Soledad Ferreiro and Marialyse Délano, "An Innovative, User Friendly Computerized Archival System Combining Text and Images: A Chilean Experience," *Symposium on Current Records: Converging Disciplines in the Management of Recorded Information. International Council on Archives Ottawa, Canada, May 15-17, 1989,* 18.

[4] Gary Marchionini and Ben Shneiderman, "Finding Facts vs. Browsing Knowledge in Hypertext Systems," *IEEE Computer* 21 (January 1988): 71 and Patricia Baird, Lizzie Davenport, and Noreen MacMorrow, "Hypertext and Hypermedia: The Transformation of Text," *Library and Information Briefings* 18, ed. Mary Feeney and John Martyn (Library and Information Technology Centre, 1990): 102.

[5] Ben Shneiderman and Greg Kearsley. *Hypertext Hands-On! An Introduction to a New Way of Organizing and Accessing Information* (Don Mills, Ontario: Addison-Wesley Publishing Co., 1989), 14.

CONCLUSION

Hypertext is a revolutionary way of structuring information on computer. The purpose of the thesis has been to examine whether hypertext could be implemented in an archival information system. It began with a summary of the development and nature of hypertext, followed by a discussion of archival retrieval systems and the needs of users regarding information retrieval, and finally, a discussion of the capacities of hypertext and its application to archival retrieval systems. Additionally, aspects of a hypothetical hypertext archival information system were presented to illustrate how information could be organized in an archival hypertext and how that information could be browsed and retrieved.

It is concluded that hypertext could be implemented in an archival information system, but there are advantages and disadvantages to a such a system. The advantages would include some of the following: the hierarchical structure of information about archives would be easy to represent in the hypertext; movement throughout the hierarchical structures would be as simple as following established links; records could have multiple links to other records; records could be structured in multiple ways simultaneously; associative browsing of the information by following the links among the records would be possible; and a variety of search options would be available, which would allow users to access the information in the hypertext in a variety in different ways.

On the other hand, the disadvantages of implementing a hypertext archival information system are: it could be too time consuming to create individual nodes and then make links between all the nodes; movement throughout the hypertext network would rely on links established by the archivist, so navigation would be as good or bad as the links that were created; and the associational, non-linear structure of hypertext might not be the most efficient way to retrieve archival information. There are also intellectual problems rooted in the nature of hypertext, such as disorientation and cognitive overhead, that would effect the implementation of an archival hypertext.

Despite its disadvantages and technical difficulties, hypertext does address a number of the concerns archivists have raised about improving the retrieval of information from archives. Provenancial, documentary and other information could be separated into various components and then linked to one another; movement throughout the linked network of records would be flexible, and not dependent on the researcher knowing the structures beforehand; the varying needs of researchers would be addressed in the variety of avenues to information retrieval offered; the system could accommodate general and specific queries, and the queries could be related to the contents of the records or to the structure of the hypertext; and the system could be designed to be comprehensive, comprehensible and self-explanatory and to operate with minimal intervention of the archivist.

In conclusion, hypertext offers a unique way of structuring archival information on computer, and despite some of its shortcomings, hypertext could be successfully implemented in an archival retrieval system.

APPENDIX

A HYPOTHETICAL ARCHIVAL INFORMATION SYSTEM

Chapter 3 described some of the elements that could comprise a hypertext archival information system. Some of the functions that were mentioned will be illustrated here in more detail by presenting a hypothetical archival hypertext. The system presented is a composite based on a number of current hypertext systems, and is used for illustration purposes only. Technical aspects of the system are not addressed, because there could be immense variation in system specifications and it is beyond the scope of the present discussion.

The system described is a structured browsing system, with nodes for authority information, records information and reference information. The information in the nodes is presented in windows, and multiple windows that can be open at a time. The nodes are connected by hierarchical, associational, and reference links. The properties of both the nodes and the links are searchable.

The system would allow searching on the text of the nodes (both controlled and uncontrolled), semantic searching, subnetwork searching, and browsing. When conducting a search on the controlled vocabulary, the system would search for matching names or terms in the authority nodes. The authority nodes would be linked to the record nodes. A search on the uncontrolled vocabulary would present the user with a list of any nodes that matched.

The system would also have a number of navigational aids to keep users oriented in the hypertext, including a browser and a backtracking mechanism.

In the examples below, the following aspects of a possible hypertext archival information system will be presented: controlled vocabulary searching, browsing, semantic searching, navigation aids (browser, backtracking mechanism), guided tours, and subnetwork searching.

Search and Browse

A sample search will illustrate how the user enters the hypertext, and then once in the hypertext, how the linked information can be browsed. In the first example, the user is interested in finding information relating to the Wilkinson family. "Search" is selected from the menu and the Search dialog box appears. Unsure of what records are available, the user decides to search for nodes containing the name "Wilkinson." The user enters the name in the Search dialog box[†] (figure 20) and clicks the "Find" button to initiate the search (figure 21). As there is no exact match according to the search term, the user is presented with a window that displays the first match in an alphabetical listing of the name authority nodes (figure 22). In the result list, a number of name authority nodes that match Wilkinson are present, beginning with "Wilkinson family" (which is highlighted). The user selects "Wilkinson, Jared Cecil" and gives the command to open the authority node relating to that name (figure 23). The Wilkinson, Jared Cecil authority node appears on the screen (figure 24). At the top of the authority record is the name, "Wilkinson, Jared Cecil," followed by a *see* reference to "Wilkinson, J.C., 1886-1976?". The link marker above "Wilkinson, J.C., 1886-1976?" indicates that another node is linked to that name. Clicking on the link

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[†] A dialog box is a window where the user must make a choice or selection.

marker would take the user to the node attached to that link.

At the bottom of the window are number of buttons that allow movement based on node to node links. Clicking "Up" or "Down" would move to the hierarchically dominant or subordinate node, while clicking "Left" or "Right" would move to the next node connected with a lateral or associational link. Shaded buttons indicate that there is no link or that the function indicated by the button is currently not available. The tour buttons "Tour" and "Pause" are inactive because a regular search is being conducted, not a guided tour. From the current node (figure 24), clicking "Left" or "Right" would take the user to the linked alphabetically preceding or succeeding authority node. Movement up and down is not possible because the node is not linked hierarchically, and movement back is not possible because this is the first node to be browsed.

The user clicks the link marker above "Wilkinson, J.C., 1886-1976?" and the J.C. Wilkinson authority node appears (figure 25). The "Back" button on the bottom of the screen is now active to indicate that backtracking is possible. At the bottom of the record is "Wilkinson family tree" with a link marker above it. Activating the link (figure 26) takes the user to an attached reference node that provides a graphical view of the Wilkinson family genealogy (figure 27). The browser has also been activated and it appears in the right hand corner of the screen. It shows the nodes that have been visited and the nodes that are linked to the current node.

The user clicks on the link marker above "Wilkinson family" (figure 28) and the Wilkinson family authority node appears (figure 29). The node has *see also* references to each of the members of the Wilkinson family as well as "Wilkinson family tree" which is linked to the reference node. The browser has updated to indicate the change in location in the hypertext. The user decides to view the record nodes attached to the Wilkinson family authority node by clicking the marker above "Wilkinson family" (figure 30). This takes the user to the Wilkinson family fonds description node (figure 31).

From this initial fonds description node, the user is able to travel to any other attached nodes. In this case, the fonds has be described down to the item level, so it is possible to navigate down the hierarchy of fonds, series, sub-series, file, and item descriptions. From the browser, which has again updated to reflect the present location in the hypertext, the user can see that there are attached series description nodes, reference nodes, authority nodes, and fonds description nodes. The "Down" button on the bottom of the window is now active: clicking it would take the user down to the first record on the next hierarchical level (Series I); clicking "Left" or "Right" would take the user to the alphabetically preceding or succeeding fonds description nodes based on the title of the fonds. The text of the fonds description extends beyond the size of the screen, but the user can scroll down the window to view the rest of the description.

The user decides to activate the link in "Lansing" (figure 32) to view the attached reference node (when the cursor is held over the link and the mouse button held down, the line to line to "Yukon Map" darkens to indicate that node is attached). The Yukon Map reference node (figure 33) illustrates the locations in the Yukon where the Wilkinsons have lived. All the location names in the biographical sketch area of the fonds description node are linked to the Yukon Map reference node. In the map, the names of the places where the Wilkinson lived have link markers above them. They are attached to reference nodes that give a brief textual description of the location. The only button active at the bottom of the window is "Back."

The user decides to close the windows to the Yukon Map reference node and the Browser (clicking in the square box in the upper left hand corner of the window would close it). This makes the Wilkinson family fonds node the active window (figure 34) again. The user scrolls down the window to view the arrangement note. In the arrangement note, the titles of the series are linked to the series descriptions (as indicated by the link markers above the title of each series). The user clicks on the link marker above Series II, "Wilkinson family correspondence, poetry and clippings," and is taken to the series node for those records (figure 35).

At the top of the series description, the title of the fonds and series number is given: "Wilkinson family fonds. Series II". There is a link marker above "Wilkinson family fonds"; activating this link would take the user back to the fonds description. For each descriptive record, the descriptive level is indicated at the top of the record to orient the user. This is particularly useful if the user is rapidly browsing through records and momentarily forgets where he or she is, or if the user arrives at a node below the level of the fonds as a result of a search and needs to know which fonds the records belong to. In the arrangement note, the sub-series titles are linked to the sub-series descriptions, and at the bottom of the description there is a list of the access points that are linked to their respective authority records. From the Series II node, movement across the hierarchy at this level is possible, as indicated by the active "Left" and "Right" buttons; clicking "Left" would take the user to Series I while clicking "Right" would take the user to Series III. Movement up and down the hierarchy is also possible, as indicated by the active "Up" and "Down" buttons. Clicking "Up" would take the user to the fonds description one hierarchical level up, while clicking "Down" would take the user to the first description one hierarchical level down.

The user decides to move across the hierarchy to Series I by clicking the "Left" button (figure 36). Once at the Series I description (figure 37), the "Left" button is no longer active because movement across the hierarchy in that direction is not possible. The user decides to return to Series II by clicking the "Back" button (figure 38). From Series II, the user clicks the "Right" button to view the next linked series (figure 39). This takes the user to the Series III node (figure 40). The user could continue to move across the hierarchy using the "Right" button at the bottom of the window, until Series XII was reached.

In the Series III description node, there is a link to a related fonds, as indicated by the link marker above the text in the related material note. The researcher decides to follow the link in the related material note by clicking on the link marker (figure 41). This takes the user to the Andy Porterfield fonds node (figure 42). The user decides not to follow any of the links from that node, and closes the window as well as the window for Wilkinson family fonds, Series III node. This makes the Series II node the active window again. The user decides to view records on the next hierarchical record down by clicking on the link marker above the title of Sub-series 3, "J.C. Wilkinson poetry" (figure 43). This takes the user to the Sub-series 3 node (figure 44). Movement down the hierarchy is still possible, as indicated by the active "Down" button. The file list attached to the node would be considered the record on the next hierarchical level down. Movement is also possible across the hierarchy at this level. The user can also move up the hierarchy by using the buttons at the bottom of the window or by activating the links in "Wilkinson family fonds" and "Series II" at the top of the description.

From the vantage point of the Sub-series 3 node, the user decides to conduct a semantic search. "Search" is selected from the menu which brings up the Search dialog box (figure 45), and the "Search Options" button is clicked (figure 46) to reveal the Search Options dialog box (figure 47). In the box, the user indicates that the search is from the current record, and it is for record nodes linked by dominant hierarchical links three nodes or less from the current node. After closing the dialog box after entering the search parameters and then clicking "Find" in the Search dialog box, the result list indicating the matching nodes appears (figure 48). The user selects "Wilkinson family fonds, Series X" and clicks "Open" (figure 49). The user would then be taken to that node.

The user could continue searching the archival hypertext by browsing from node to node and conducting additional searches. The links between the nodes make it easy to travel from node to node, and the browser mechanism ensures that the user remains oriented in the hypertext. Further, the backtracking mechanism allows the user to return to any previously viewed node.

Guided Tour

To begin a guided tour, the user would select "Guided Tour" from the Search menu, and the Guided Tours dialog box would appear. The dialog box allows the user to select a tour and determine how the tour will proceed. The user has selected automatic and five seconds as the rate at which the nodes will advance (figure 50). The tours are selected from a pull-down list. The following categories of tours are available: Anniversaries, Genealogy, Inventories, Oral Histories, Territorial Government, and Themes (figure 51). The category "Anniversaries" is selected ; within the category of Anniversaries, "Alaska Highway" is chosen (figure 52). With the tour selected, the "Tour" button is clicked to activate the tour (figure 53).

The first node in the tour provides a graphical overview of the categories under which the records in the tour are organized (figure 54). These categories include: Historical Background, Personal Narratives, Photographs and Pictorial Works, Military and Civilian Governance, Socio-Economic Impacts, and Special Events. The tour has been programmed to cycle through the fonds and collection descriptions in each of the categories. When the tour is in operation, all the usual linking actions are inaccessible; this is evident by the inactive buttons at the bottom of the window (the only active button is "Pause").

After five seconds, the first description node in the category Historical Background is opened, the Al Wright fonds description node (figure 55). The researcher clicks the "Pause" button at the bottom of the window to pause the tour so that some of the links in the node can be manually explored (figure 56). When the tour is paused, the buttons on the bottom of the screen become active, indicating that the links can be followed (figure 57). The user could follow links from the node and then return to the tour by clicking the "Tour" button at the bottom of the window. This would take the user back to the node of departure (in this case, the Al Wright fonds description node) and then automatically resume the tour.

Subnetwork Search

Subnetworks would be available to be viewed, much the same way that tours are available to be viewed. Browsing through the records in a subnetwork would be similar to a tour, with the exception that the browsing would be limited to the records in the subnetwork. After selecting "Subnetworks" from the menu, the Subnetwork dialog box would appear (figure 58). It would have a pull-down menu similar to the one in the Guided Tours dialog box. The user selects the "Alaska Highway" subnetwork (figure 59) and clicks the "Open" button to open the first node in the subnetwork (figure 60). Again, the overview node appears as the first node in the series (figure 61). The user clicks the link marker above "Special Events" (figure 62) to view the attached nodes. Multiple nodes are attached to the link anchor, so the Link Destination box appears (figure 63). The user selects the Harry O. Carpentier fonds as the destination (figure 64) and clicks "OK" (figure 65) to be taken to that node (figure 66). From the Harry O. Carpentier fonds description node, the user is free to follow any of the links. The user clicks on the link marker above Series II (figure 67) and is taken to the description of that series (figure 68).

This has been an illustration of the following elements of a hypothetical hypertext archival information system: controlled vocabulary searching, browsing, semantic searching, navigational aids (browser, backtracking mechanism), guided tours, and subnetwork searching. Many other functions would be possible in such a system, but as mentioned, it is beyond the scope of the present study. The aim here has only been to illustrate how an archival hypertext could be explored, and how it would differ from current archival retrieval systems.

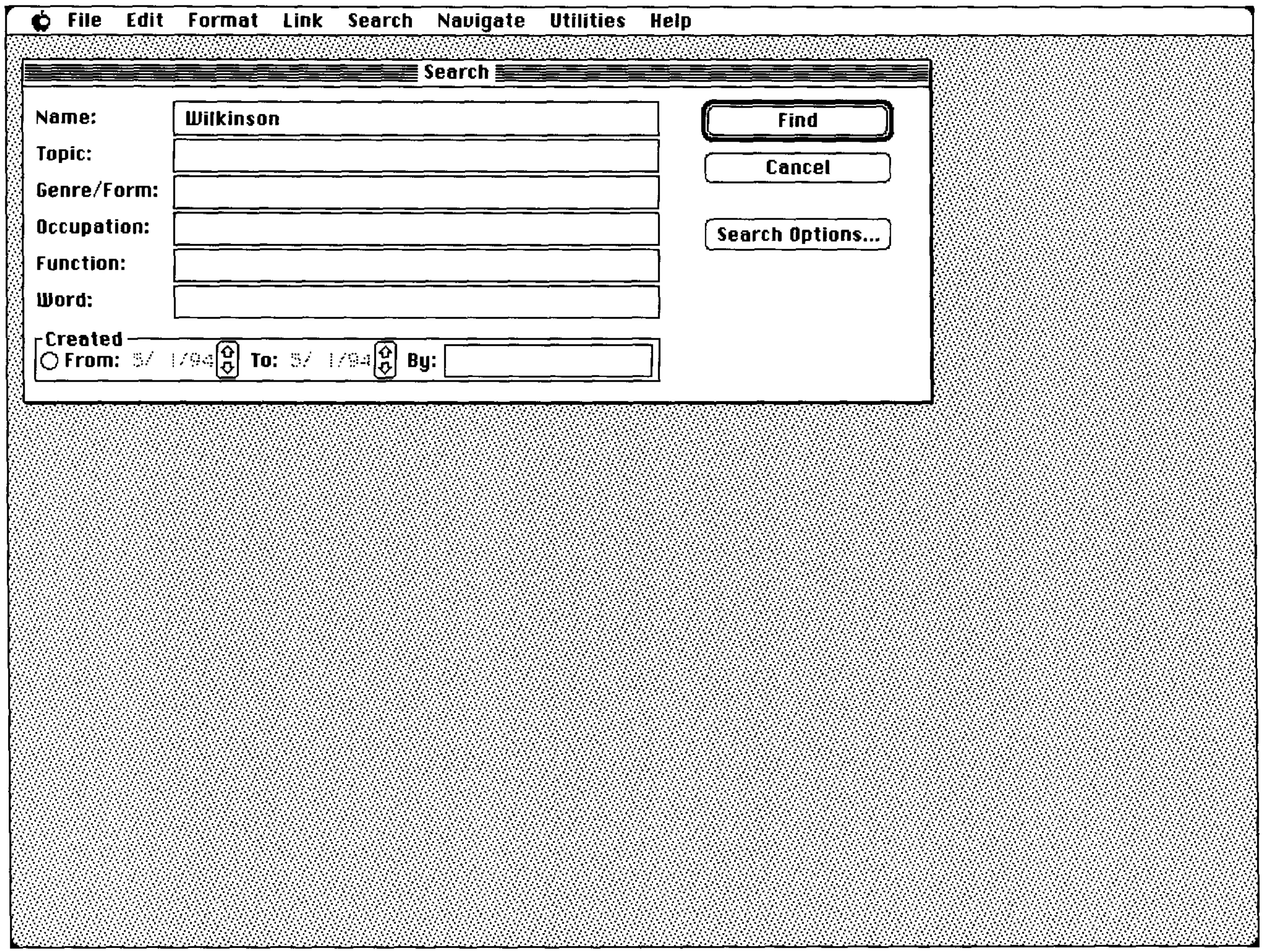

Fig. 20. The Search dialog box includes an area to enter name, topic, genre/form, occupation, and function access points, and keywords. There is also an area to delimit the search by date of creation of the node and author of the node. "Wilkinson" has been typed in the name area. The search will look for any authority nodes containing the name "Wilkinson".

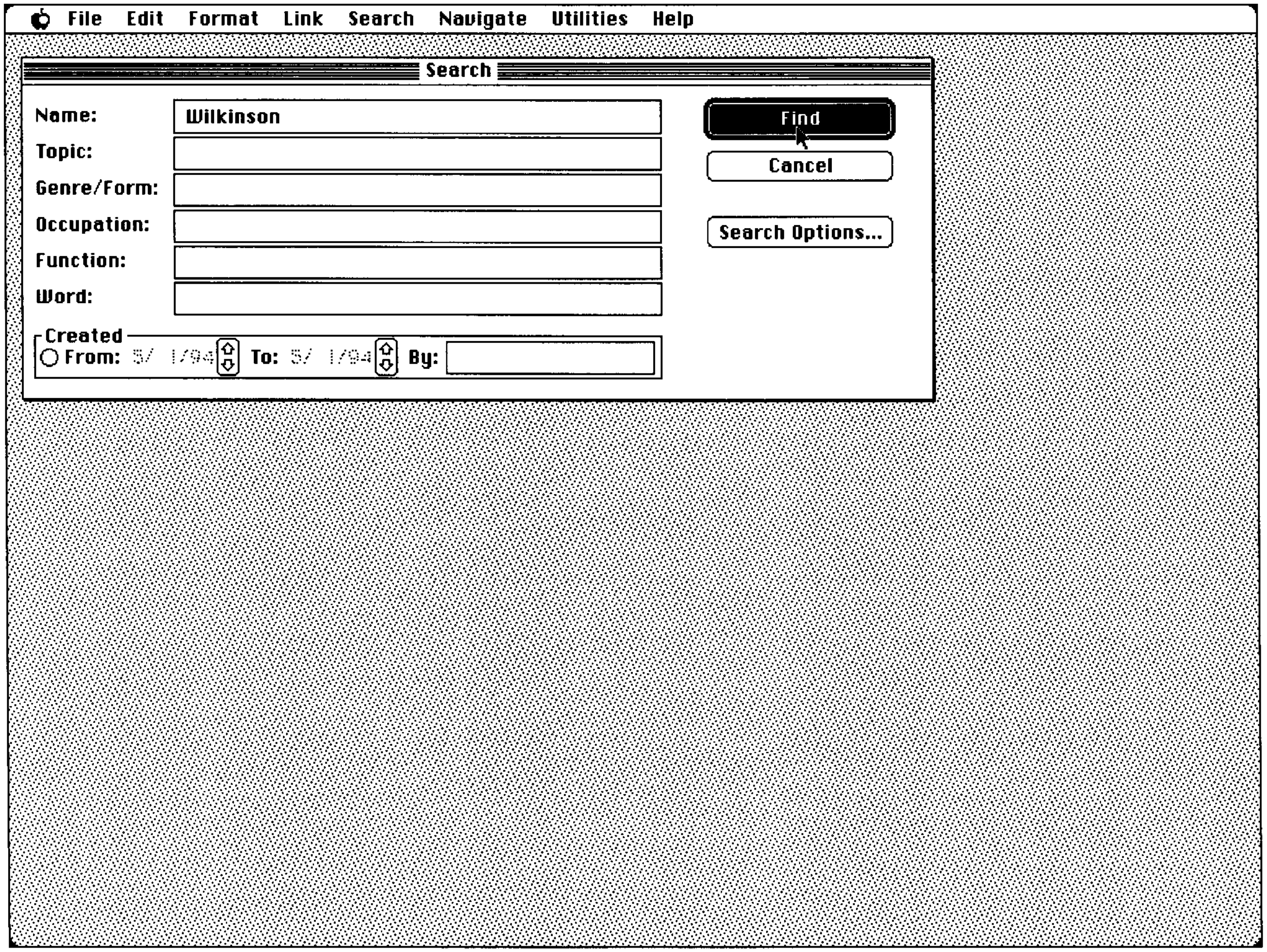

Fig. 21. Clicking the "Find" button in the Search dialog box to initiate the search.

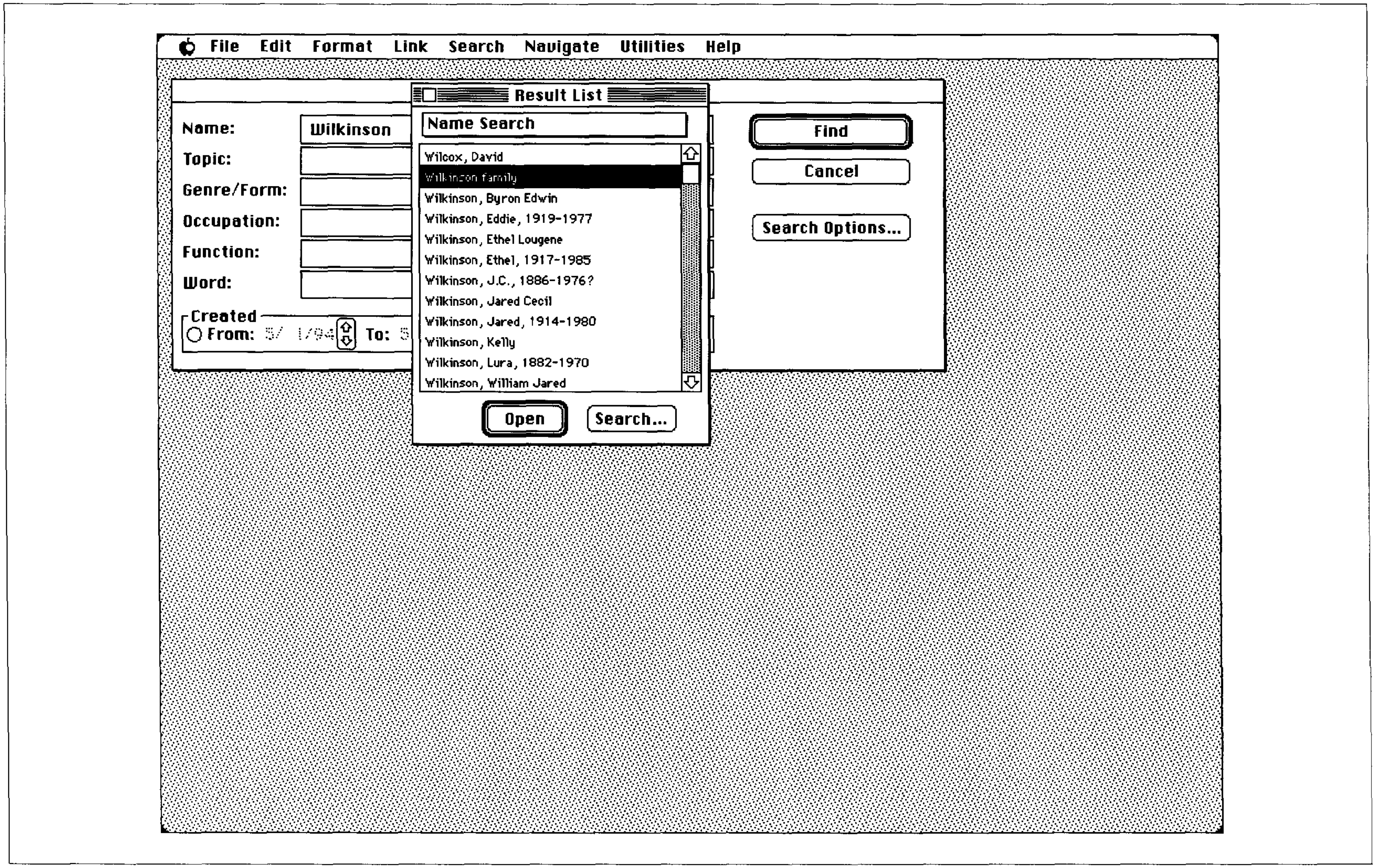

Fig. 22. The Result List window showing a list of authority nodes. As there was no exact match for the search term, an alphabetical list of authority nodes with the closest match highlighted ("Wilkinson family") is presented.

