A Practical Project

Here I suggest the practical steps to go to in order to find a real solution at CERN. After a preliminary discussion of the requirements listed above, a survey of what is available from industry is obviously required. At this stage, we will be looking for systems which are future-proof:

- Portable, or supported on many platforms.
- Extendible to new data formats.

We may find that with a little adaptation, parts of the system we need can be combined from various sources: for example, a browser from one source with a database from another.

I imagine that two people for 6 to 12 months would be sufficient for this phase of the project.

A second phase would almost certainly involve some programming in order to set up a real system at CERN on many machines. An important part of this, discussed below, is the integration of a hypertext system with existing data, so as to provide a universal system, and to achieve critical usefulness at an early stage.

(...and yes, this would provide an excellent project with which to try our new object oriented programming techniques!)

George Landow and Paul Delany

"Hypertext, Hypermedia and Literary Studies: The State of the Art" (1991)

<< **21** >>
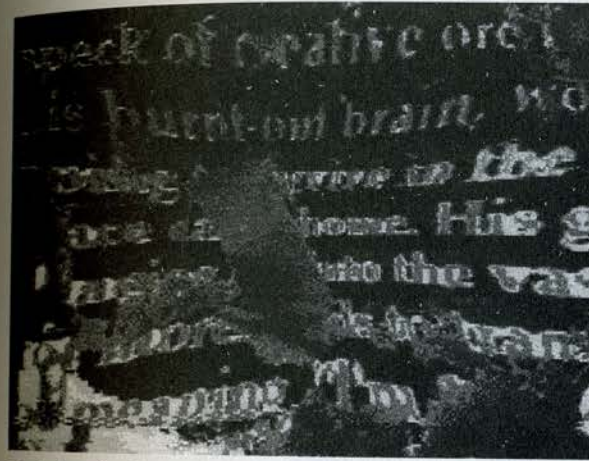
Mark Amerika, Grammatron. ©Mark Amerika.
Courtesy of Mark Amerika.

"Hypertext . . . changes our sense of authorship, authorial property, and creativity (or originality) by moving away from the constrictions of page-bound technology. In so doing, it promises to have an effect on cultural and intellectual disciplines as important as those produced by earlier shifts in the technology of cultural memory that followed the invention of writing and printing."

<< George Landow has done much to pave the way for the critical acceptance of hypermedia as a medium for creative and academic writing. A noted literary theorist from Brown University—a hotbed for hypertext since Ted Nelson was a fellow there during the 1960s—Landow introduced the potential of hypermedia to a generation of writers and scholars eager to explore the medium's possibilities. His associates include noted hyperfiction authors Stuart Moulthrop and Mark Amerika, who began pioneering forms of interactive writing while studying hypertext at Brown. Landow also helped develop the Intermedia software system in the late 1980s, one of the first authoring tools for creating interactive texts. Intermedia was popular among hypermedia enthusiasts at the time and served as a model for Tim Berners-Lee's initial development of the World Wide Web.

Hypertext erodes the rigidity of print by encouraging the reader to navigate its contents freely, clicking through it in multiple directions, creating a unique, participatory reading experience. Landow, with Paul Delany from Simon Fraser University, discusses hypermedia's impact on reading and writing, and how this ability to reassemble the text is an almost "embarrassingly literal" example of the deconstruction of meaning explored in late-twentieth-century critical theory.

Landow and Delany examine literary conventions, such as footnotes and indexes, to illustrate how electronic means of linking texts have roots in traditional writing practice. They describe how hypertext extends these devices in such a way that they become central to the reading, transforming the text into a complex network of paragraphs, sentences, and fragments of "textual units" or "lexias," as they are called. The reader's ability to explore this network freely, and disrupt the linearity of the text, enables a dramatic shift from what they regard as hierarchical, centralized, and author-dominated literary forms. Landow and Delany describe this new form as "intertextualities," a terrain where the boundaries between literary works dissolve as they join into a single, vast "docuverse." While they note that this literature of the future may introduce chaos into the experience of reading, they see a greater potential for an enhanced "technology of cultural memory," inspired by Vannevar Bush and Douglas Engelbart, that calls for a revitalized cultural dialogue and collaborative exchange between author and reader. >>