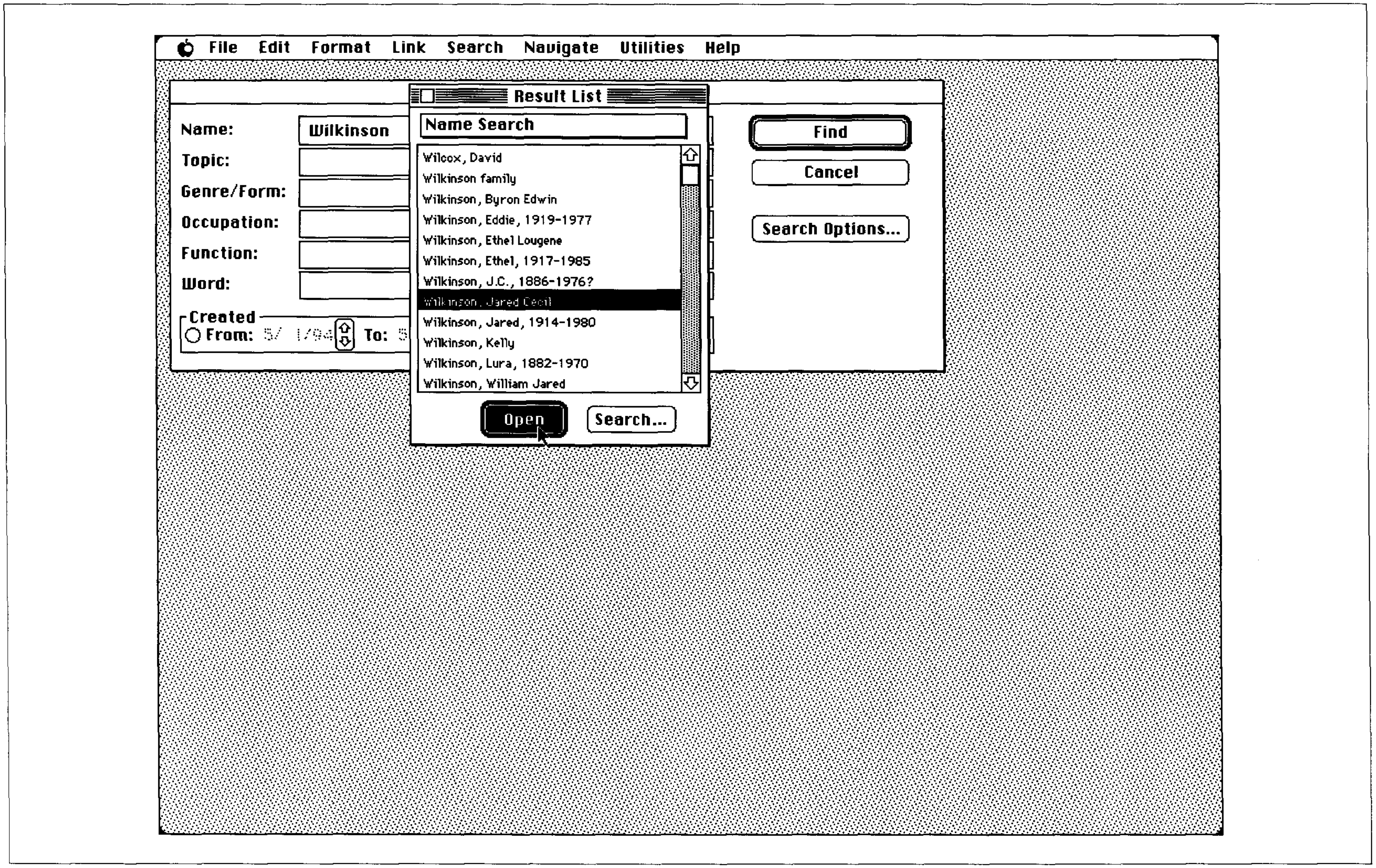

Fig. 23. The researcher selects “Wilkinson, Jared Cecil” from the list of names, and clicks the “Open” button to open that authority node.

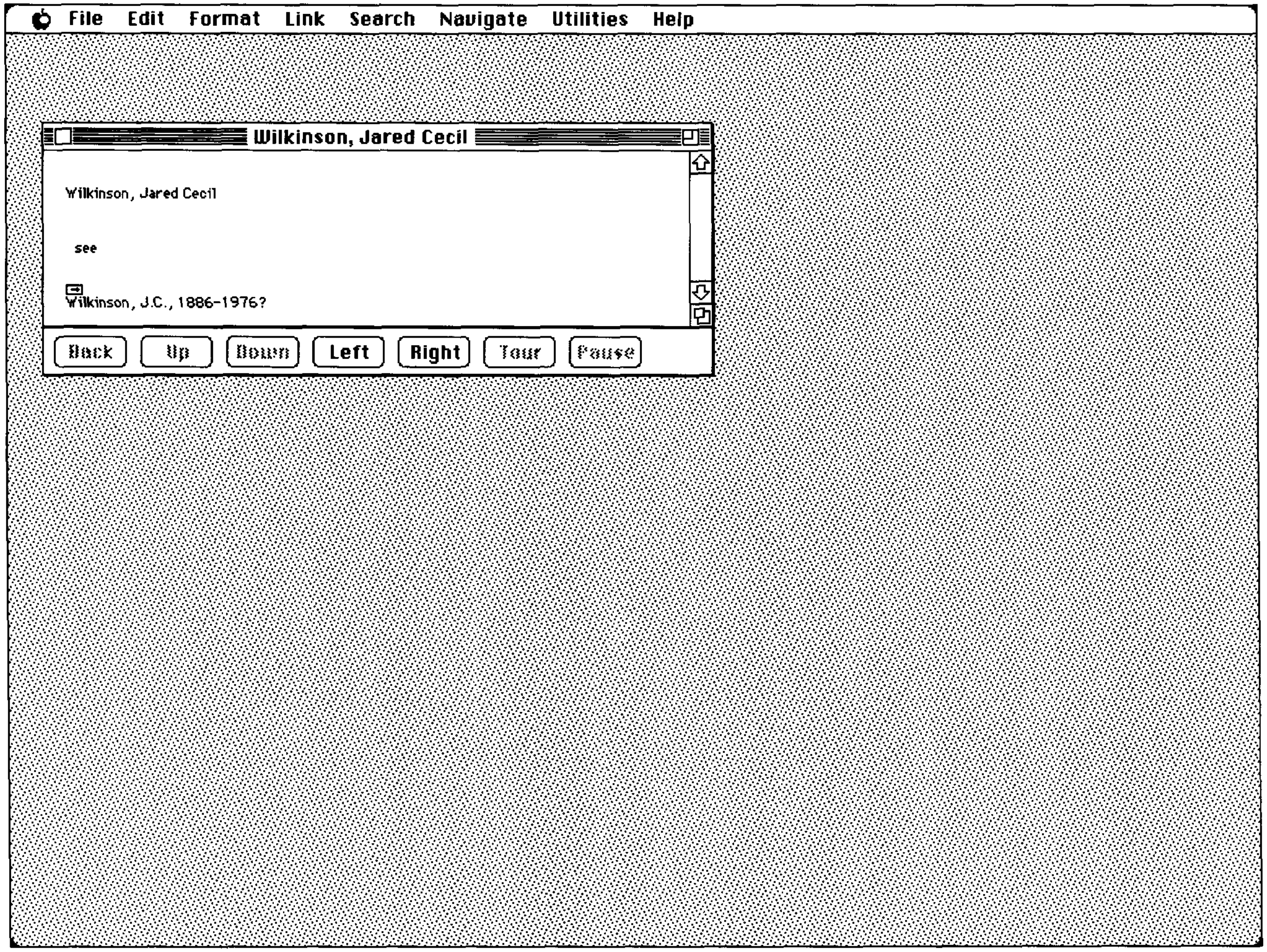

Fig. 24. The Wilkinson, Jared Cecil authority node. The name is not the preferred form of the name, as there is a *see* reference to another authority record. The link marker above the *see* reference indicates that there is a link to the authority node that contains the preferred form of the name. The "Left" and "Right" buttons along the bottom of the window are active to indicate that the researcher can travel to the alphabetically preceding and succeeding authority records. The researcher activates the link to the attached node clicking the link marker above "Wilkinson, J.C., 1886-1976?"

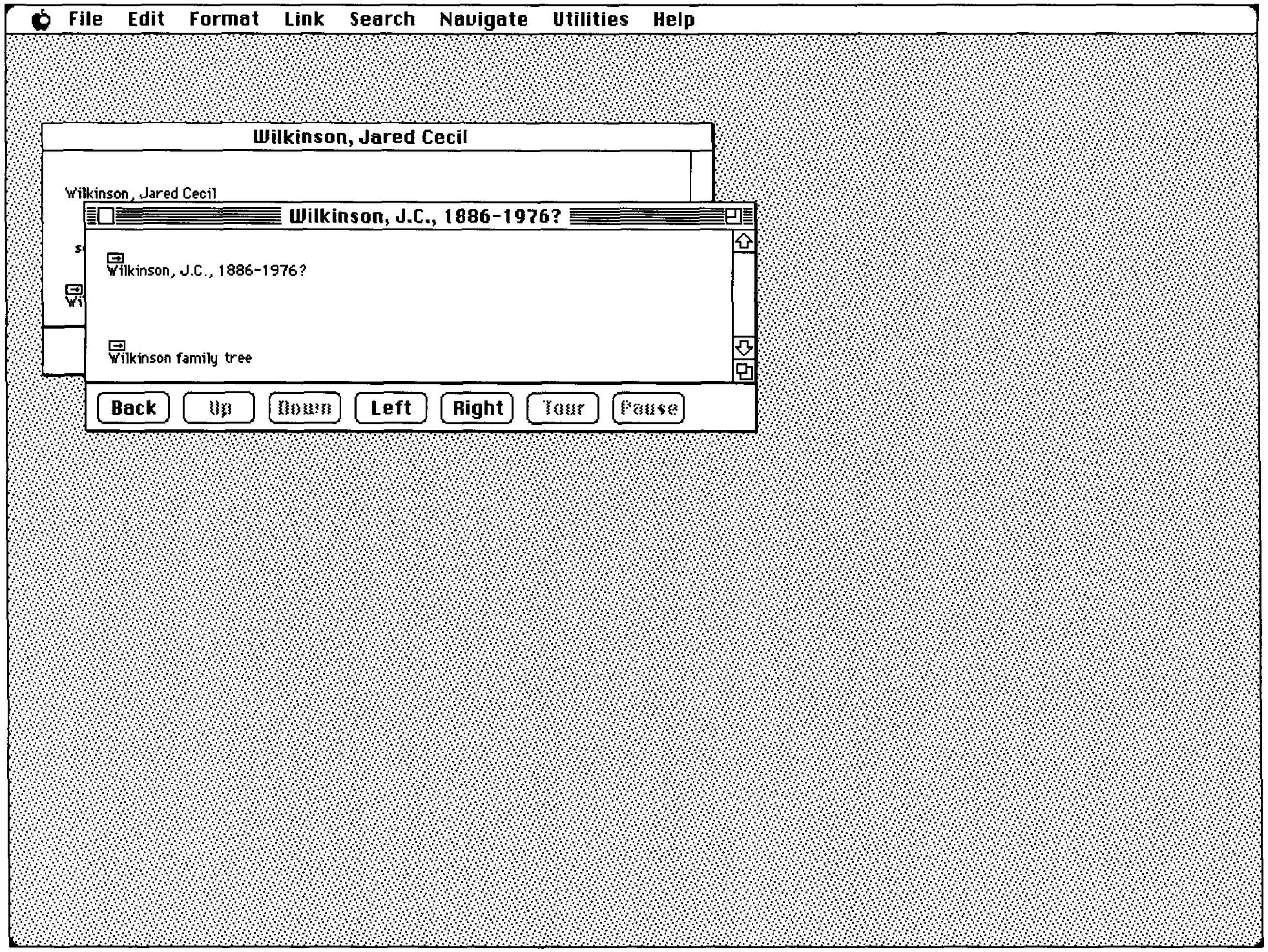

Fig. 25. The user has called up the Wilkinson, J.C. authority node by activating the link marker above the name in the preceding authority node (figure 24). There is referential information attached to the authority node, as evidenced by the text "Wilkinson family tree" that has a link marker above it. As this is the second node in the search, the "Back" button at the bottom of the window is now active. Clicking that button would return the researcher to the previous node.

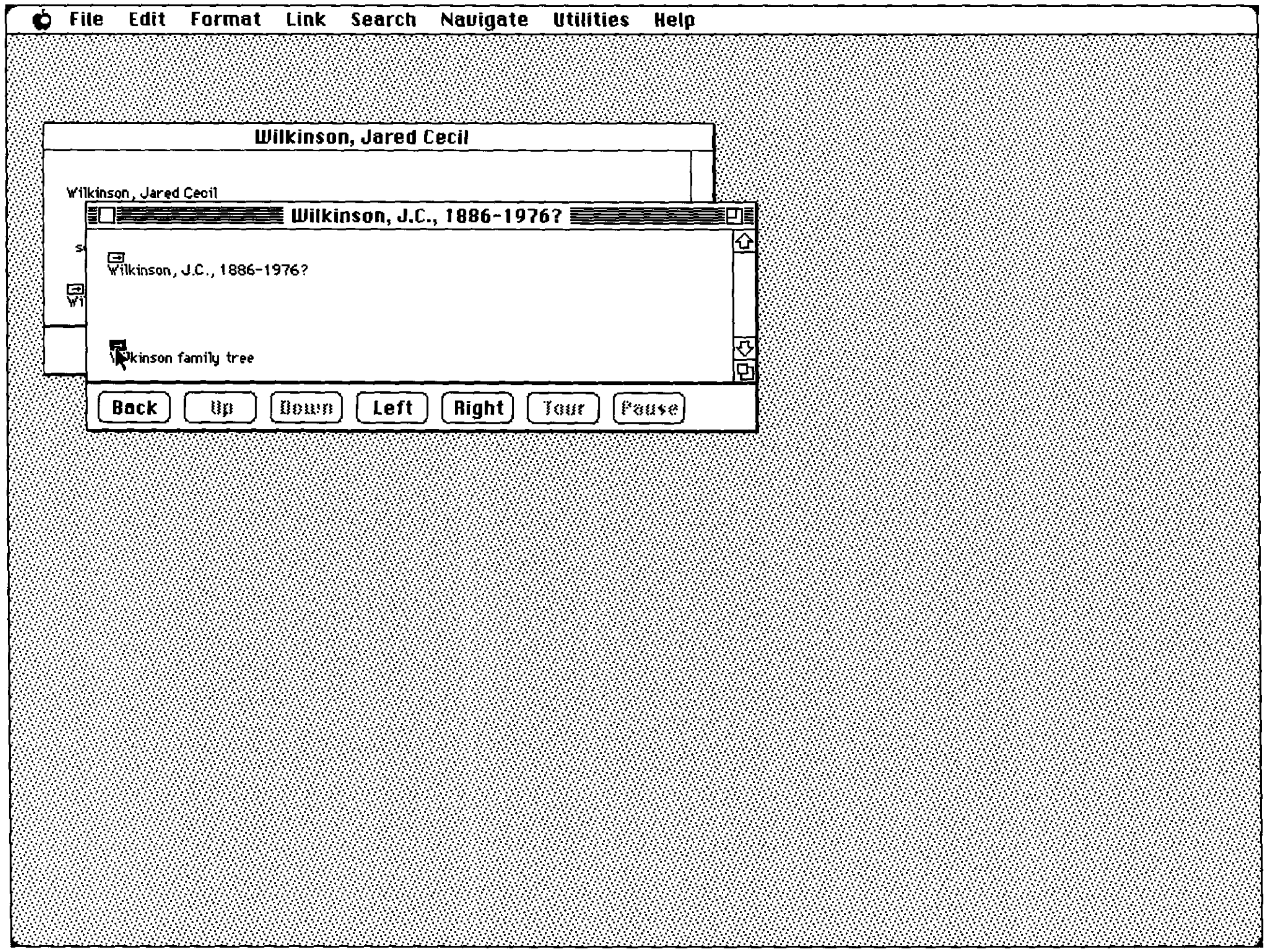

Fig. 26. The researcher activates the link to the reference node by clicking on the link marker above "Wilkinson family tree".

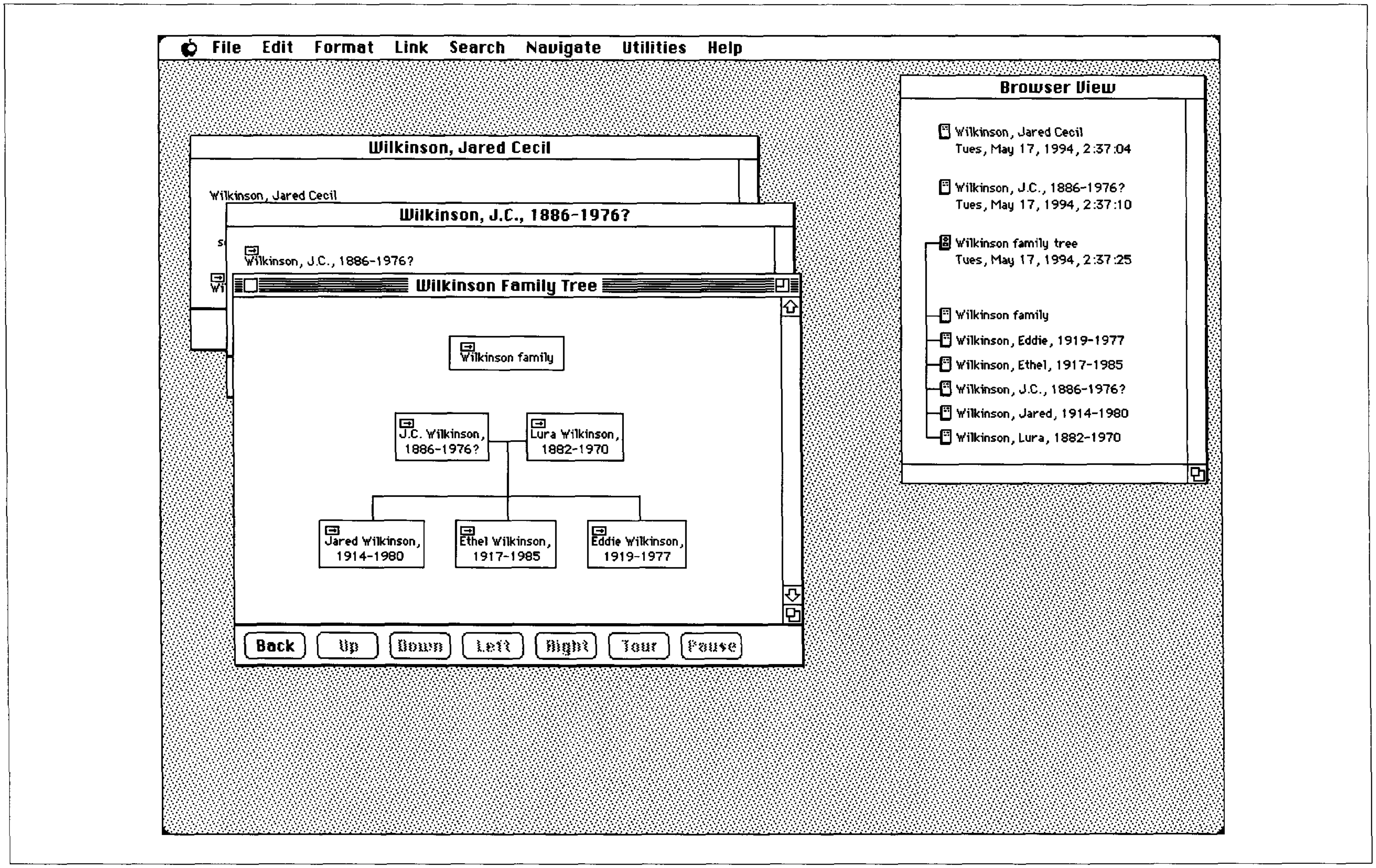

Fig. 27. The Wilkinson family tree reference node gives a graphical representation of how the members of the Wilkinson family are related. Above each of the names is a link marker that indicates a link to the authority node for each of those names. The buttons along the bottom of the window are all inactive except for "Back." The user has also activated the browser, which appears on the right hand side of the screen. It shows the researcher's path through the nodes, and indicates which nodes are attached to the current node.

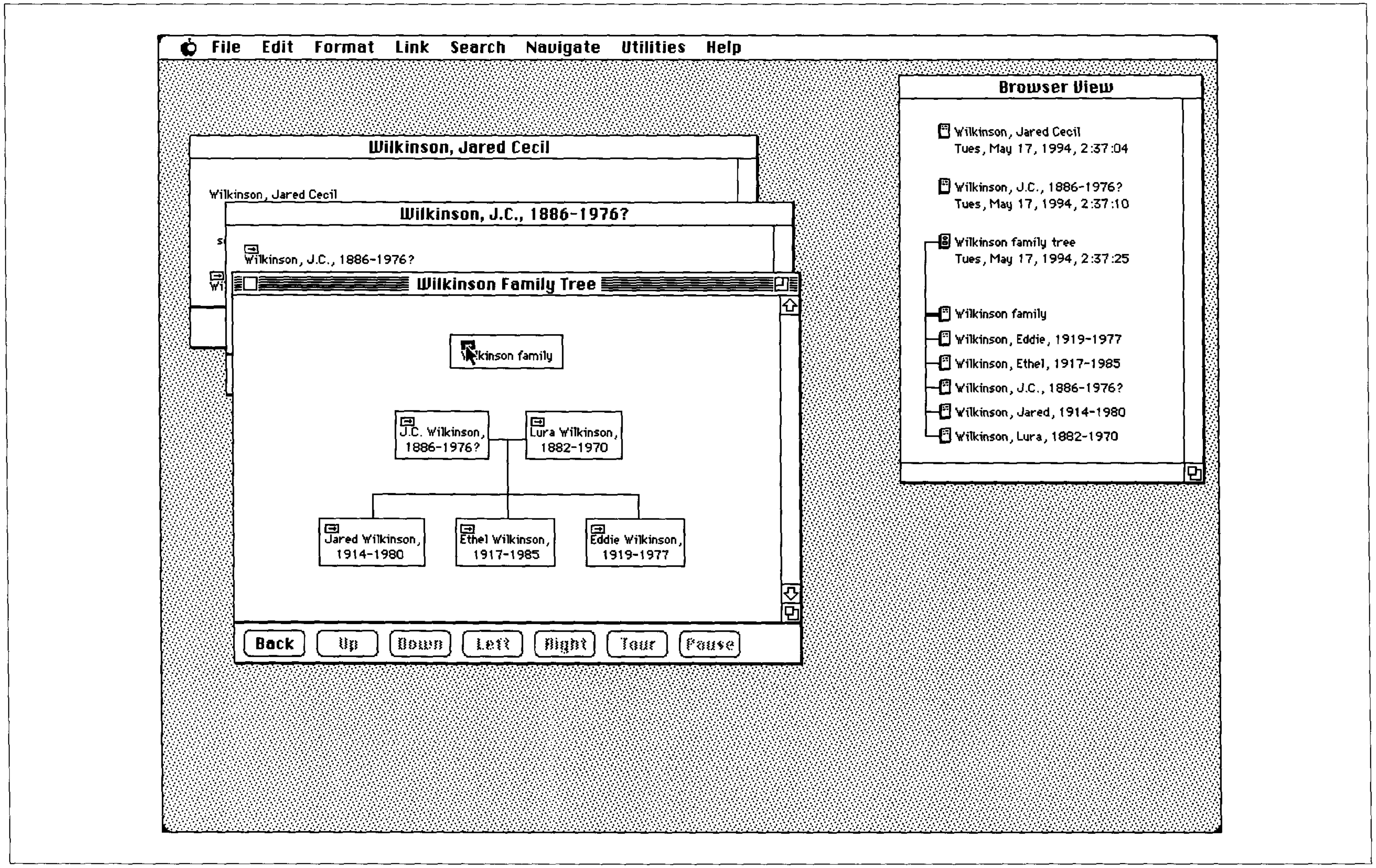

Fig. 28. The user decides to activate the link above "Wilkinson family" to view the Wilkinson family authority node. The user knows that the authority record is attached because it is indicated by the darkened line in the browser.

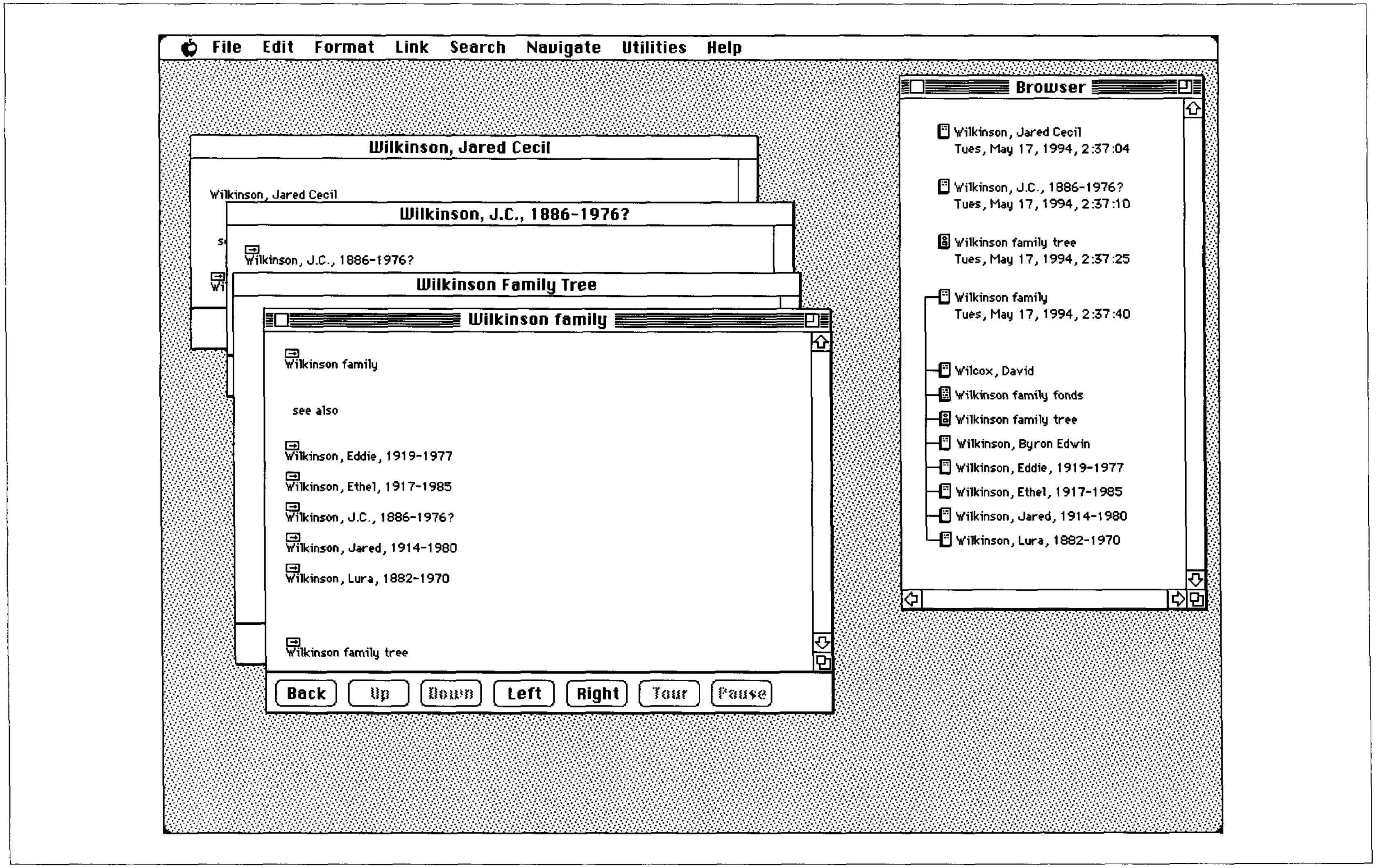

Fig. 29. The Wilkinson family authority node with "Wilkinson family" at the top of the record and *see also* references to each of the members of the Wilkinson family. There is also the "Wilkinson family tree" text at the bottom of the node with a link marker indicating a link to the "Wilkinson family tree" reference node. The browser has updated to reflect the new view: the path history has advanced one node and the links emanating from the current node are shown. Also, the "Left" and "Right" buttons at the bottom of the window are active.

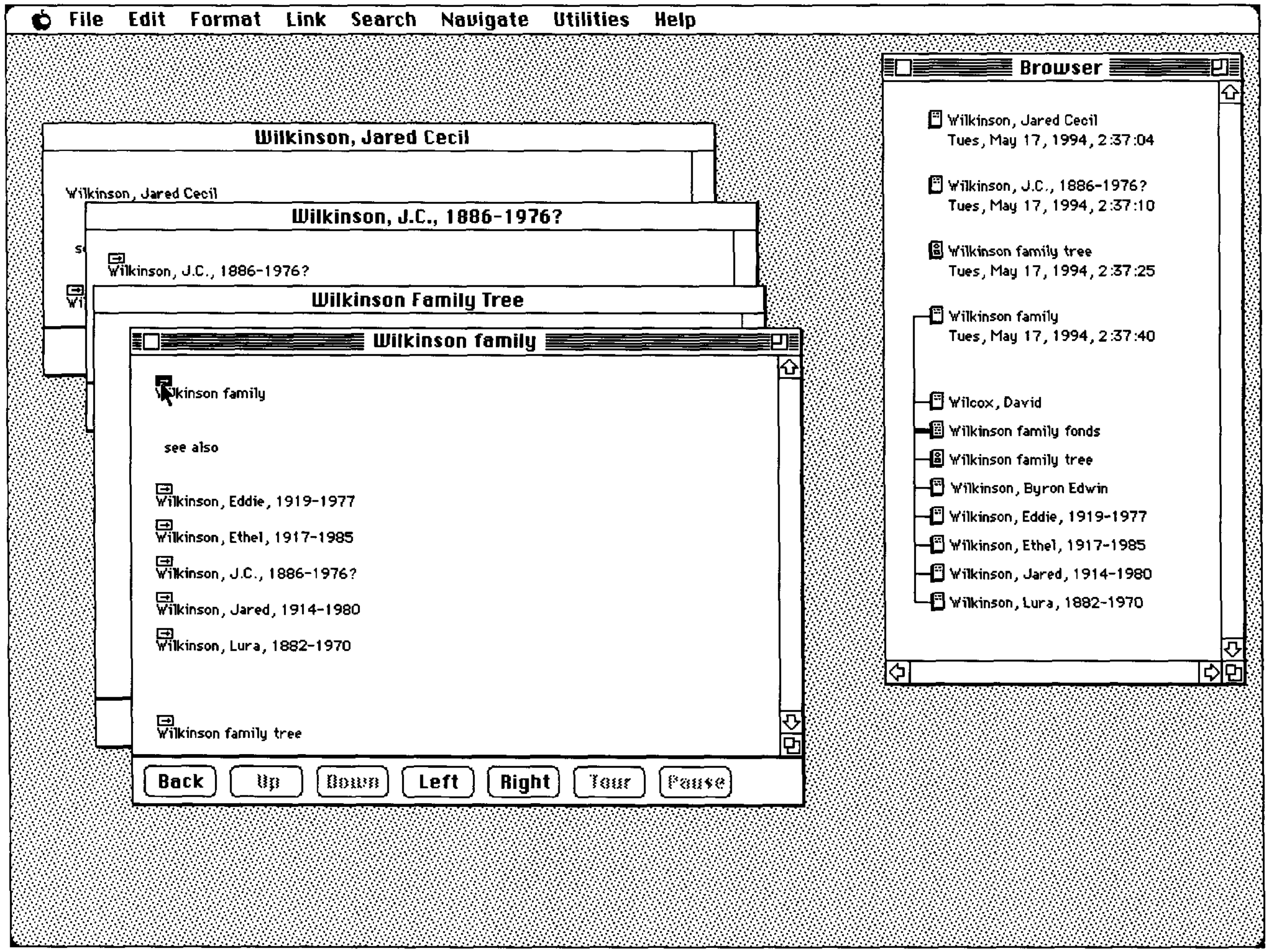

Fig. 30. The user activates the link attached to "Wilkinson family" by clicking the link marker. From the browser, the user knows that the link leads to the Wilkinson family fonds node.

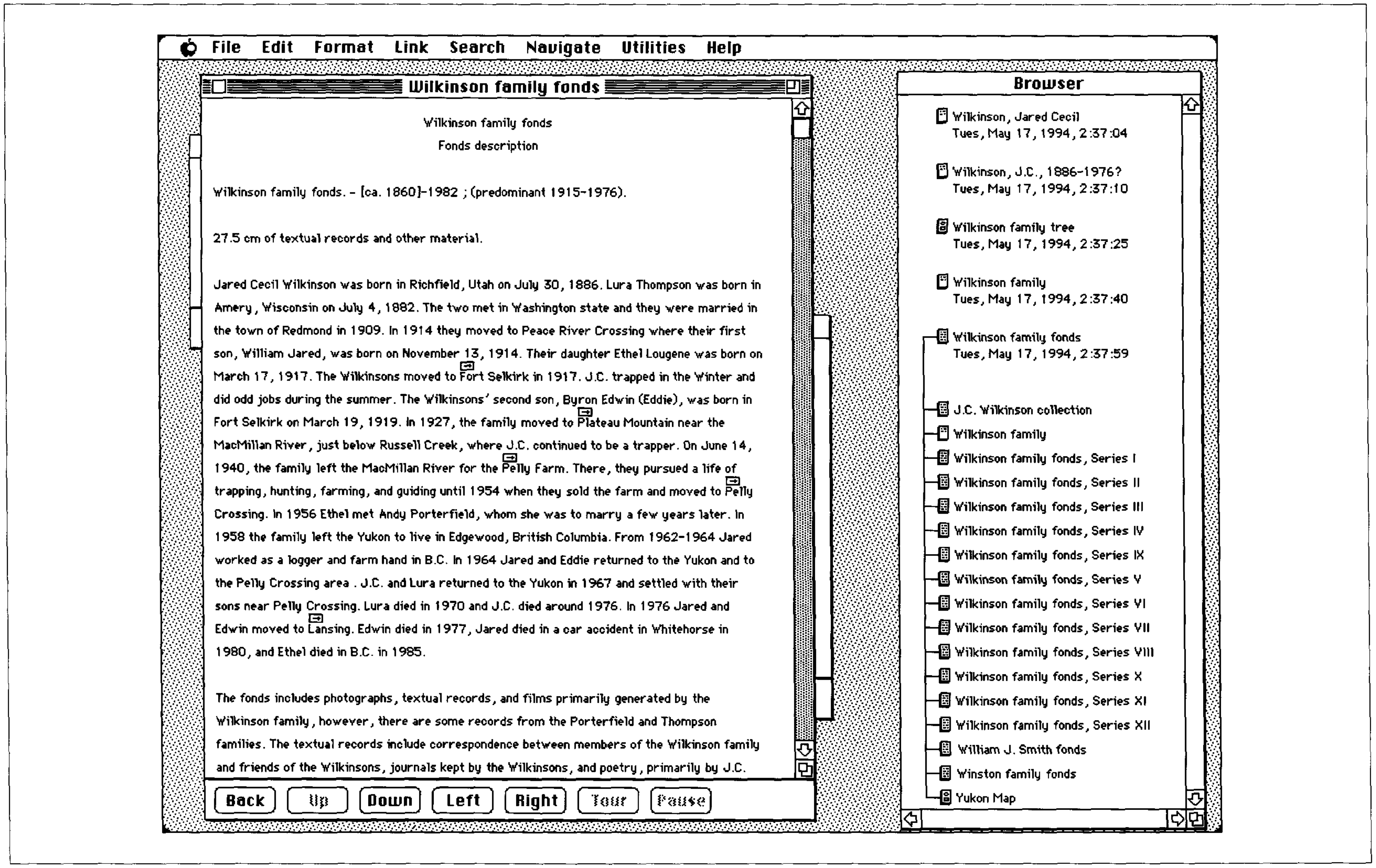

Fig. 31. The Wilkinson family fonds node. The information in the node extends beyond the limit of the screen, but the user can scroll down the window to view that information. The "Down" button on the bottom of the window is active—clicking "Down" would take the user to the first node on the next hierarchically subordinate level. The browser has updated the path history and the links from the current node are also shown.

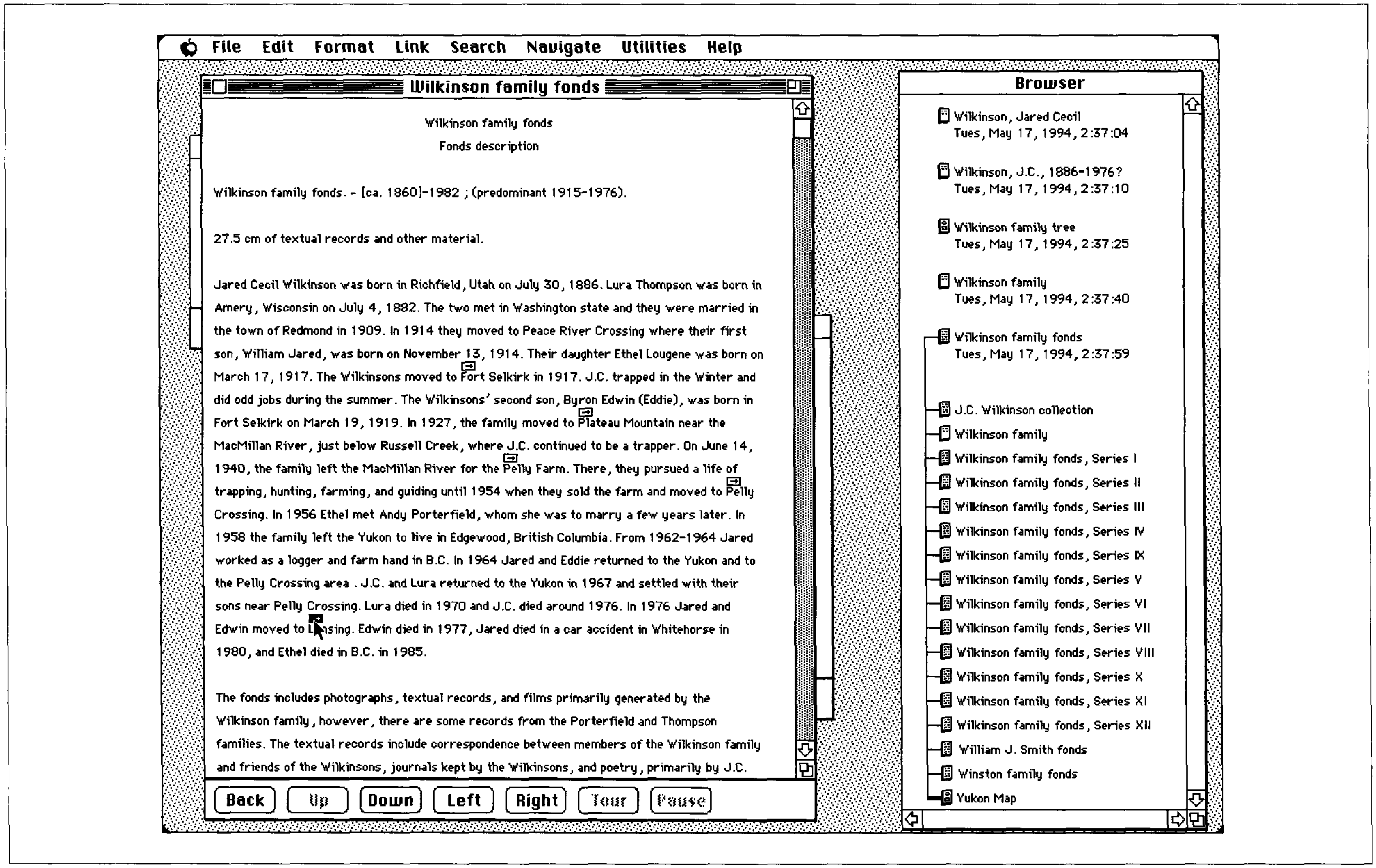

Fig. 32. The user decides to activate the link attached to "Lansing". From the browser, the researcher knows that the Yukon Map reference node is attached.

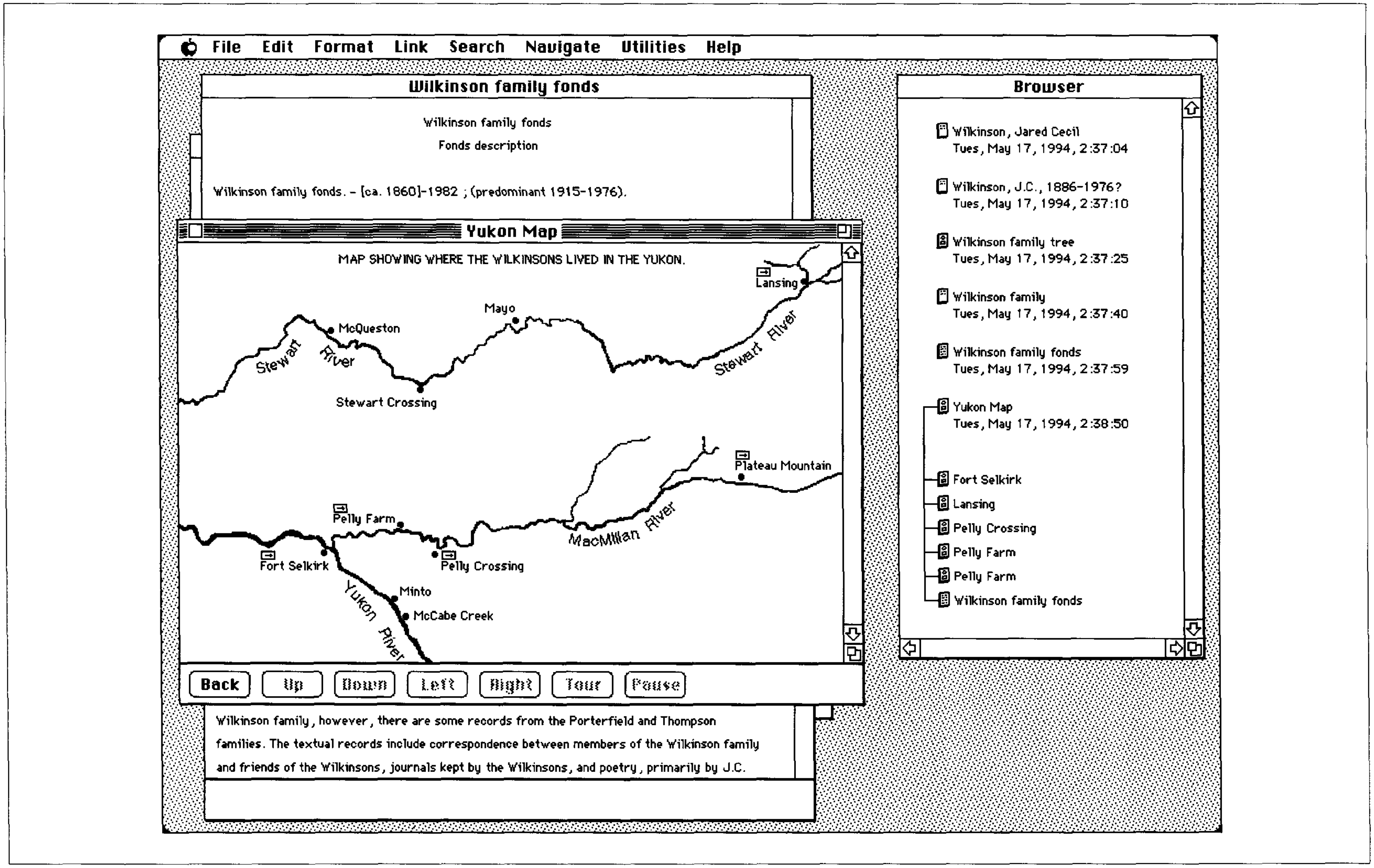

Fig. 33. The Yukon Map reference node provides a graphical representation of the locations where the Wilkinsons lived in the Yukon. There are link markers above the names of the places where the Wilkinsons lived. Activating the link in any of the names would reveal a reference node that that gave a brief description of the location. The only function available through the buttons on the bottom of the window is "Back." Again, the browser has updated to reflect the current position in the hypertext.

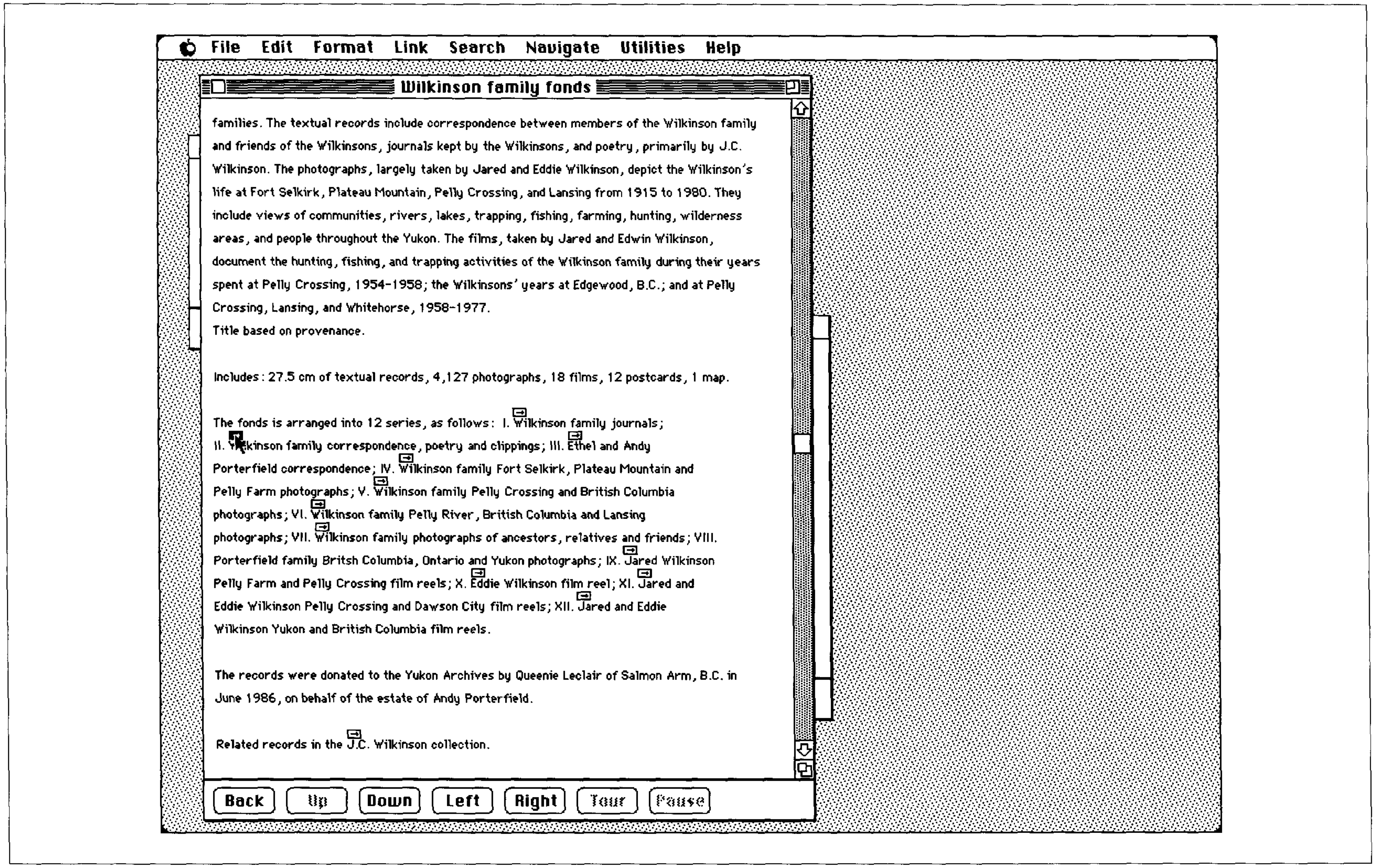

Fig. 34. The researcher has closed the browser window and the Yukon Map annotation node. The Wilkinson family fonds node is the active window again. The researcher has scrolled down to reveal the arrangement note. In the arrangement note, the series titles are given, and above each title is a link marker indicating a link to the respective series description node. The user clicks on Series II to reveal the description.

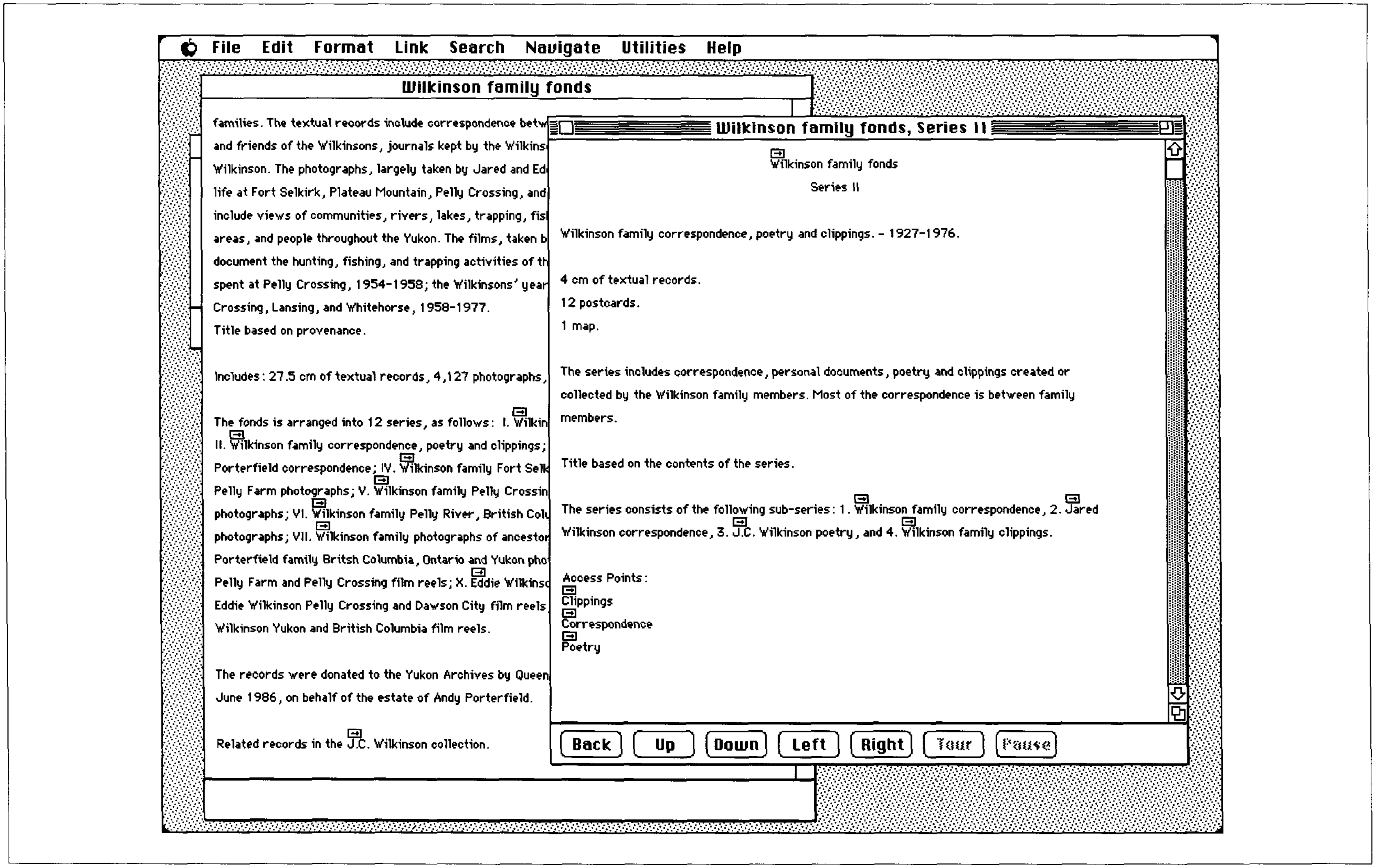

Fig. 35. The Wilkinson family fonds, Series II description node is active. From this node there are links to sub-series descriptions, as indicated in the arrangement note, and there are also links to form authority record nodes. Also, there is a link marker above "Wilkinson family fonds" at the top of the description indicating a link to the fonds description. All the buttons on the bottom of the window are active except for "Tour" and "Pause." "Up" would take the user to the fonds description node, "Down" would go the first description node on the next hierarchically lower level, and "Left" and "Right" would take the user across the hierarchy.