Hypertext, Hypermedia and the History of the Text

The written text is the stable record of thought, and to achieve this stability the text had to be based on a physical medium: clay, papyrus or paper; tablet, scroll or book.[1] But the text is more than just the shadow or trace of a thought already shaped; in a literate culture, the textual structures that have evolved over the centuries *determine* thought almost as powerfully as the primal structure that shapes all expression, language. So long as the text was married to a physical media, readers and writers took for granted three crucial attributes: that the text was *linear*, *bounded*, and *fixed*. Generations of scholars and authors internalized these qualities as the rules of thought, and they had pervasive social consequences. We can define *Hypertext* as the use of the computer to transcend the linear, bounded and fixed qualities of the traditional written text.[2] Unlike the static form of the book, a hypertext can be composed, and read, non-sequentially; it is a variable structure, composed of blocks of text (or what Roland Barthes terms *lexia*) and the electronic links that join them.[3] Although conventional reading habits apply within each block, once one starts to follow links from one block to another new rules and new experience apply. Instead of facing a stable object—the book—enclosing an entire text and held between two hands, the hypertext reader sees only the image of a single block of text on the computer screen. Behind that image lies a variable textual structure that can be represented on the screen in different ways, according to the reader's choice of links to follow. Metaphors that can help us to visualise the structure "behind" the screen include a network, a tree diagram, a nest of Chinese boxes, or a web.

The immediate ancestor of modern hypertext was described in a pioneering article by Vannevar Bush in the 1945 *Atlantic Monthly*.[4] Bush called for mechanically linked information-retrieval machines to help scholars and decision makers in the midst of what was already an explosion of information. In the 1960s Douglas C. Englebart and Theodor H. Nelson began to design and implement computer systems that could implement some of these notions of linked texts, and today hypertext as a term refers almost exclusively to computerized hypertext programs, and to the textual structures that can be composed with their aid. Hypertext programs began to be widely available on personal computers in the late 1980s; current examples are *Guide* and *Linkway* for IBM-compatible PCs, *Intermedia* for Macintoshes running A/UX, and *Writing Space* and *HyperCard* for most Macintoshes.

Because hypertext breaks down our habitual way of understanding and experiencing texts, it radically challenges students, teachers, and theorists of literature. But it can also provide a revelation, by making visible and explicit mental processes that have always been part of the total experience of reading. For the text as the reader *imagined* it—as opposed to the physical text objectified in the book—never had to be linear, bounded or fixed. A reader could jump to the last page to see how the story ended; could think of relevant passages in other works; could re-order texts by cutting and pasting. Still, the stubborn materiality of the text constrained such operations: they required some physical task such as flipping pages, pulling another book from a shelf, or dismembering the original text beyond repair.[5] Over the centuries, readers developed a repertoire of aids to textual management; these aids operated both within a single volume, and in the relations between volumes. They constituted a *proto-hypertext,* in which we can find important models for hypertext design today—though the special powers of the computer allow us to look beyond the textual aids that evolved during the long history of writing and printing.

Within the individual volume of the traditional book we may find such *internal* hypertextual functions as tables of contents, page-numbers, chapters, verses, rubrications, footnotes, and indexes. Some of these may be assigned by the original author, others by specialists in textual organization such as indexers or printers, or by later generations of scholars. *External* hypertextual functions have traditionally been post-authorial, supplied by librarians and bibliographers. Indeed, once one extends the idea of "a text" to include a collection of volumes the object of study ceases to be bounded, linear or fixed, and some kind of implicitly hypertextual organization will always be necessary.

How does hypertext actually work? Two examples, already familiar to most scholars, will help to show its underlying principles. Take first the elementary, but not trivial, question faced by large research libraries: we have a hundred and fifty kilometers or more of shelves—in what order should the books be placed on them? The primitive solution is an accession system, like the British Library, where each new volume is simply added on at the "end" of the shelf, and volumes are classified by the *physical* address of their original placement. Modern systems try to establish a *logical* order that places related books together, independent of any particular arrangement of shelves. This creates a kind of hypertextual linking, but done on a fixed and one-dimensional basis (so that, for example, one must choose between uniting all the books on the same subject, or all by the same author).

On-line library catalogues, now coming into general use, can be thought of

as coarse-grained and rudimentary hypertext systems that support a "virtual" re-arrangement and retrieval of individual volumes at the terminal. However, they are usually limited to a few standardized search categories, such as author, title and subject; and they cannot discriminate between any textual units smaller than a complete book. More sophisticated systems, such as the on-line MLA Bibliography, can perform subtler searches, using more detailed descriptors and dealing with articles as well as books. But neither deserve to be called true hypertext systems, because they operate on textual classifications rather than on the actual underlying complete texts. True hypertext must be able to define textual units, and link them in various ways, within an overall textbase or, to use another term now gaining currency, "docuverse."

Our second example of the principles underlying hypertext could be any standard scholarly article in the humanities. In reading an article on, say, Joyce's *Ulysses,* one reads through the main text, encounters a symbol that indicates the presence of a footnote, and leaves the main text to read that note, which can contain a citation of passages in *Ulysses* that supposedly support the argument in question as well as information about sources, influences, historical background, or related articles. In each case, the reader can follow the link to another text and thus move entirely outside the scholarly article itself. Having completed reading the note—and perhaps some of the texts to which it refers—one returns to the main text and continues reading until one encounters another note, and again leaves the main text.