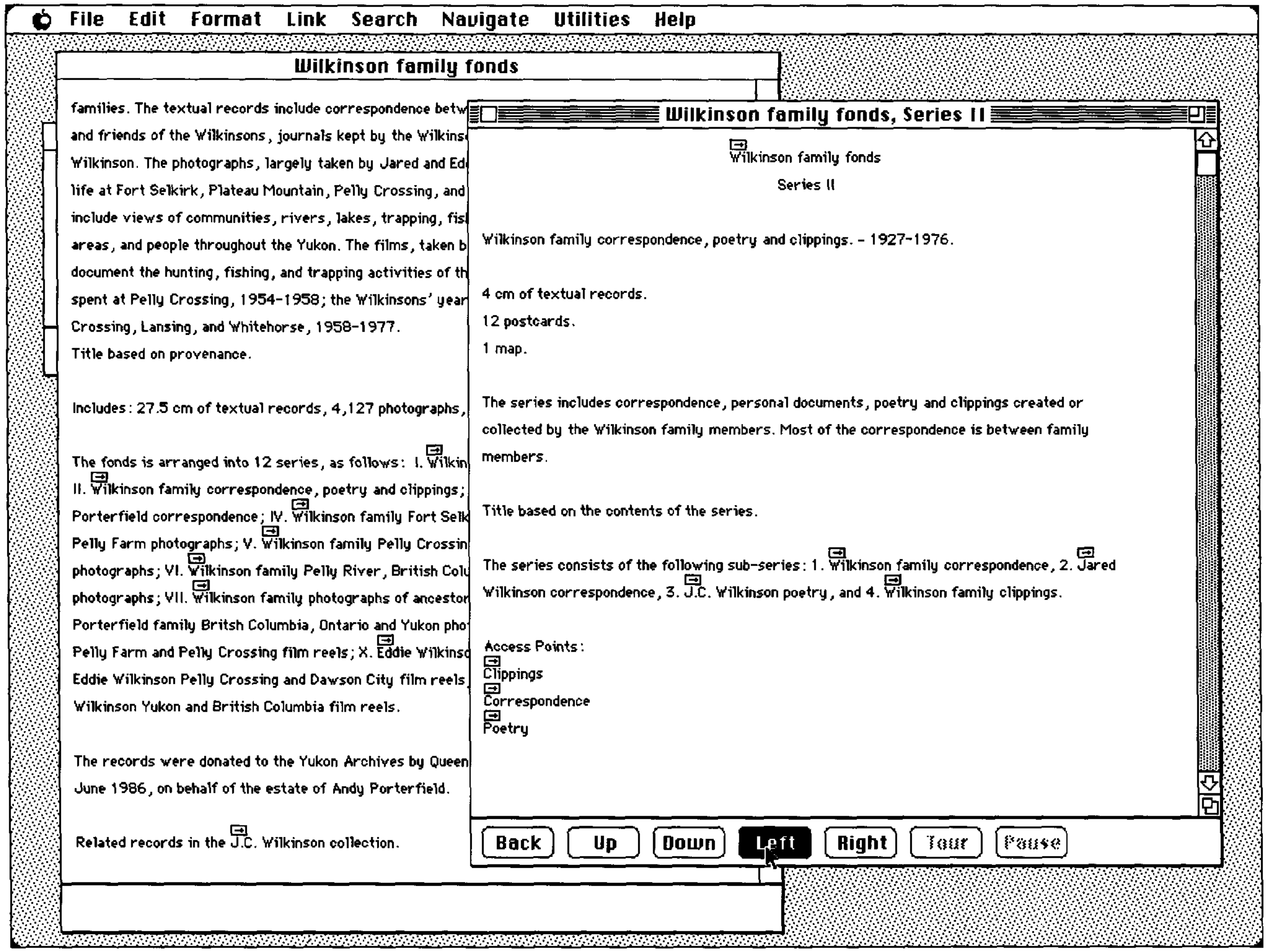

Fig. 36. The user decides to move across the hierarchy by clicking the "Left" button. This would take the researcher to the Series I description node.

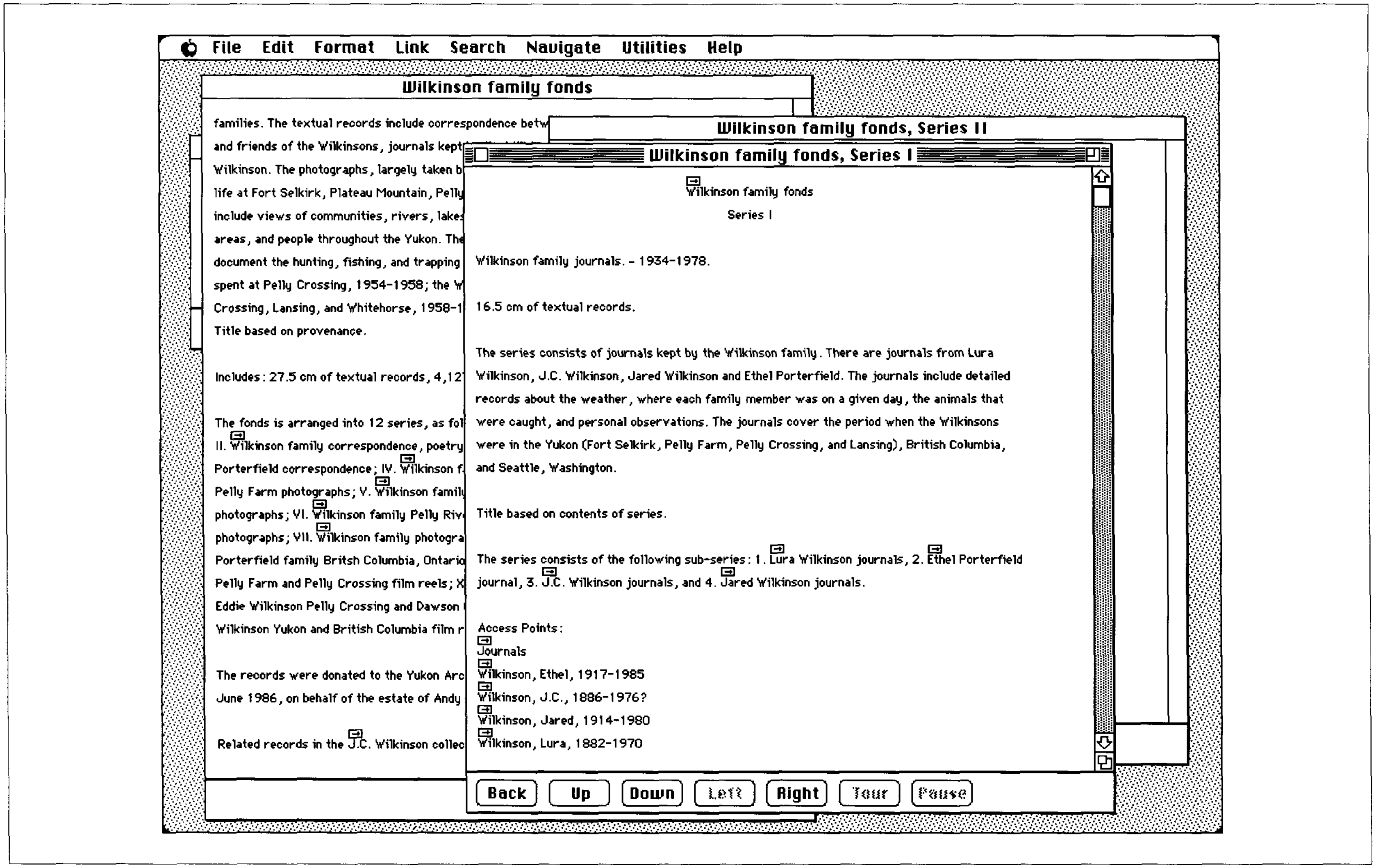

Fig. 37. The user is at the Wilkinson family fonds, Series I node. The "Left" button at the bottom of the screen is shaded to indicate that movement across the hierarchy in that direction is no longer possible.

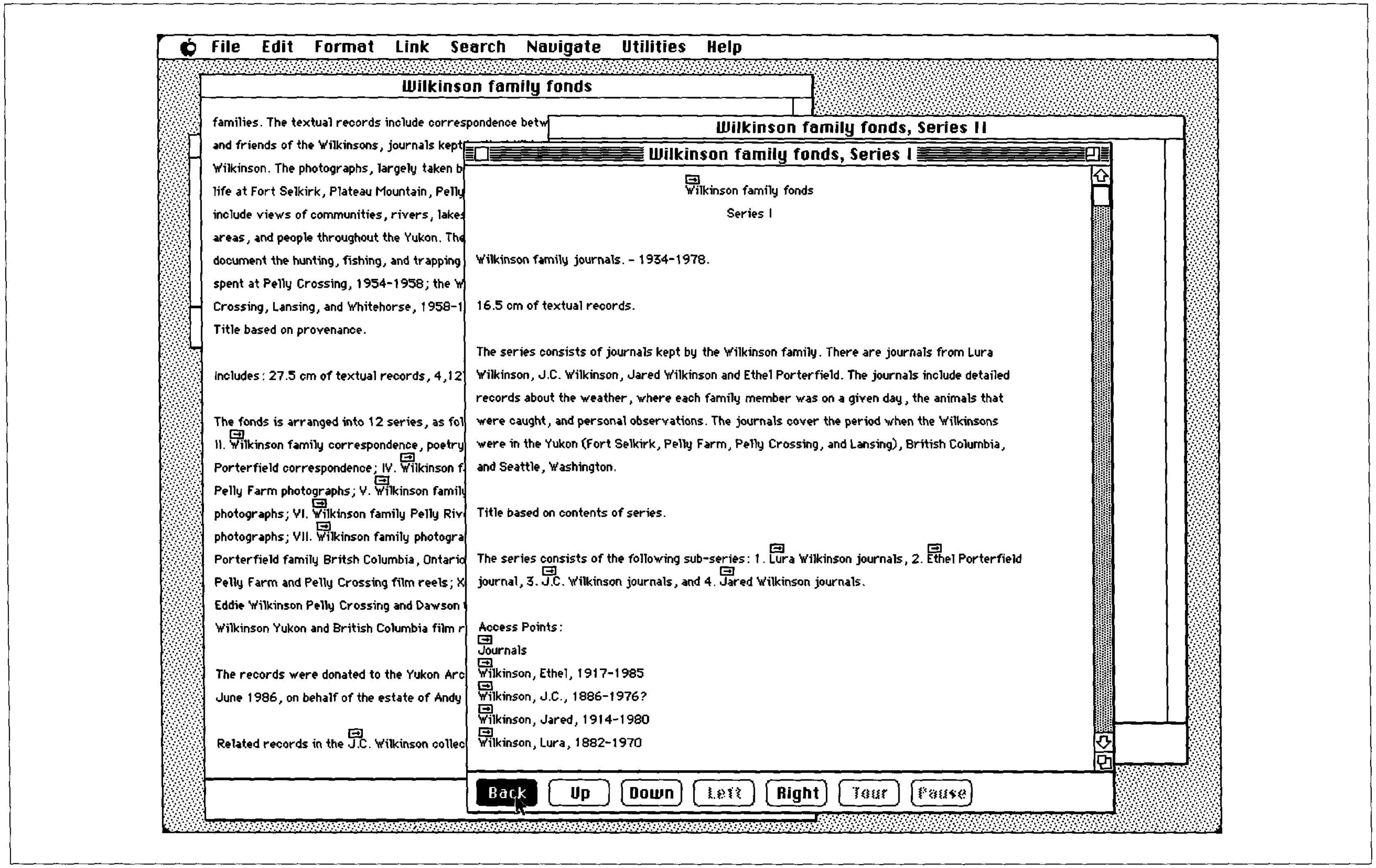

Fig. 38. The user clicks the "Back" button to return to the Series II node.

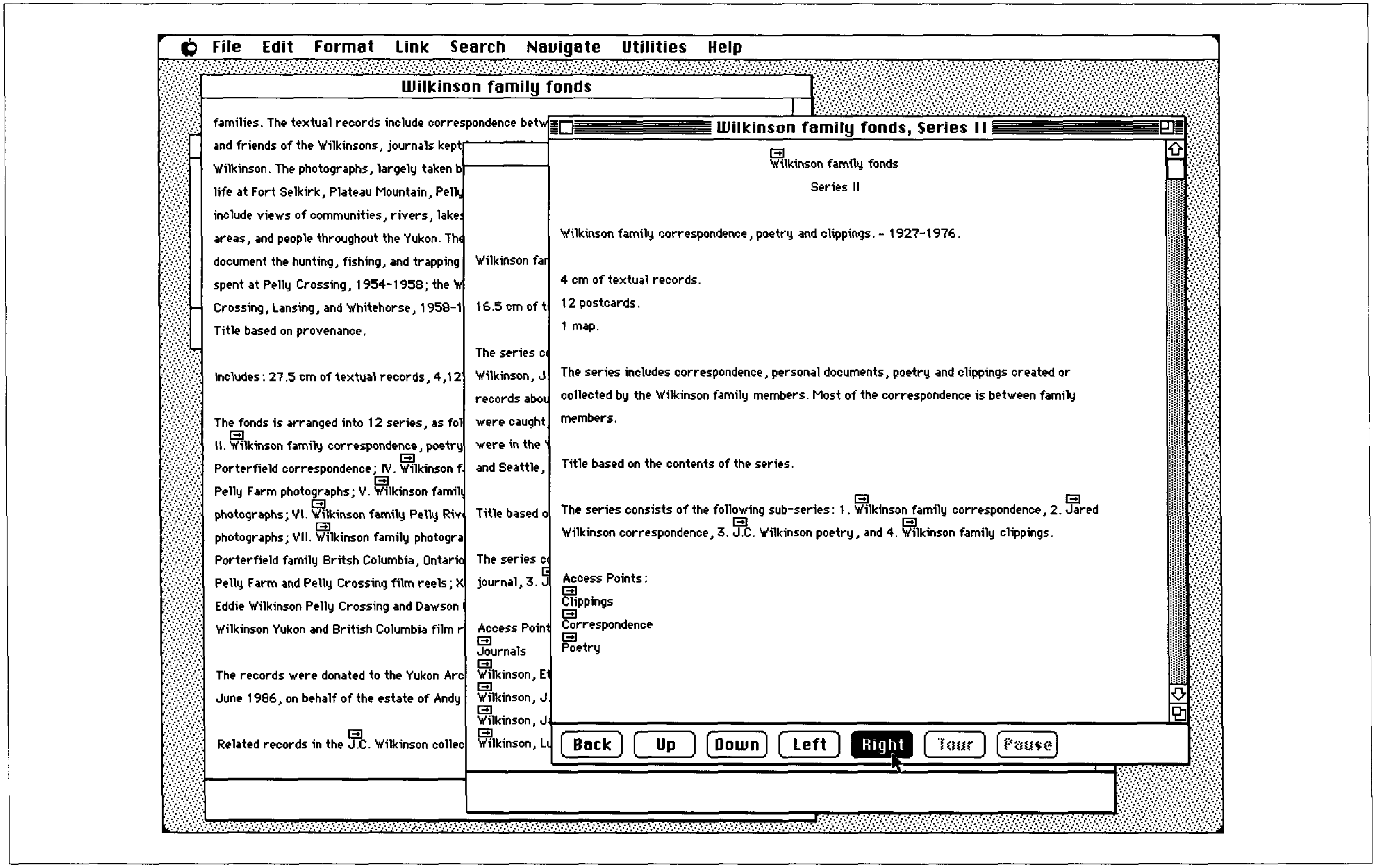

Fig. 39. From the Series II node, the user continues to move across the hierarchy by clicking the “Right” button. This takes the researcher to the next linked series, Series III.

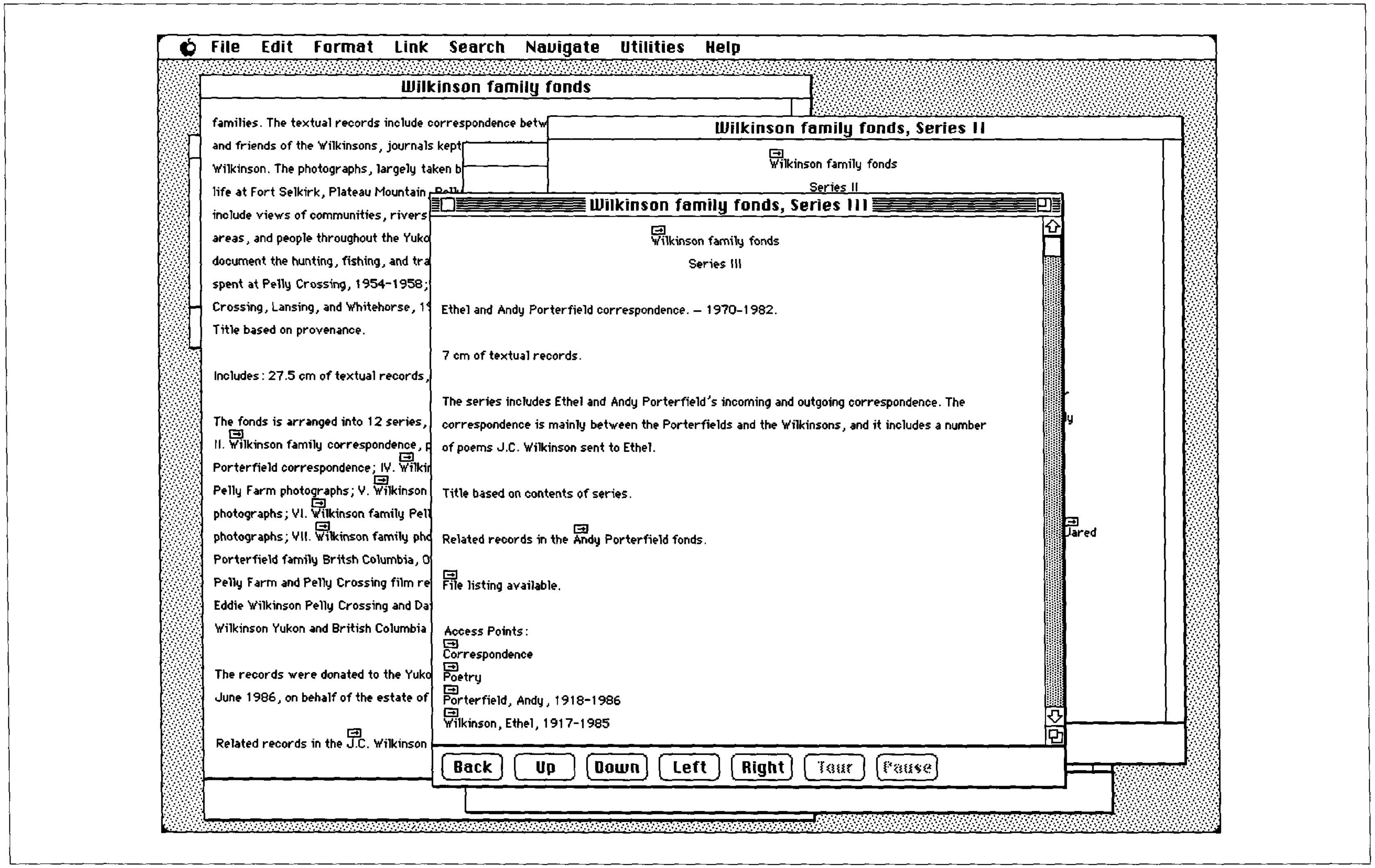

Fig. 40. The user is at the Wilkinson family fonds, Series III node. Related records are linked to the series description, as indicated by the link marker above the text in the related material note. There is also a link to a file list that identifies the records in the series.

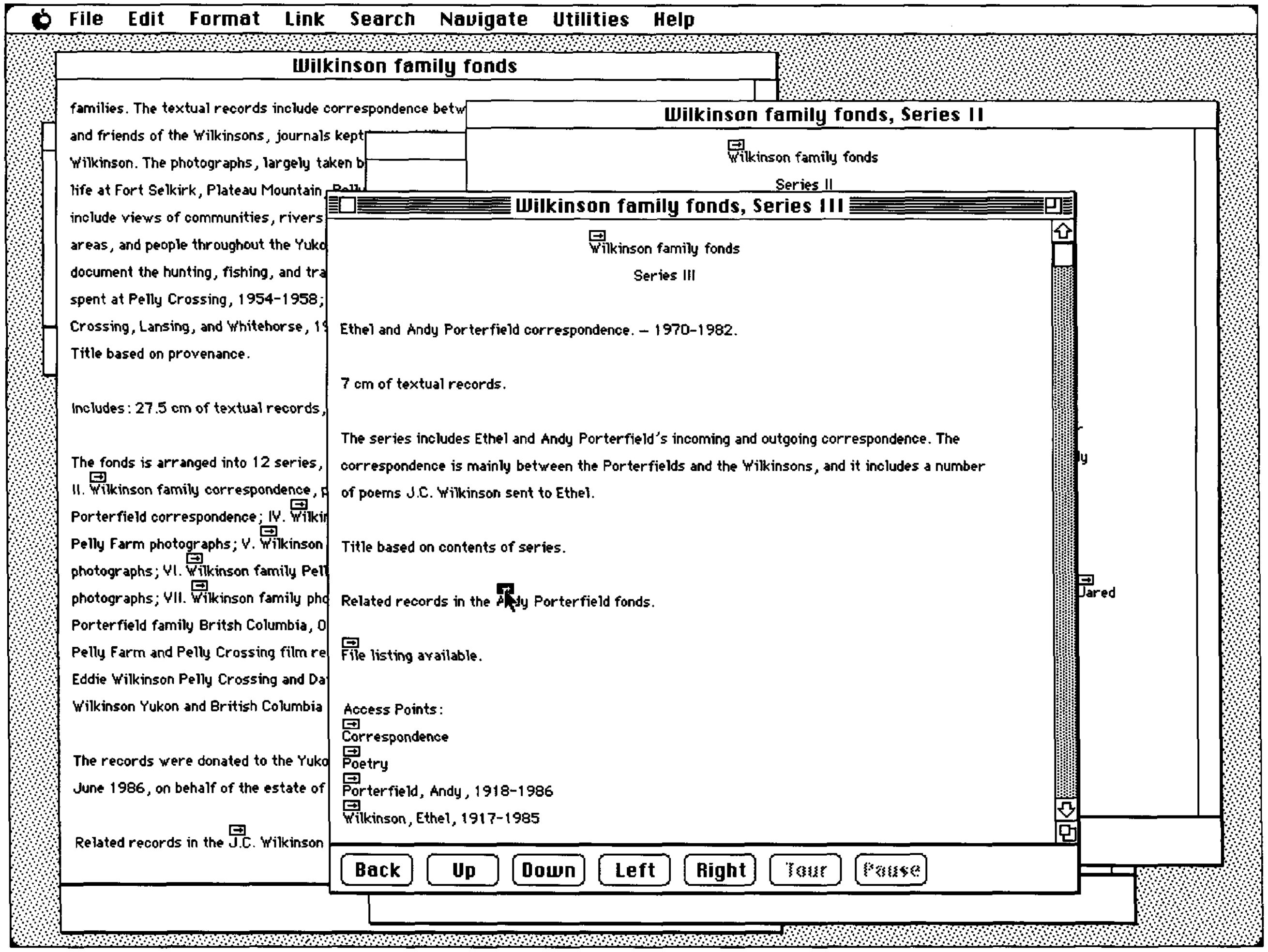

Fig. 41. The researcher decides to follow the link in the related material note by clicking on the link marker.

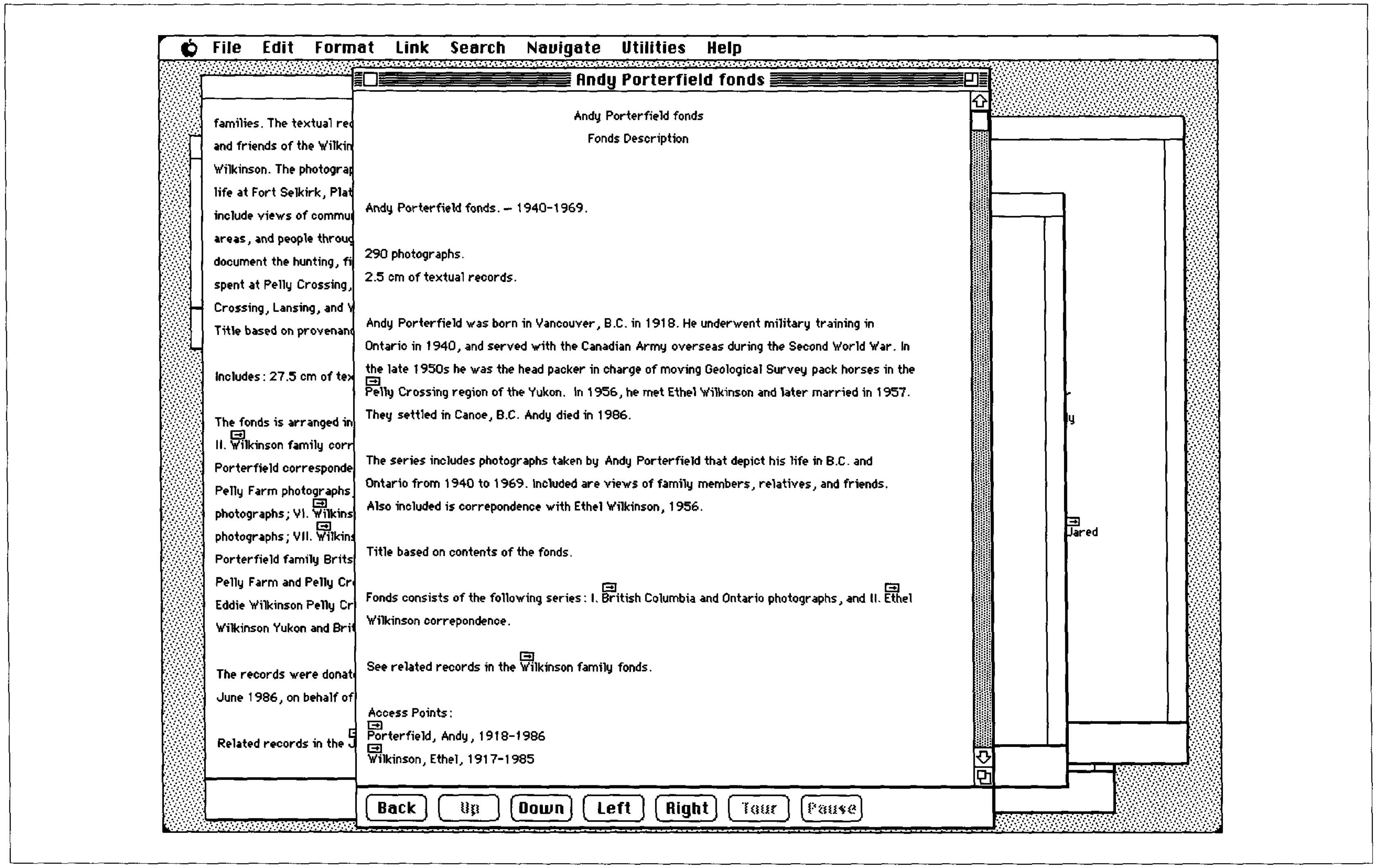

Fig. 42. The Andy Porterfield fonds node. There are a number of links from the node to other record, authority and reference nodes.

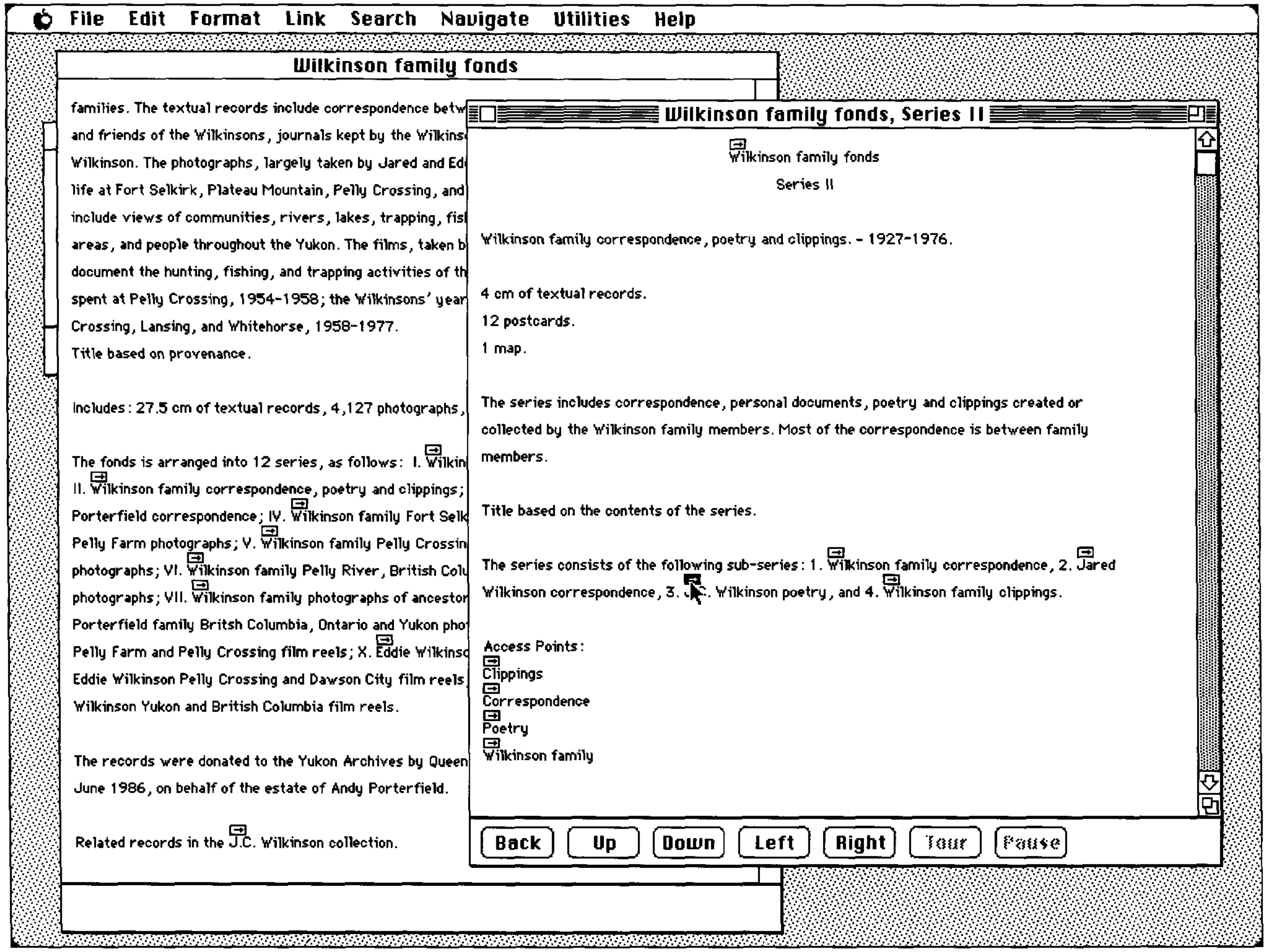

Fig. 43. The user has closed the Andy Porterfield fonds and Wilkinson family fonds, Series III nodes, which makes the Wilkinson family fonds, Series II node active again. The researcher decides to view the records in Sub-series 3 by clicking on the link marker above the text.

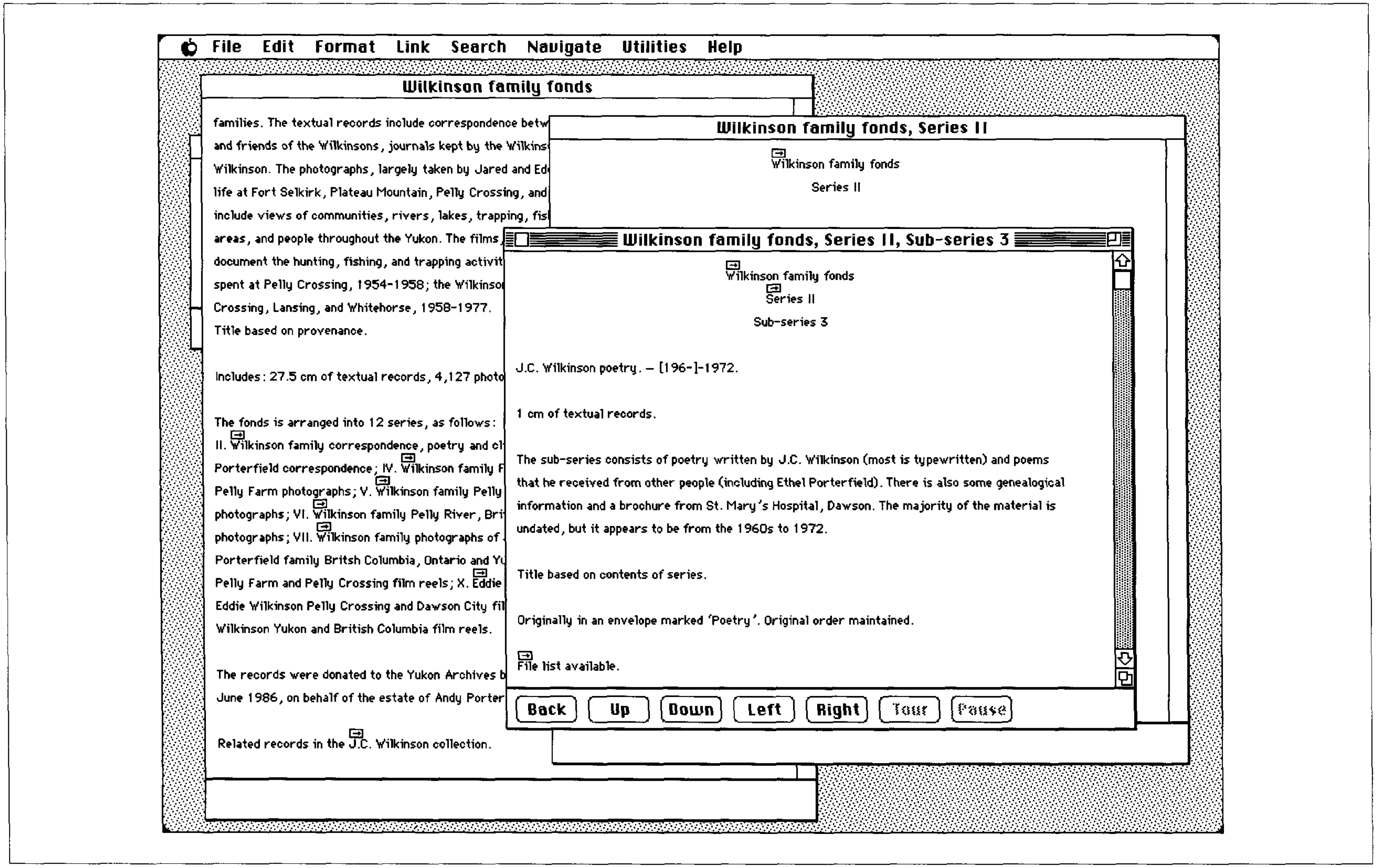

Fig. 44. The researcher has moved down one level in the hierarchy and is at the Wilkinson family fonds, Series II, Sub-series 3 node. The user can return to the fonds or series description by activating the links in "Wilkinson family fonds" and "Series II" at the top of the window.

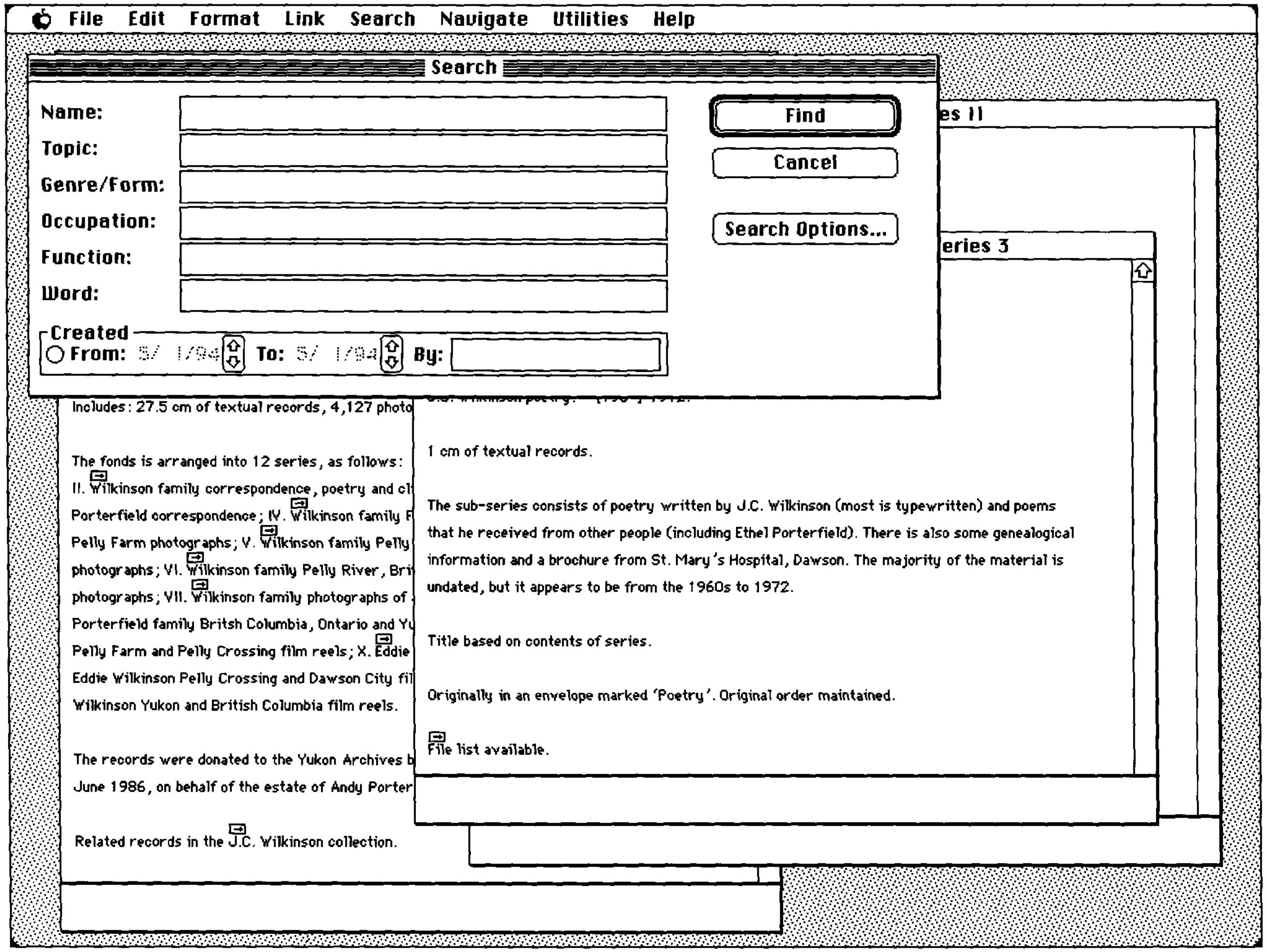

Fig. 45. From the Wilkinson family fonds, Series II, Sub-series 3 node, the user decides to conduct a semantic search. The researcher activates the search dialog box.

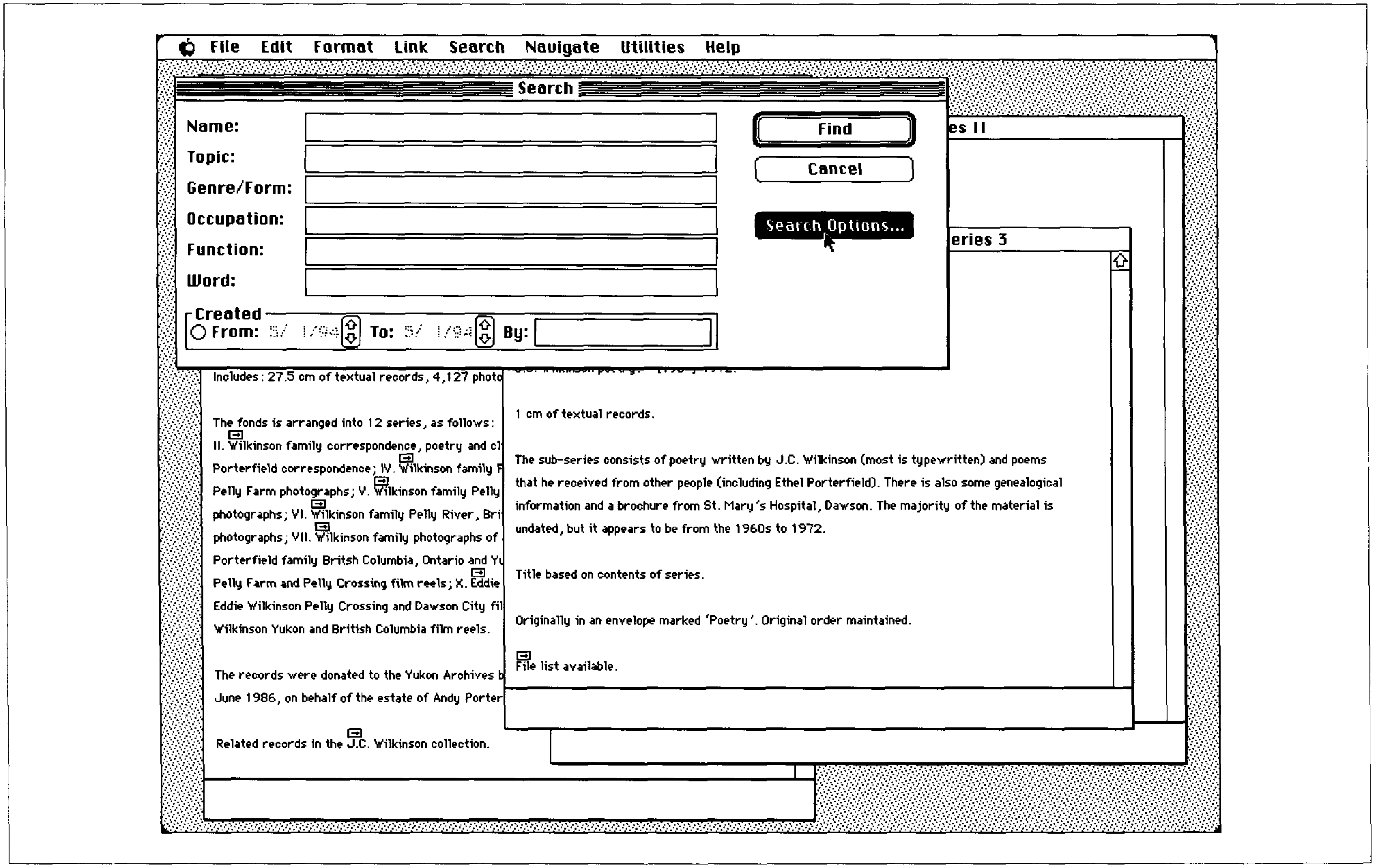

Fig. 46. The researcher clicks the "Search Options" button.

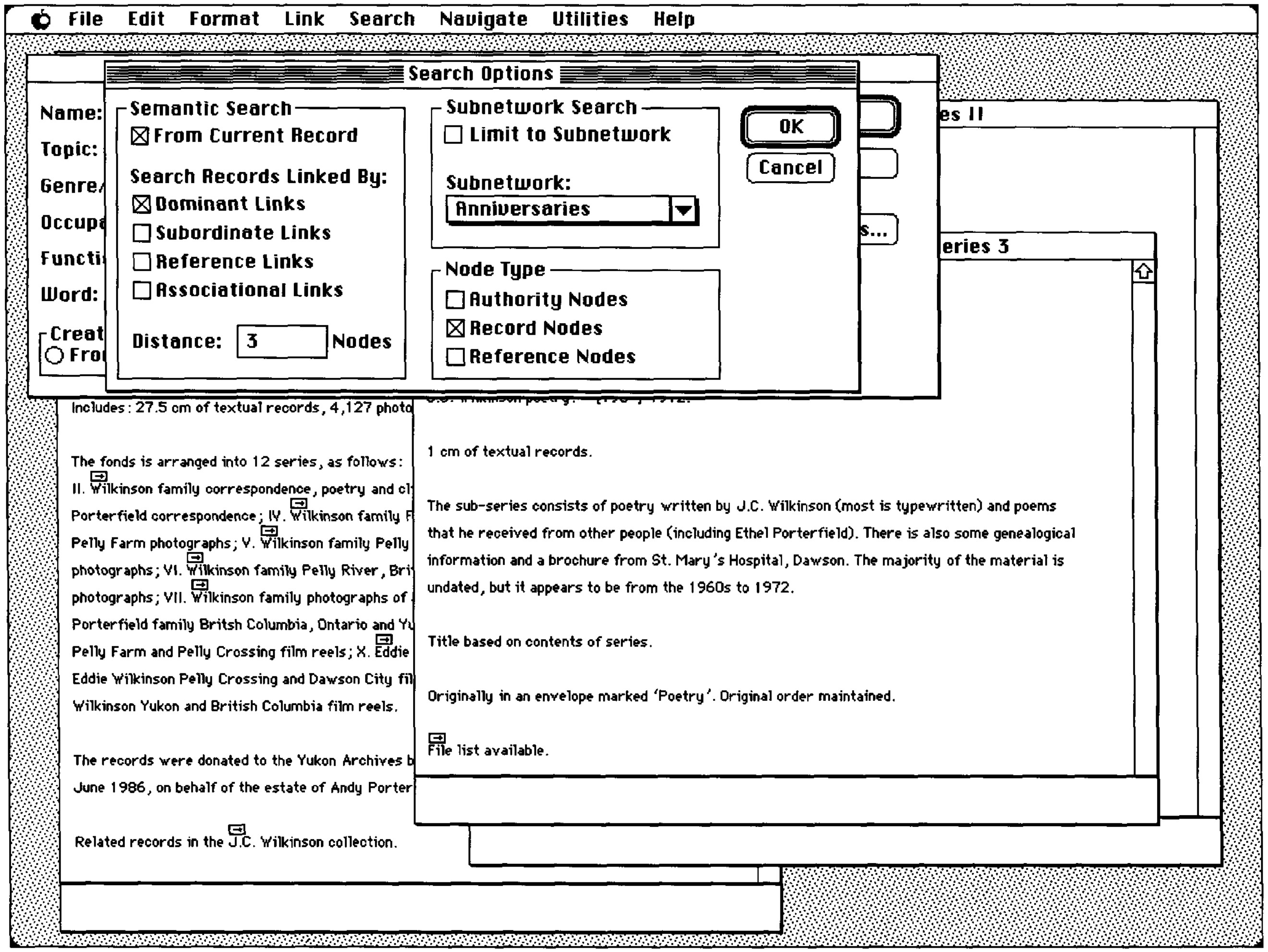

Fig. 47. In the Search Options dialog box, the user clicks the box indicating that the search is from the current node, and that it is for record nodes linked by dominant hierarchical links three nodes or less from the search node.

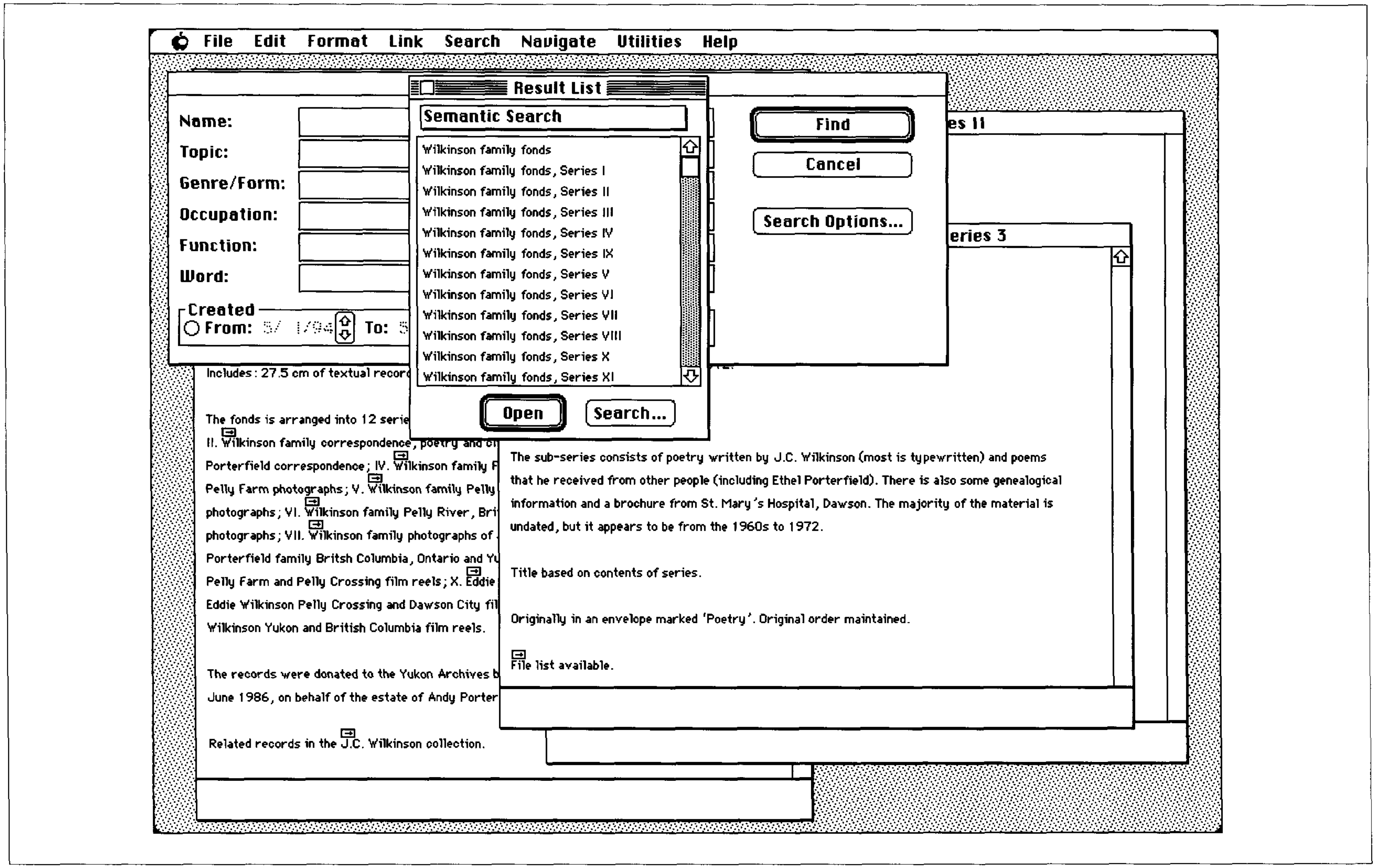

Fig. 48. After selecting the search options and clicking the "Find" button in the Search dialog box, the result list showing the matching nodes appears. The result list shows all the nodes that match the search criteria.

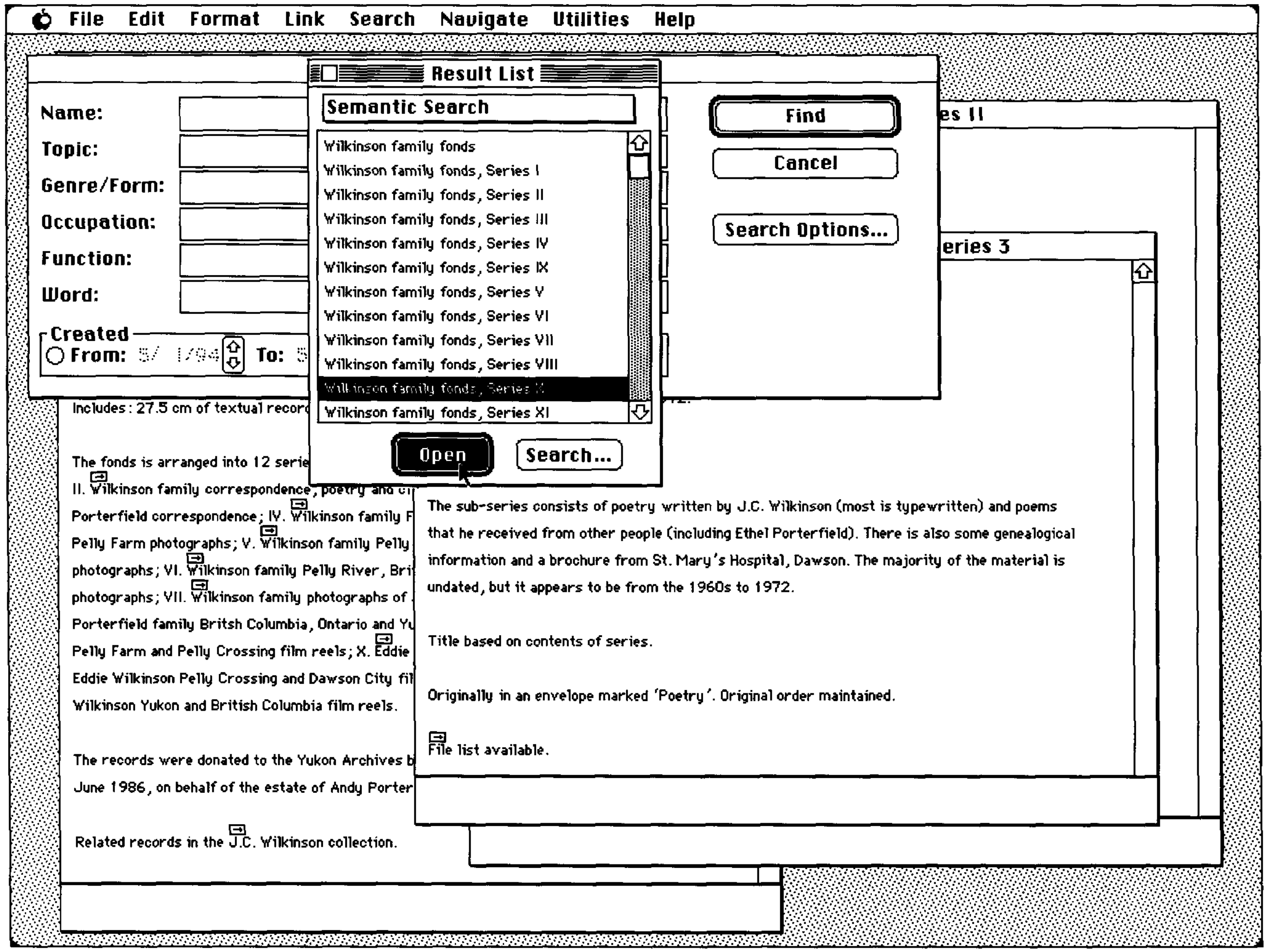

Fig. 49. The user selects "Wilkinson family fonds, Series X" and clicks the "Open" button to open the node.

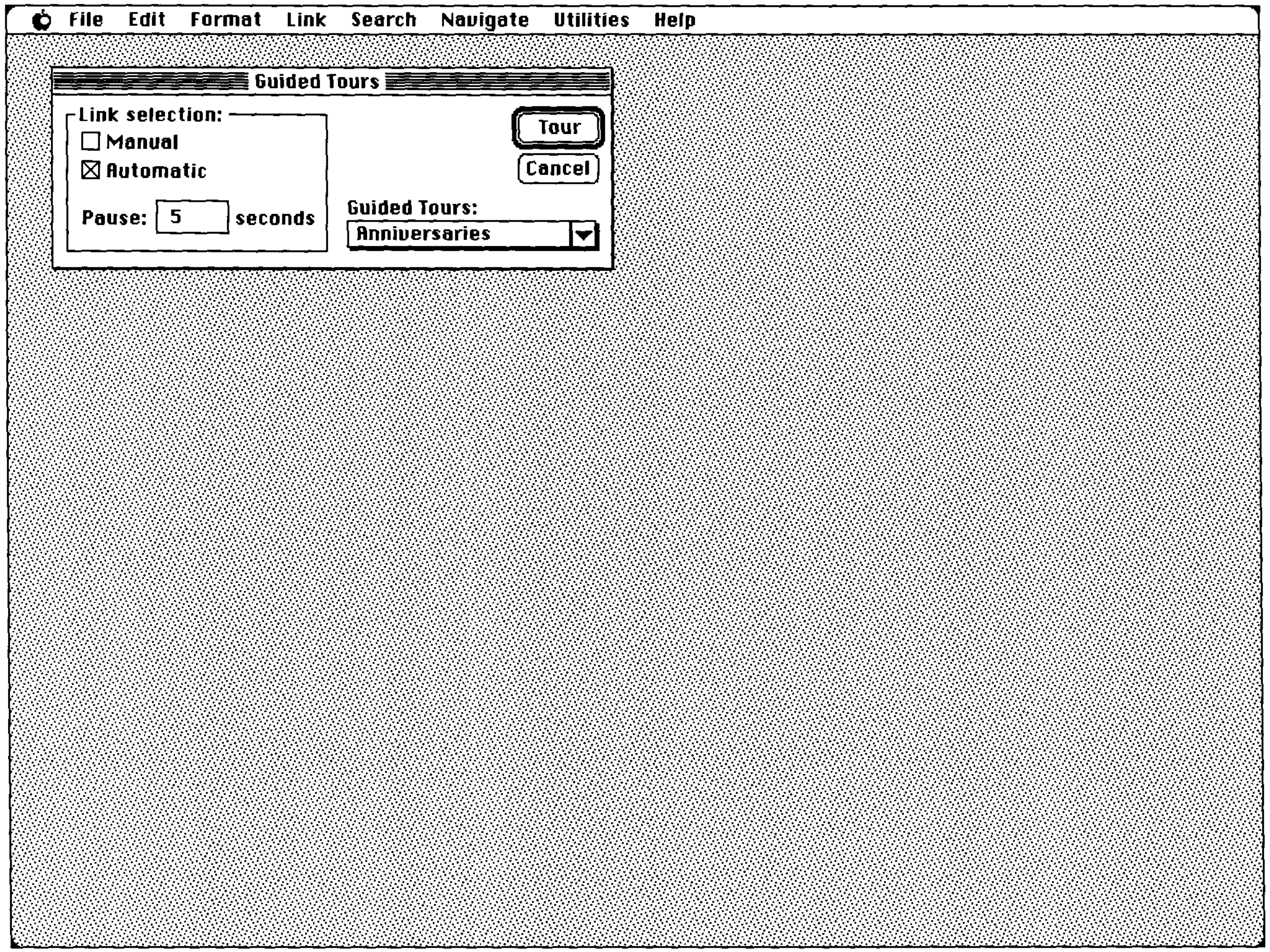

Fig. 50. After selecting Guided Tours from the Search menu, the Guided Tours dialog box appears. The user has clicked automatic link selection and the rate of advancement between nodes as five seconds.

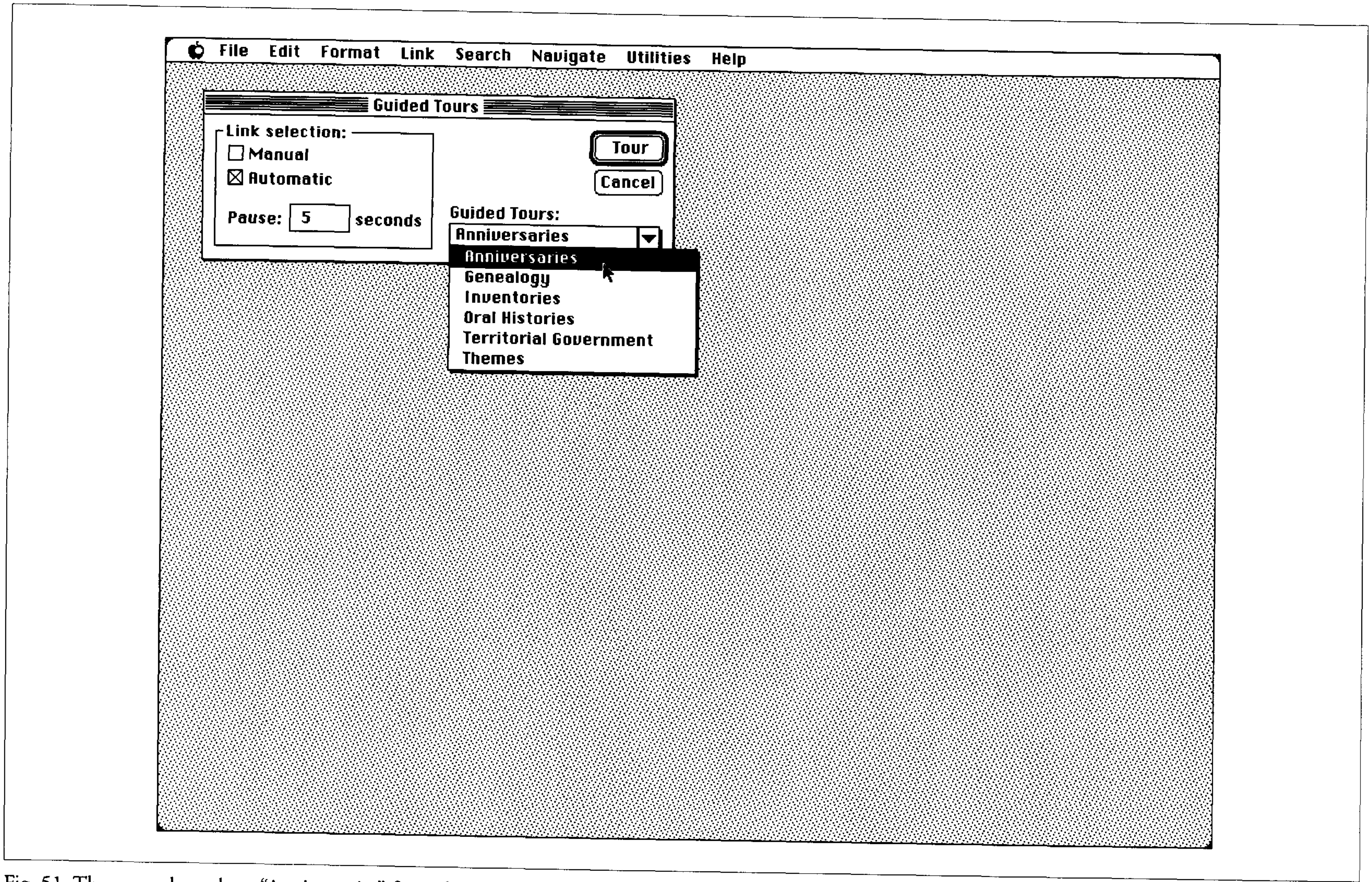

Fig. 51. The researcher selects "Anniversaries" from the pull-down list of categories of available.

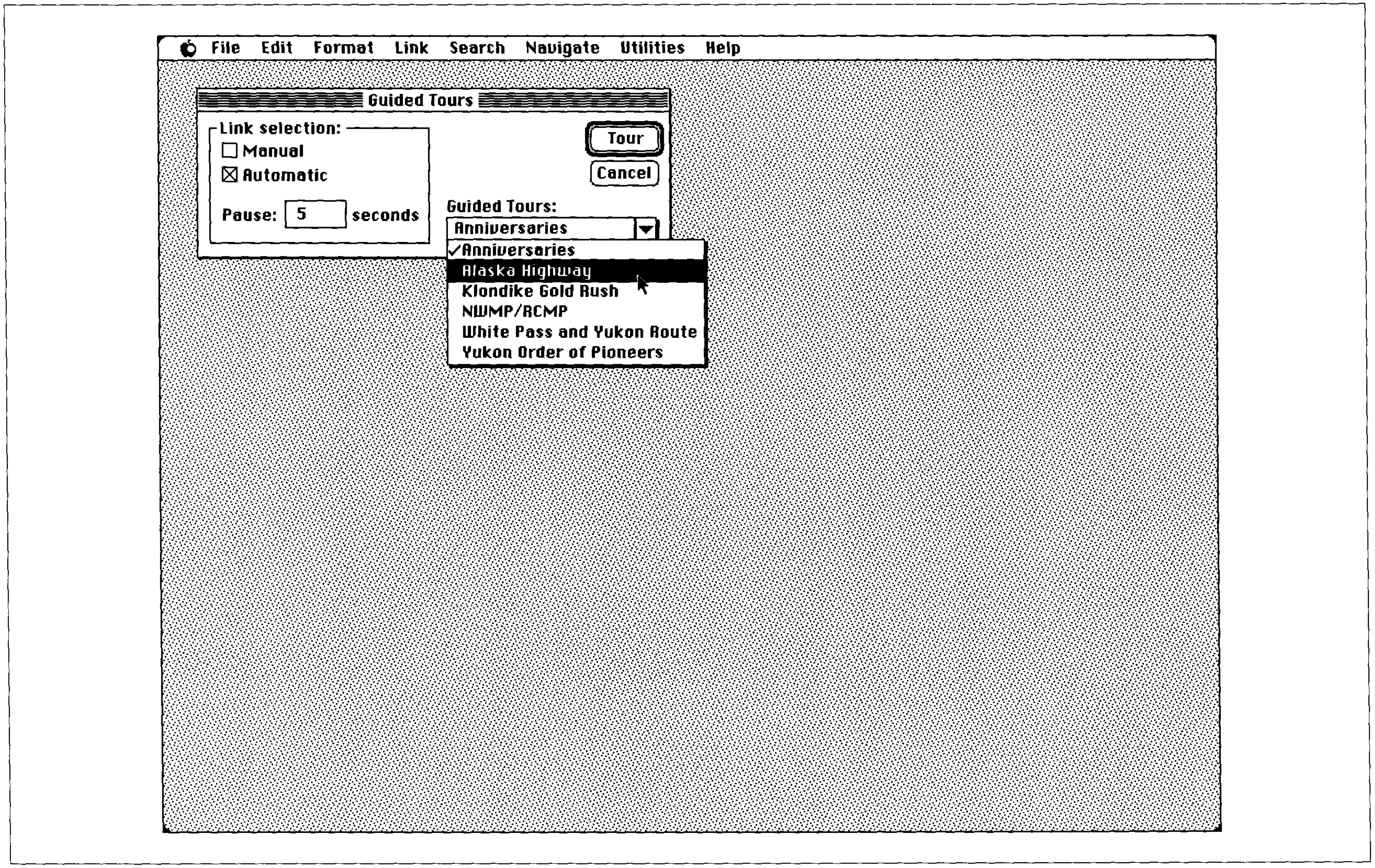

Fig. 52. The researcher selects "Alaska Highway" from the tours available under the category of Anniversaries.

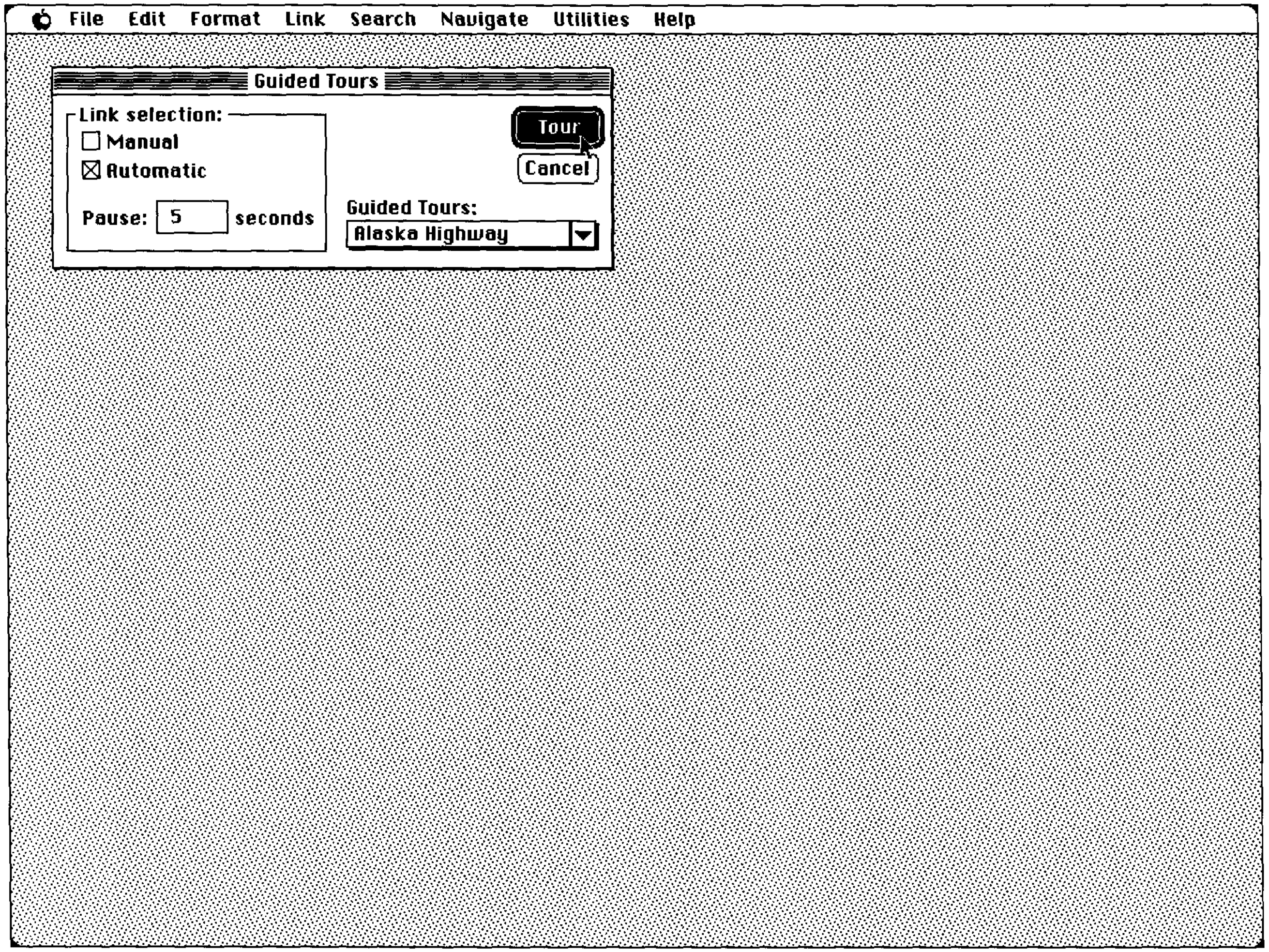

Fig. 53. With the tour selected, the researcher intiates the tour by clicking the "Tour" button.

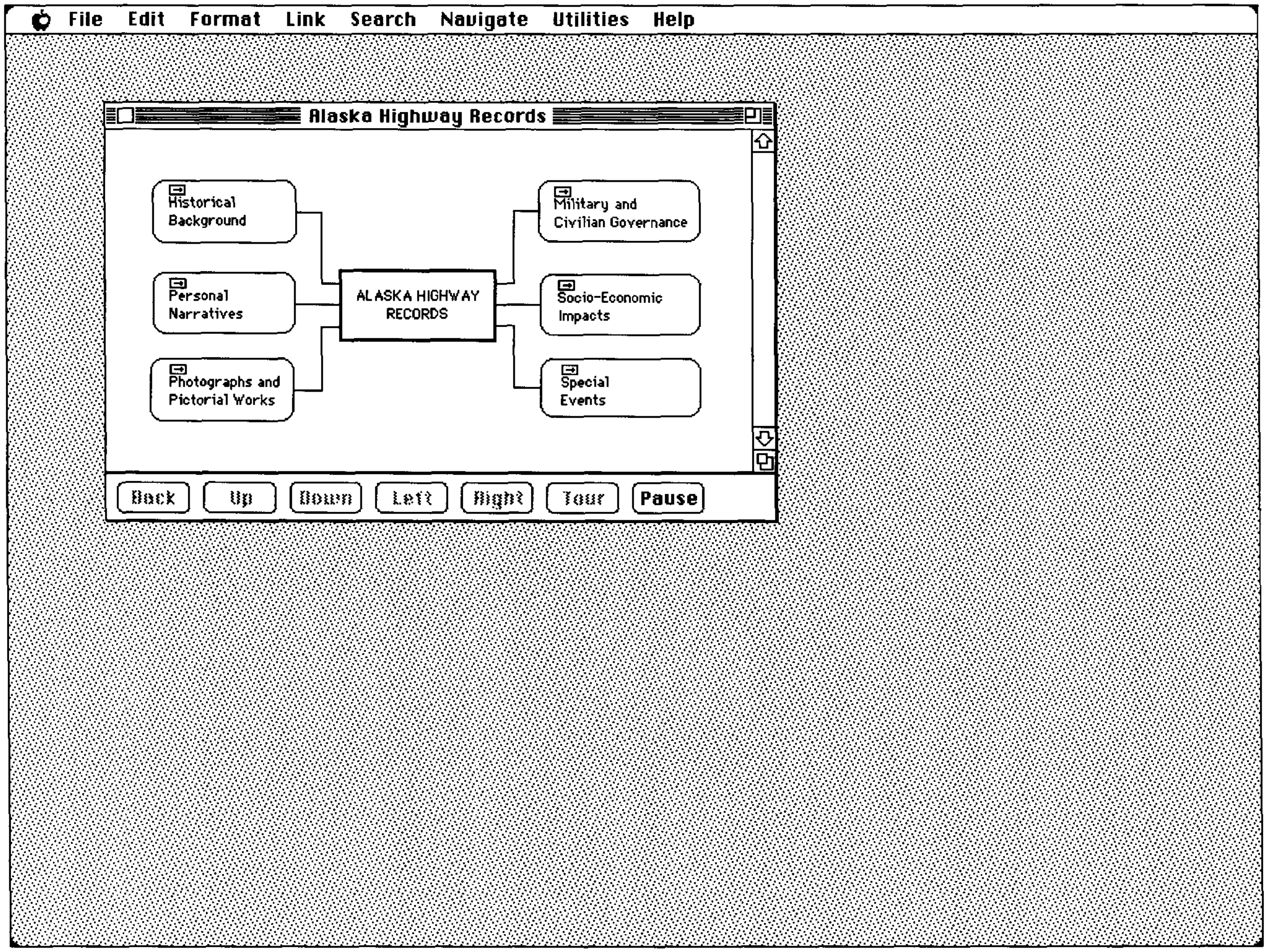

Fig. 54. The first node in the Alaska Highway tour is a graphical overview of the categories under which the nodes are organized. The tour is set to cycle through the fonds and collection descriptions within each category. When the tour is in operation, the buttons along the bottom of the window are inactive, with the exception of "Pause".

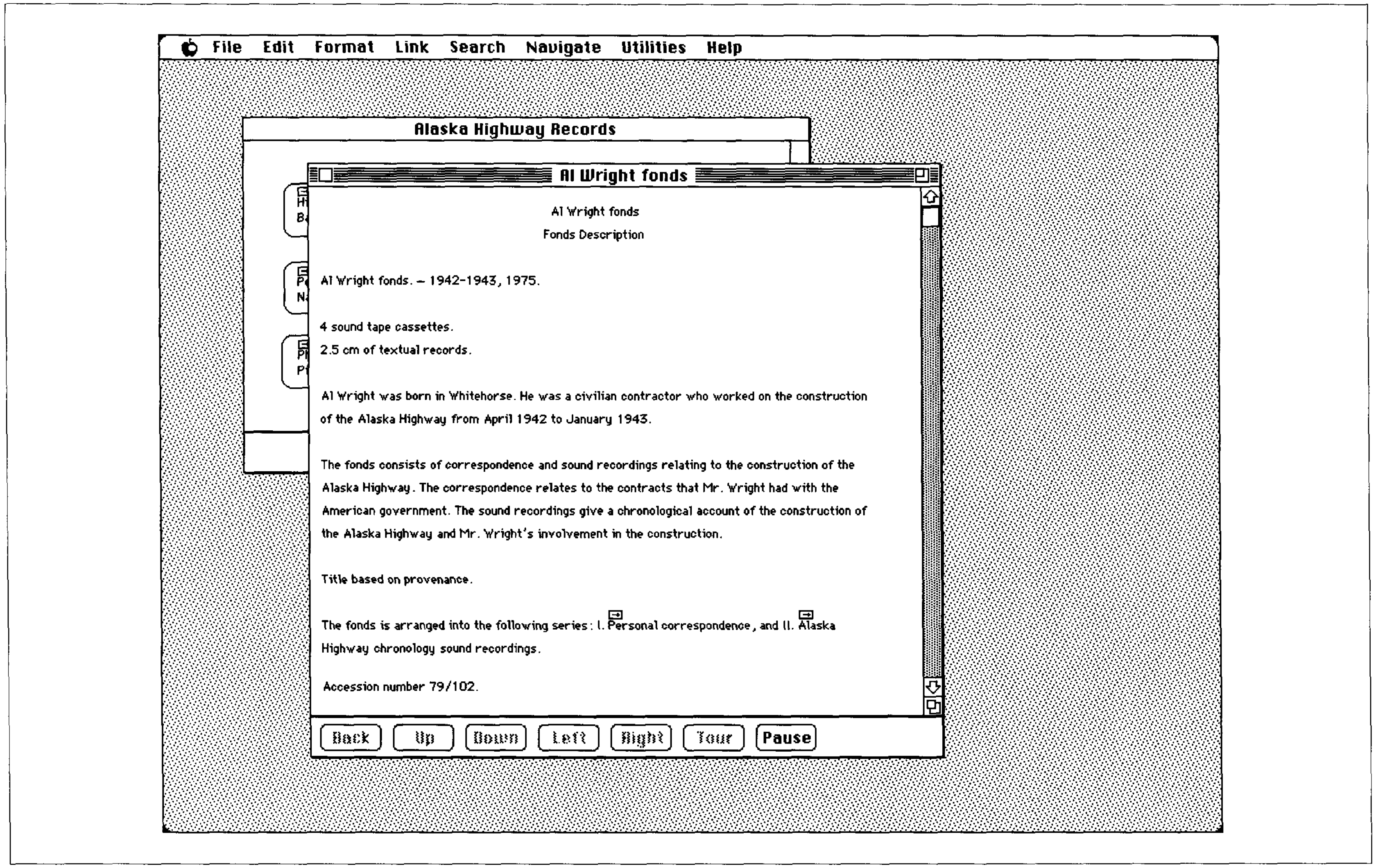

Fig. 55. After five seconds, the first fonds description node in the Historical Background category is opened, the "Al Wright fonds".

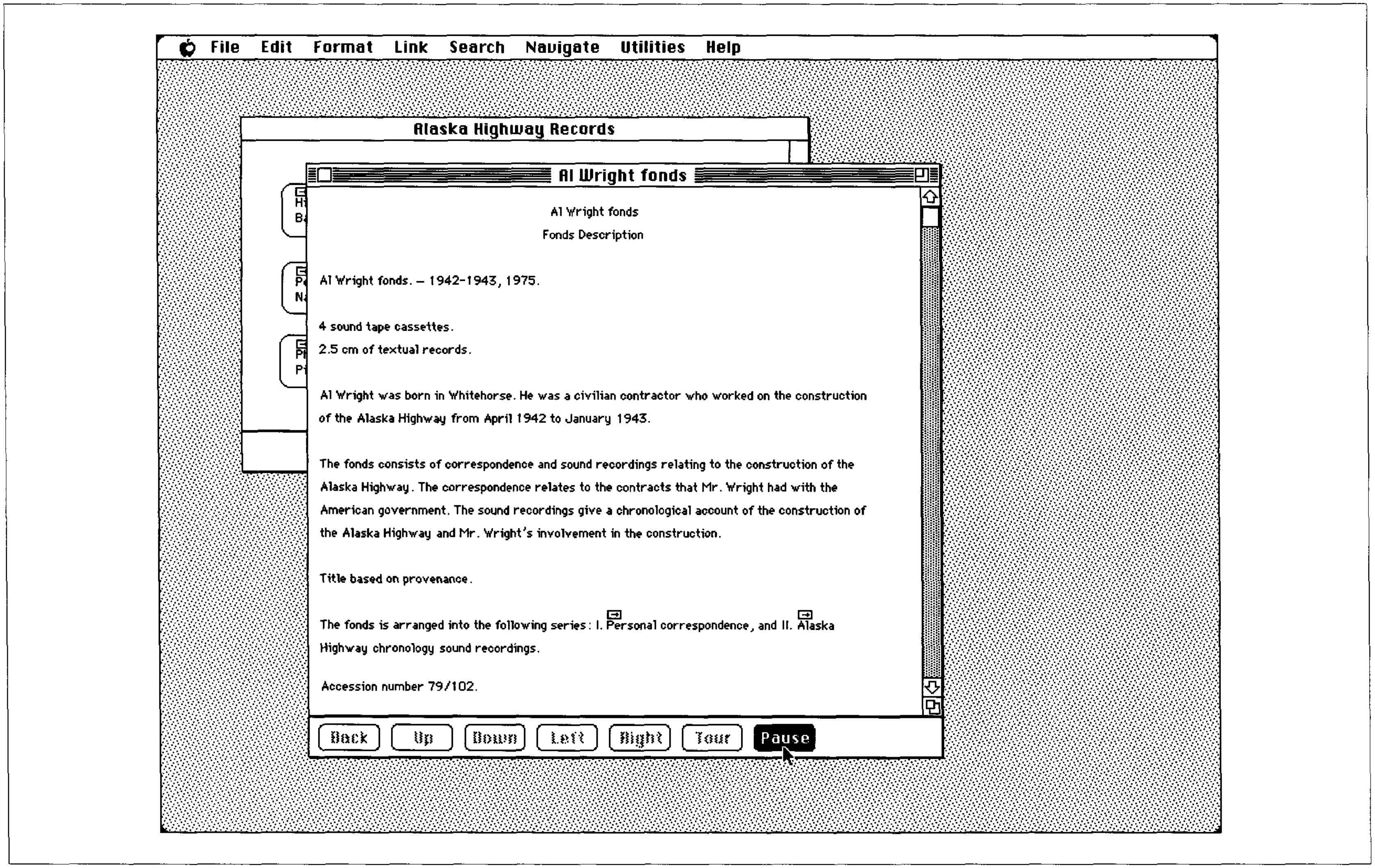

Fig. 56. The researcher clicks the "Pause" button at the bottom of the window to pause the tour so that some of the links can be manually explored.

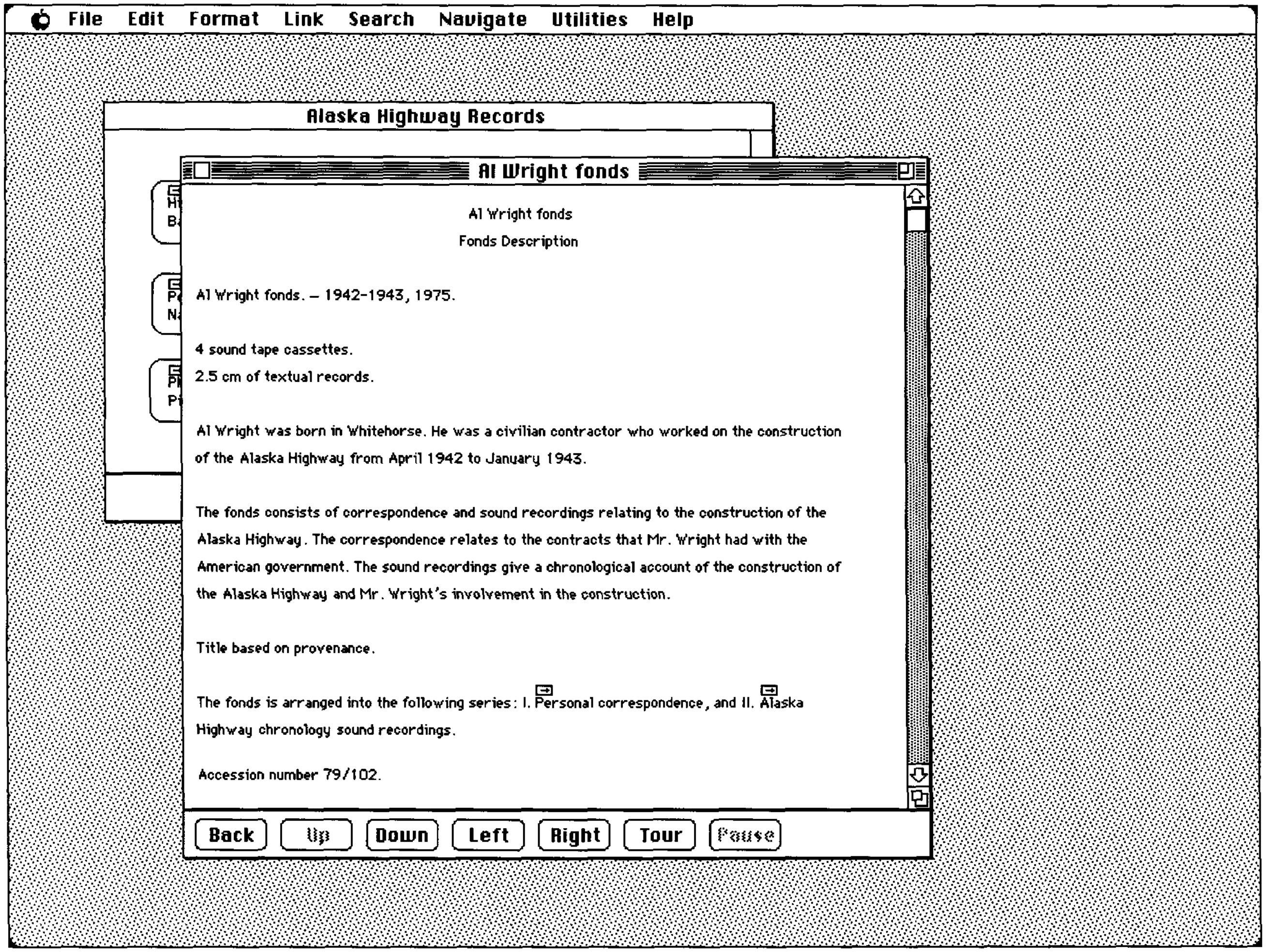

Fig. 57. When the tour is paused, the regular link buttons along the bottom of the window are active. The user is free to browse throughout the hypertext by activating links represented by link markers or buttons. To return to the tour after viewing nodes, the user would click the "Tour" button, which would return the user to the departure node and resume the tour.

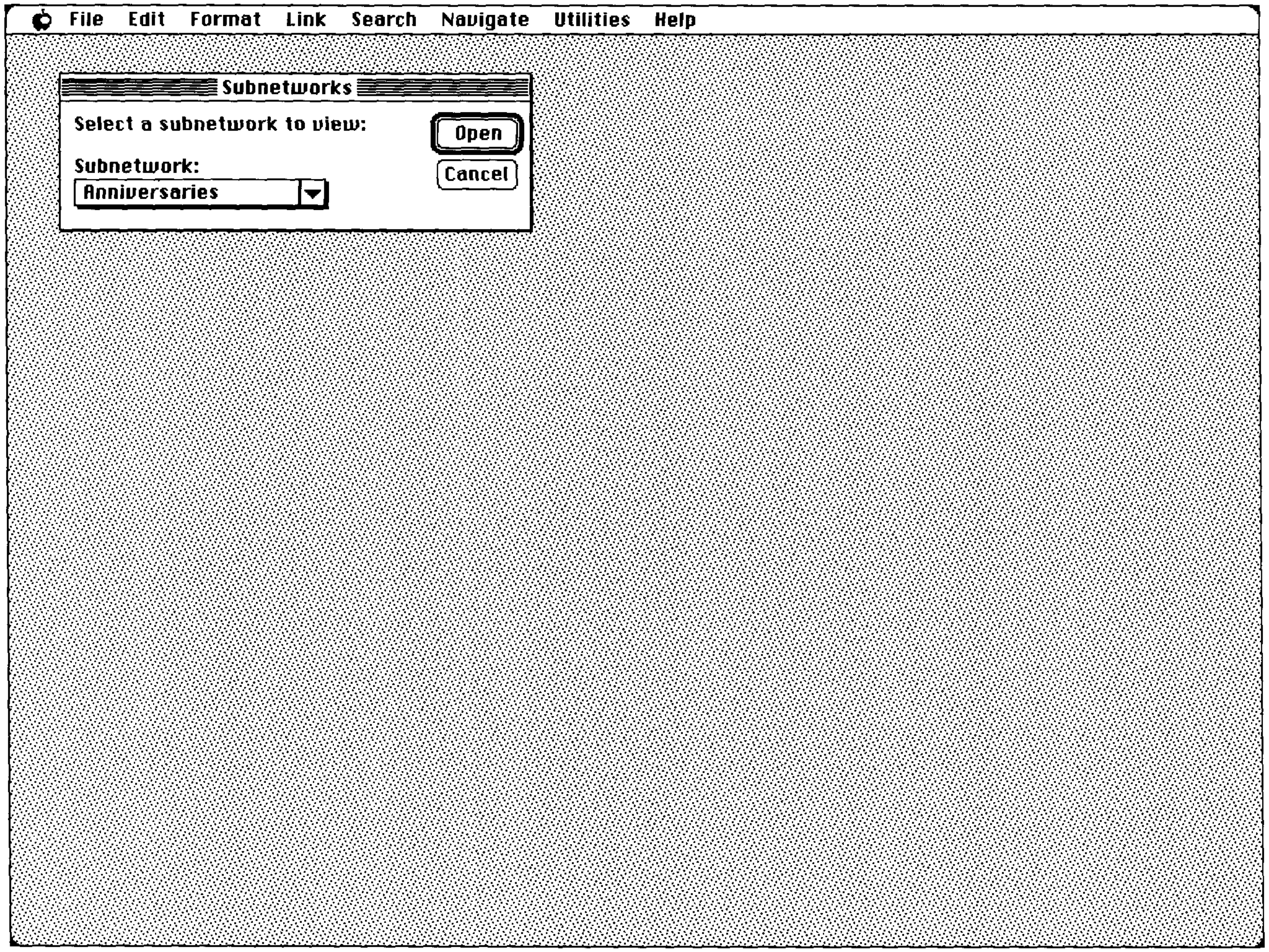

Fig. 58. To view the records in a subnetwork, the user opens the Subnetworks dialog box by selecting the option from the menu. The subnetwork window has a pull-down list of subnetworks, similar to the guided tour pull-down list.

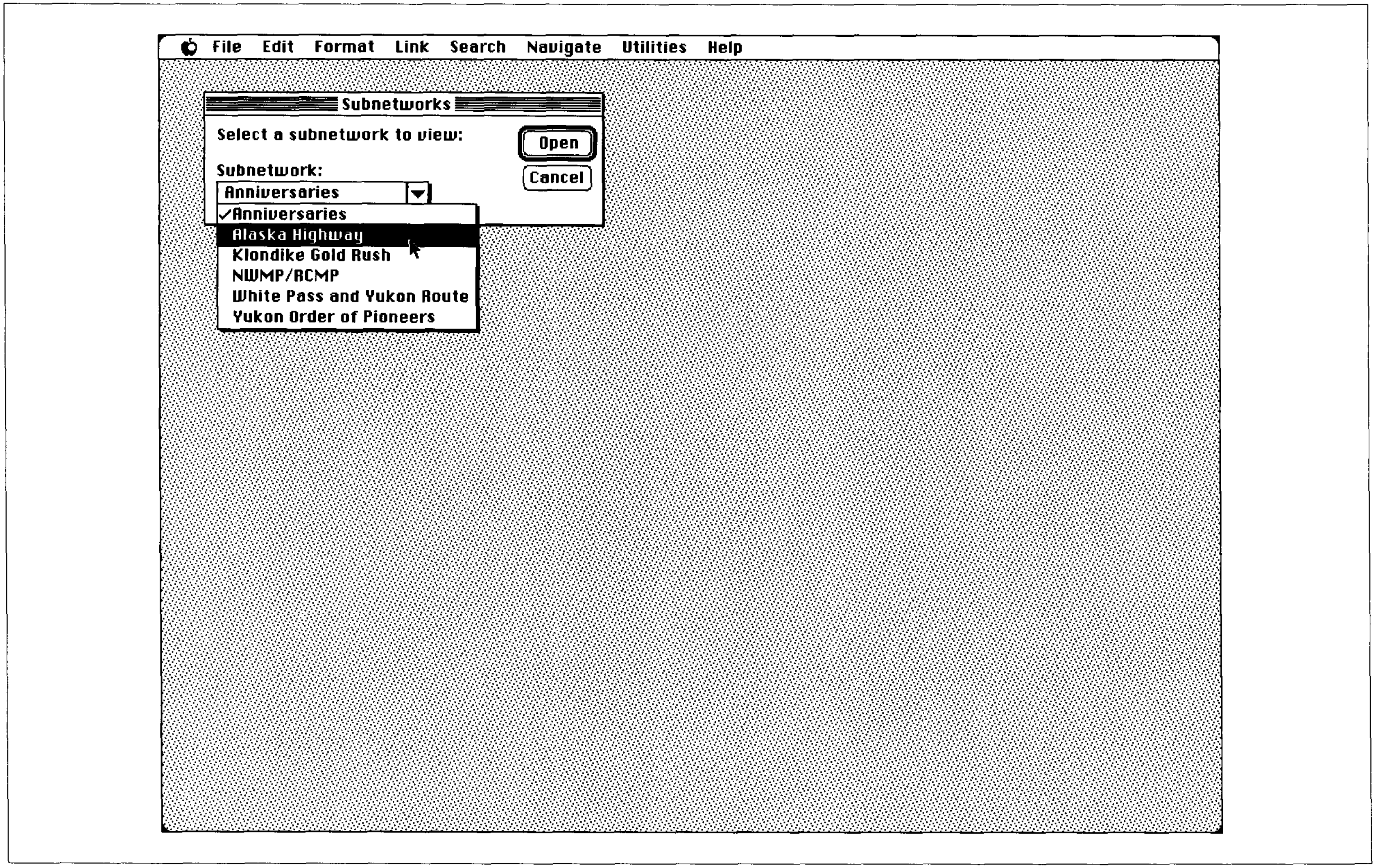

Fig. 59. From the tours available under “Anniversaries”, the user selects “Alaska Highway”.

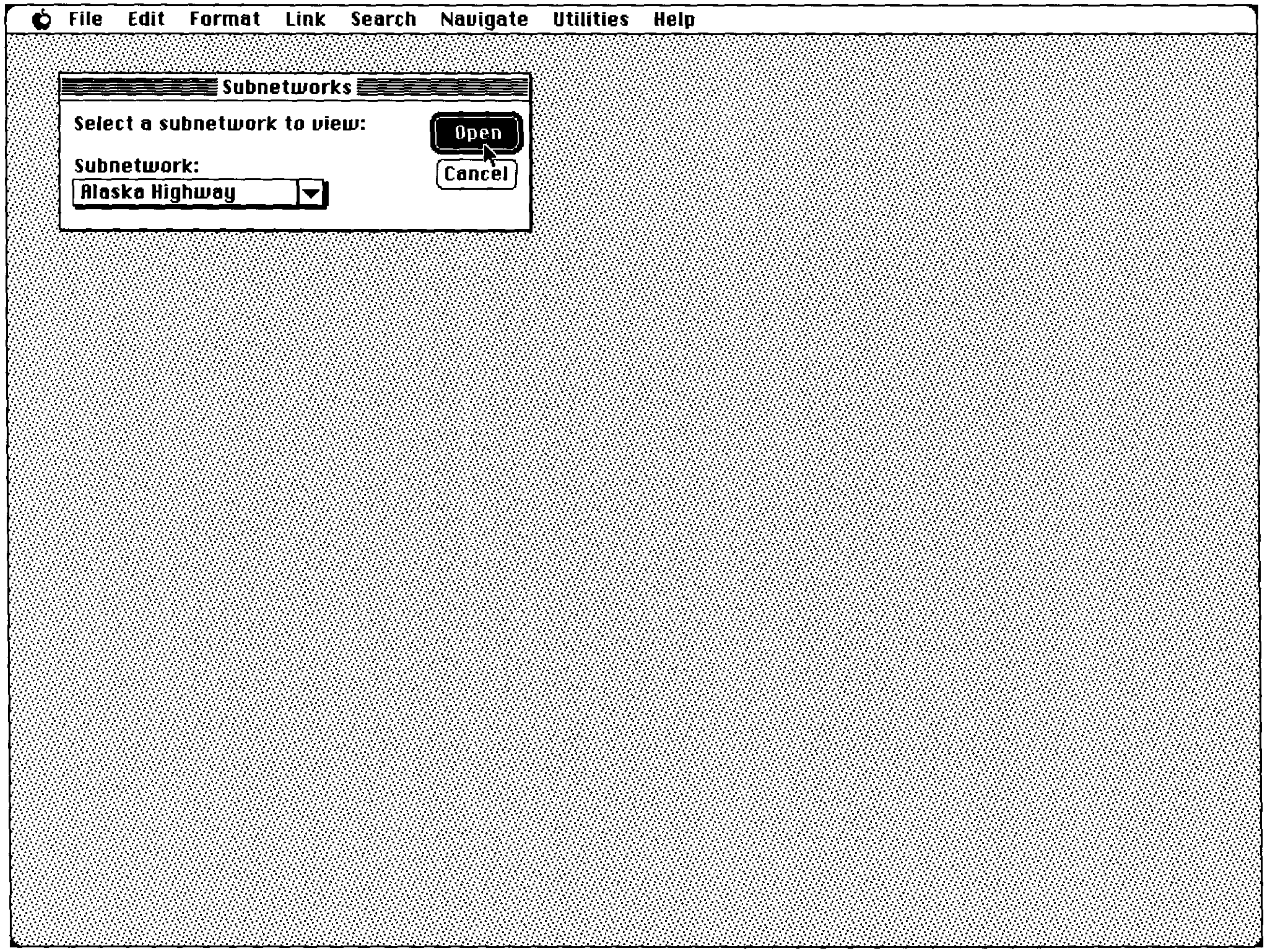

Fig. 60. The researcher gives the command to open the subnetwork.

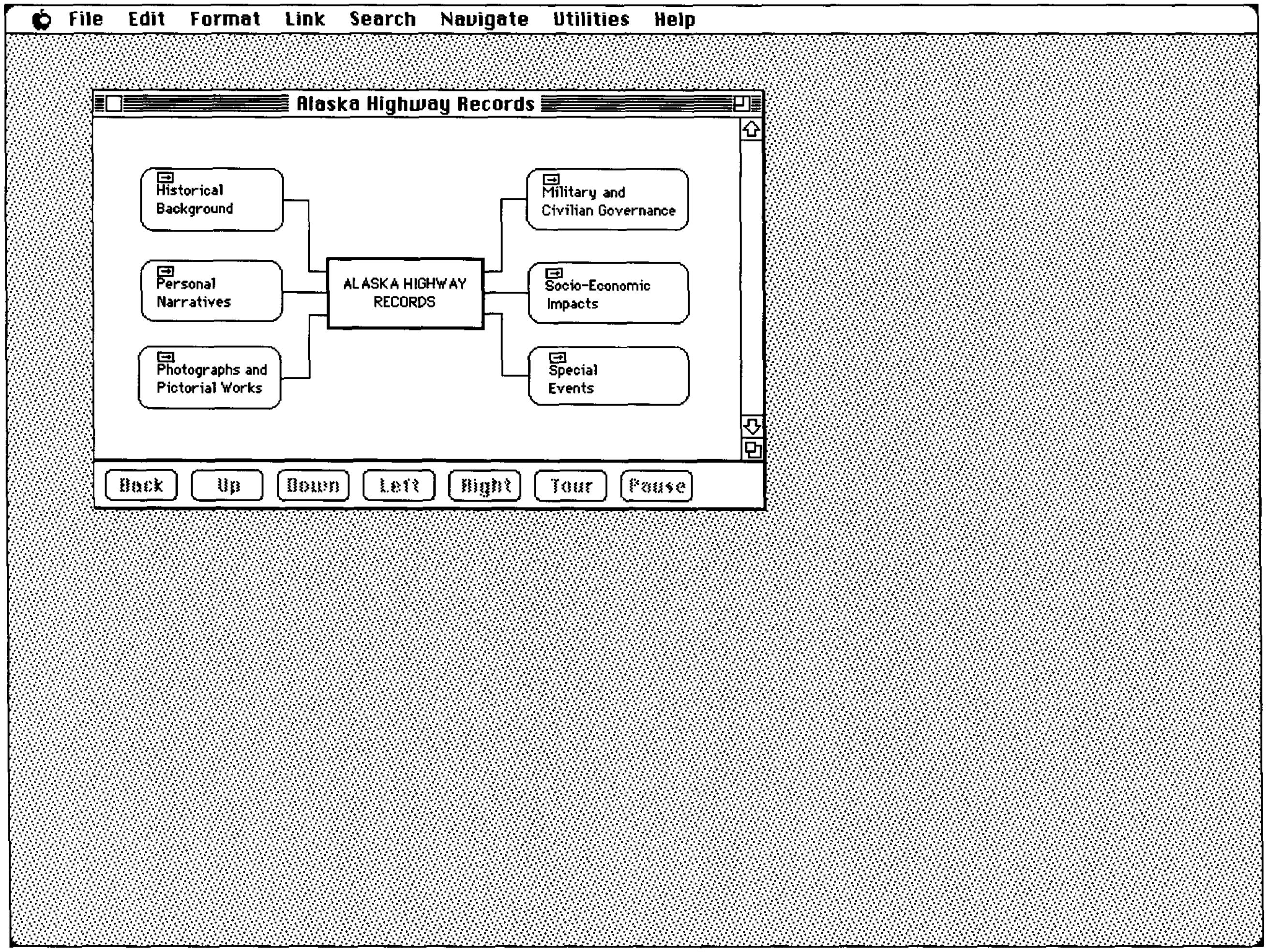

Fig. 61. The first node in the subnetwork is the Alaska Highway overview. This is similar to the guided tour, with the exception that the link selections are made by the researcher, rather than being made automatically by the system.

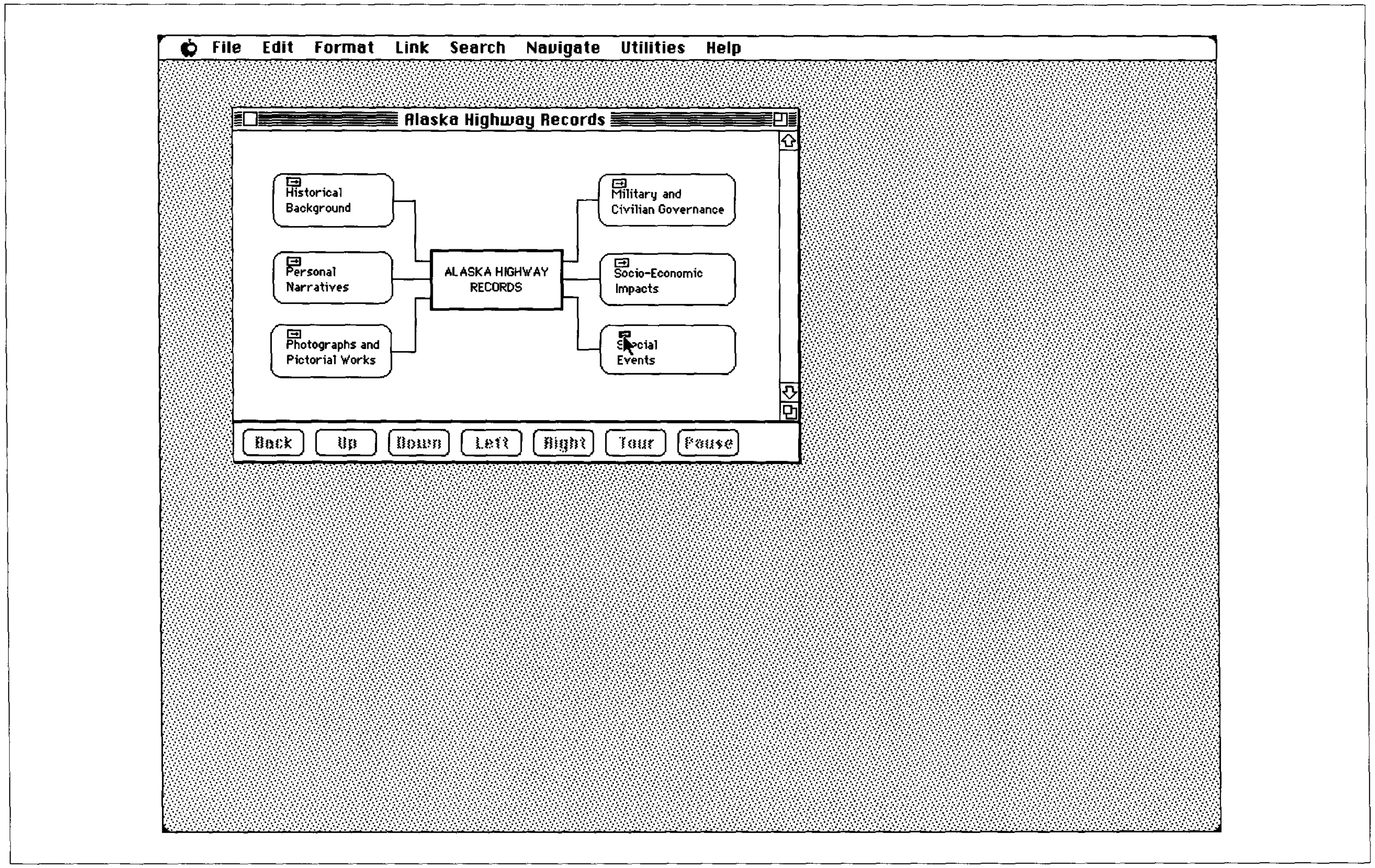

Fig. 62. The user clicks on the link marker above "Special Events" to view the attached nodes. Multiple nodes are linked to the anchor, so the link destination has to be selected.

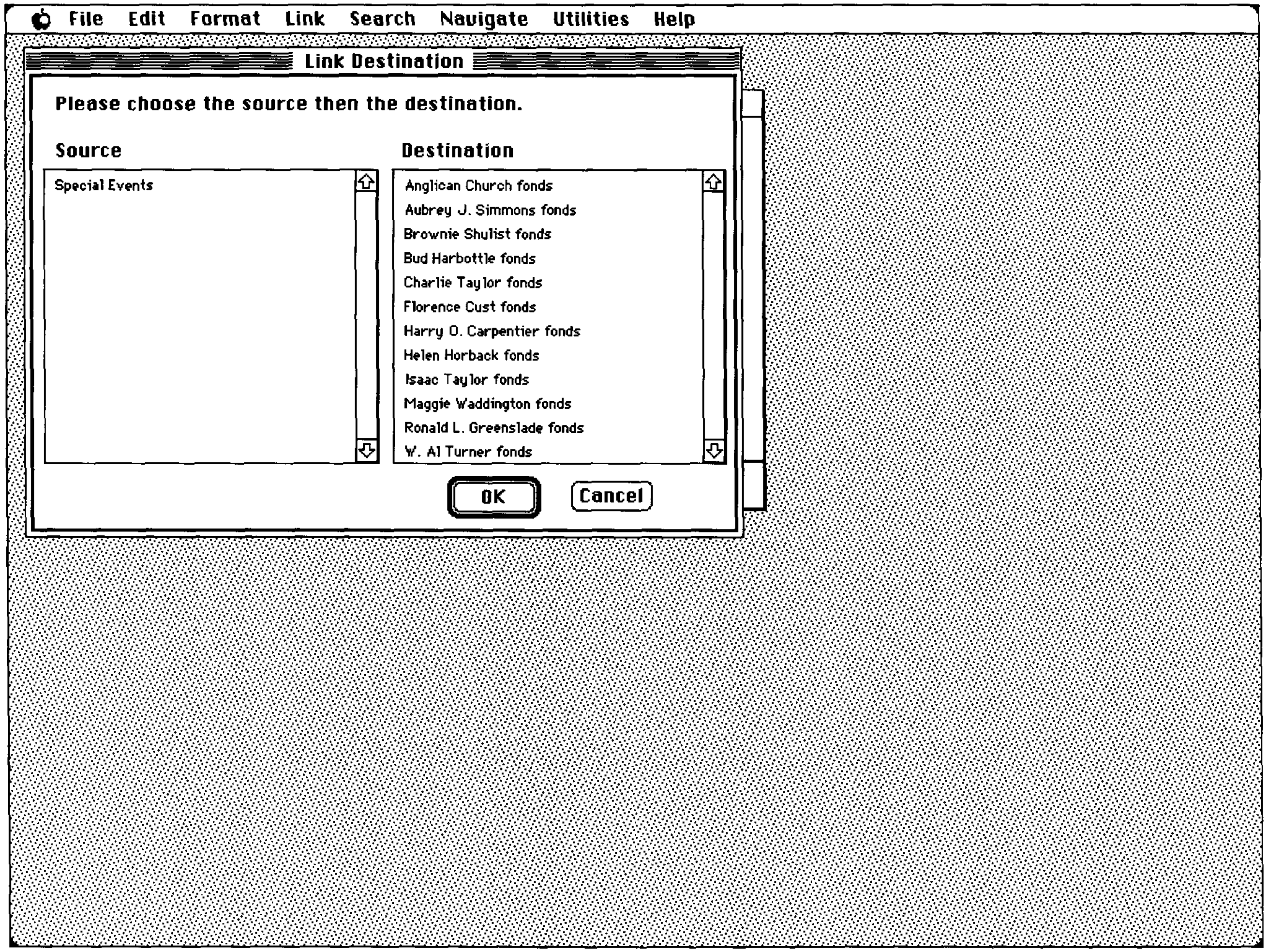

Fig. 63. The Link Destination dialog box indicates which nodes are attached to the link anchor "Special Events".

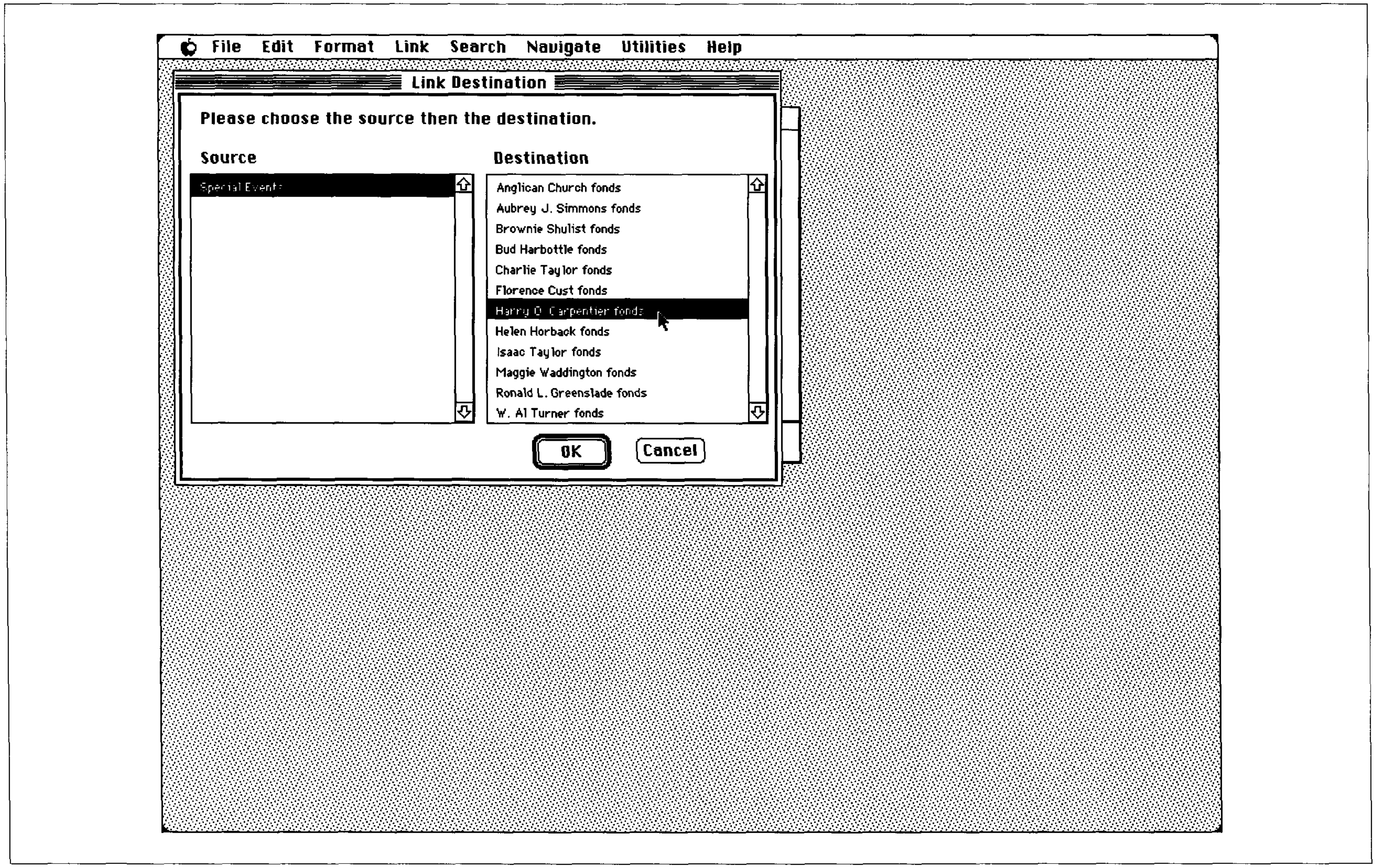

Fig. 64. The user selects the "Harry O. Carpentier fonds" as the destination node.

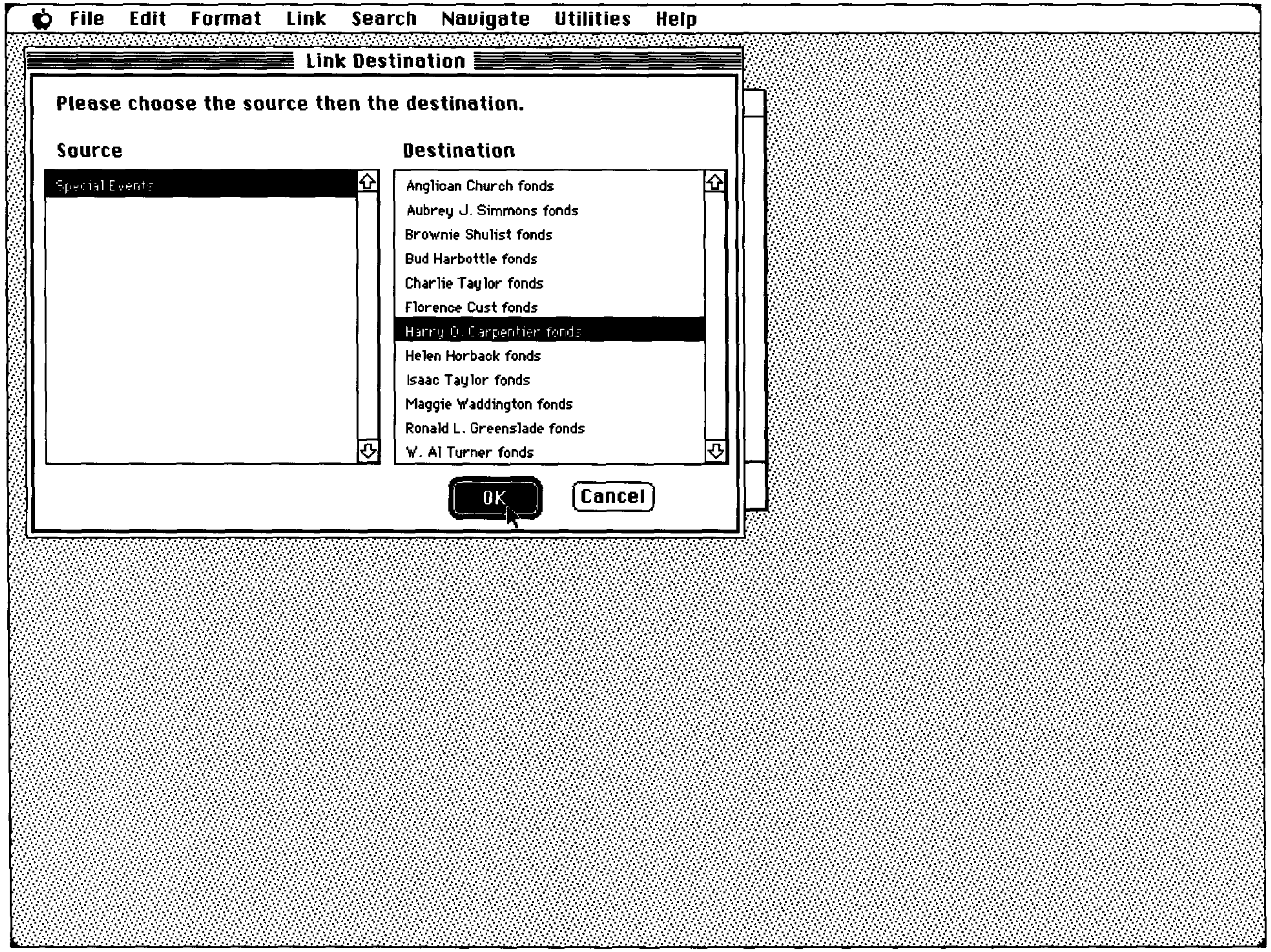

Fig. 65. The researcher clicks the "OK" button to go to the destination node.

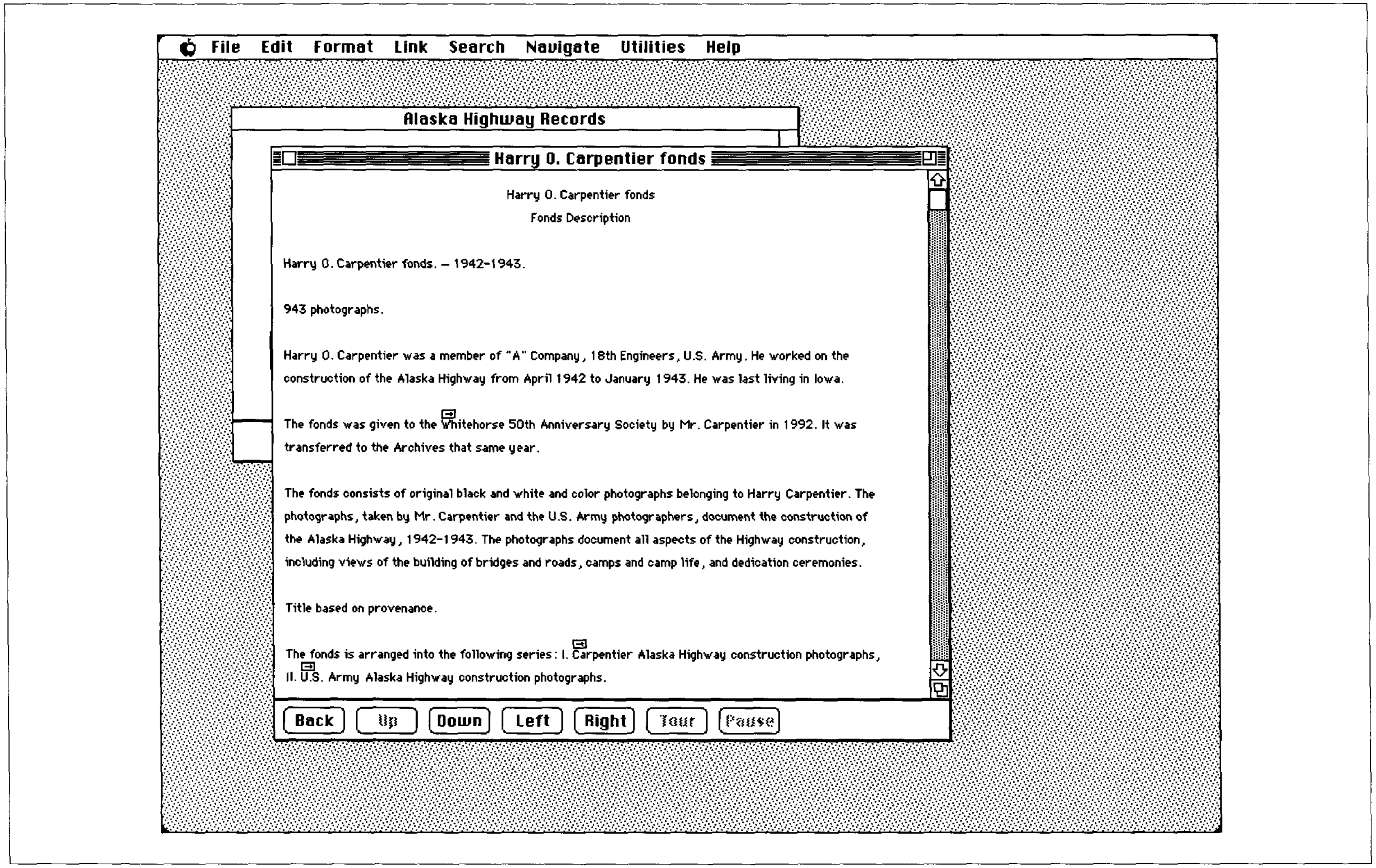

Fig. 66. The Harry O. Carpentier fonds node.

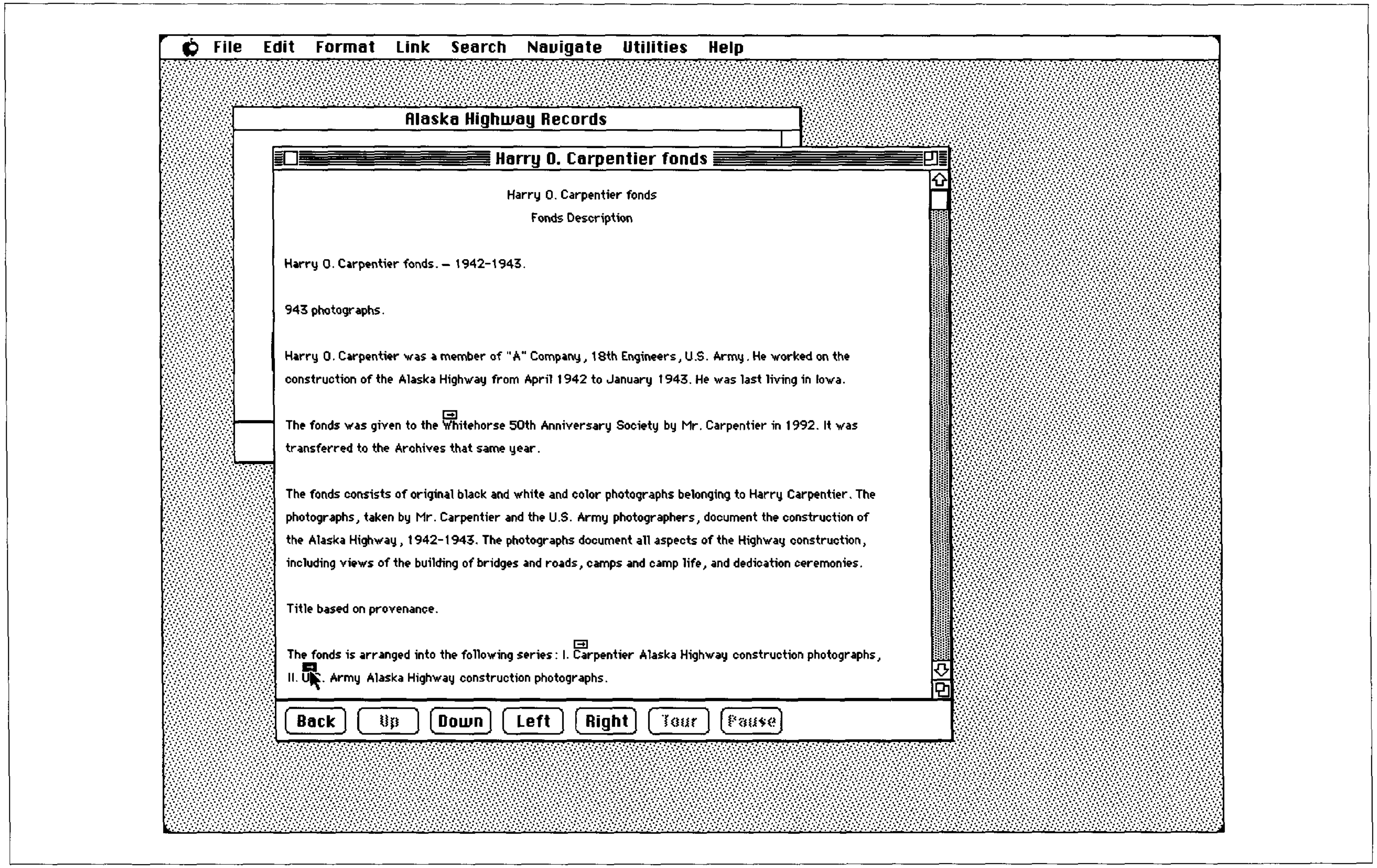

Fig. 67. The researcher decides to follow the link in the Series II title in the arrangement note.

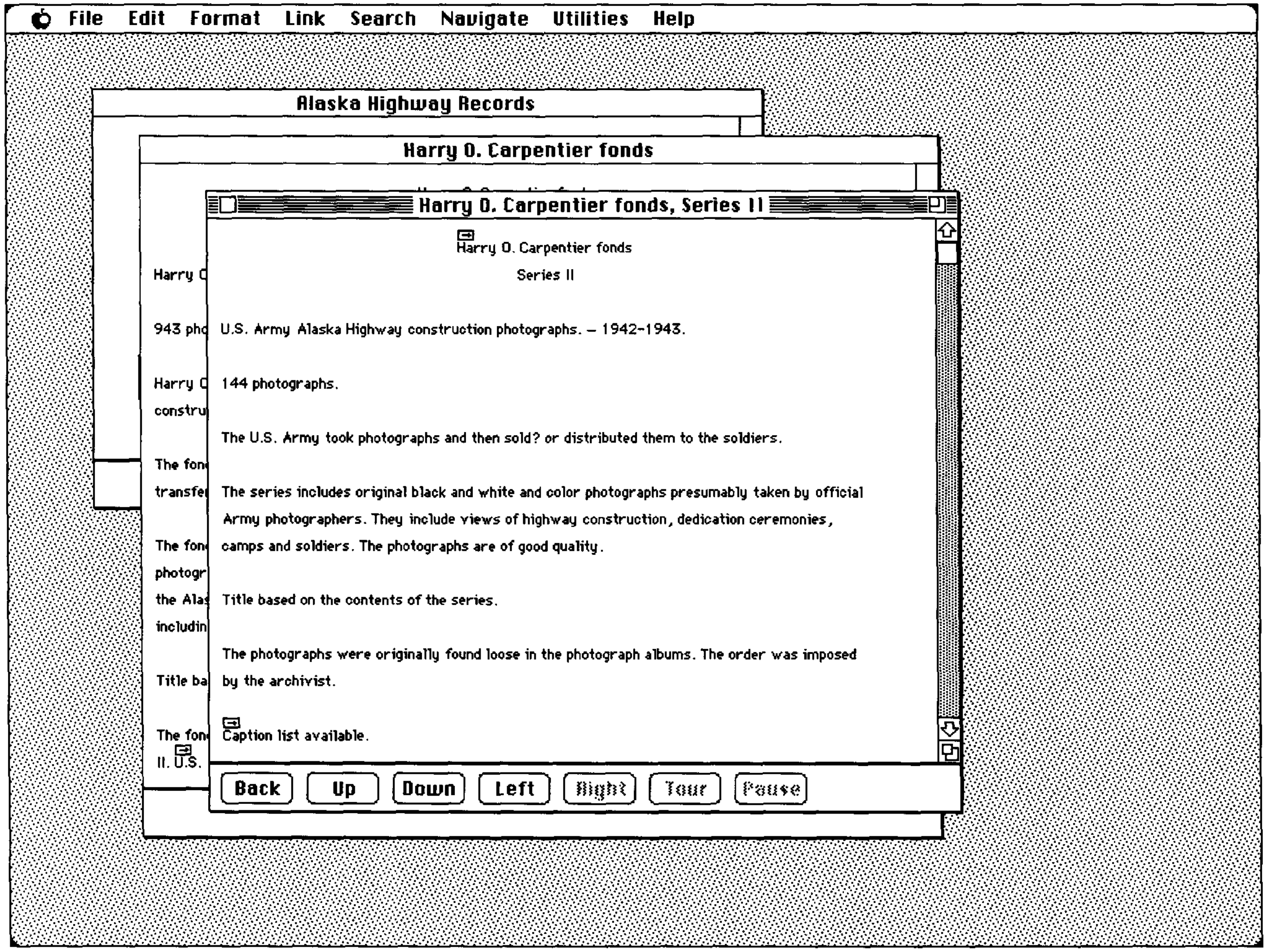

Fig. 68. The Series II node of the Harry O. Carpentier fonds. From this node, the user can continue to browse the nodes in the subnetwork.

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