This kind of reading constitutes a mental model of hypertext. Suppose now that one could simply touch the page where the symbol of a note, reference, or annotation appeared, and that act instantly brought into view the material contained in a note or even the entire other text—here all of *Ulysses*—to which that note refers. Scholarly articles situate themselves within a network of textual relations, most of which the print medium keeps out of sight and relatively difficult to follow—because the referenced (or linked) materials lie spatially distant from the reference mark. Electronic hypertext, in contrast, makes individual references easy to follow and the entire field of interconnections explicit and easy to navigate. Instant access to the whole network of textual references radically changes both the experience of reading and, ultimately, the nature of that which is read. If our putative Joyce article was linked, through hypertext, to all the other materials it cited, it would exist as part of a much larger system in which the totality might count more than the individual document; the article would now appear woven more tightly into its context than would a print-technology counterpart. The ease with which readers traverse such a system has further

consequences: for as they move through this web or network of texts, they continually shift the center—and hence focus or organizing principle—of their investigation and experience. Hypertext provides an infinitely re-centerable system whose provisional point of focus depends upon the choices made by a truly active reader.

Hypertext thus presages a potential revolution in literary studies. However, an almost unlimited power to manipulate texts brings with it conceptual problems of extreme difficulty, which can be summed up by the questions: "What is a unit of text?" and "What are the relevant links between units?" Among traditional textual units the best-recognized and most functional ones are the word, the sentence, and the book. To think of them as commensurable units on a linear scale of magnitude is natural, but misleading. A word is a conceptual unit, a sentence a syntactical one, a book a unit whose identity is largely determined by its traditional status as a physical object. Nonetheless, they are units that can be handled by many kinds of textual aids developed over the whole period of literacy. But between the sentence and the book (in terms of magnitude) we find such units as footnotes, paragraphs, chapters and essays; these are less amenable to definition, because they are largely informal means of organizing thought.[6] For the same reason, however, they are likely to be important elements for building hypertext structures: they are the kind of mental "chunks" that we use to break a complex issue into components and make it intelligible. In addition, we are beginning to imagine new textual units, not yet codified or even named, that will be specific to the hypertext environment. They will come into being and pass away in the dynamic virtual text of the computer, products of such broad cognitive principles as identity, association and structure.[7]

These deep theoretical implications of hypertext converge with some major points of contemporary literary and semiological theory, particularly with Derrida's emphasis on decentering, with Barthes's conception of the readerly versus the writerly text, with post-modernism's rejection of sequential narratives and unitary perspectives, and with the issue of "intertextuality." In fact, hypertext creates an almost embarrassingly literal embodiment of such concepts. . . .

Finally, hypertext can be expected to have important institutional as well as intellectual effects, for it is at the same time a form of electronic text, a radically new information technology, a mode of publication, and a resource for collaborative work. "Both an author's tool and a reader's medium, a hypertext document system allows authors or groups of authors to link information together, create paths through a corpus of related material, annotate existing texts, and create notes that point readers to either bibliographic data or the body of the referenced text. . . . Readers can browse through linked, cross-referenced, annotated texts in an orderly but nonsequential manner."[8] Such electronic linking shifts the boundaries between individual works as well as those between author and reader and between teacher and student. It also has radical effects upon our experience of author, text, and work, revealing that many of our most cherished, most commonplace, ideas and attitudes towards literary production are the result of the particular technology of information and cultural memory that has provided the setting for them. This technology—that of the printing-press, the book, and the library—engenders certain notions of authorial property, authorial uniqueness, and a physically isolated text that hypertext makes untenable. Hypertext historicizes many of our most commonplace assumptions, forcing them to descend from the ethereality of abstraction and appear as corollary to a particular technology and historical era. We can be sure that a new era of computerized textuality has begun; but what it will be like we are just beginning to imagine.

From Hypertext to Hypermedia

Expository prose, with its linear and propositional structures, has been too much identified with the privileged form of reason itself. Hypertext provides a better model for the mind's ability to re-order the elements of experience by changing the links of association or determination between them. But hypertext, like the traditional text from which it derives, is still a radical reduction—to a schematic visual code—of what was originally a complex physical and intellectual experience, engaging all the five senses. *Hypermedia* takes us even closer to the complex interrelatedness of everyday consciousness; it extends hypertext by re-integrating our visual and auditory faculties into textual experience, linking graphic images, sound and video to verbal signs. Hypermedia seeks to approximate the way our waking minds always make a synthesis of information received from all five senses. Integrating or (re-integrating) touch, taste and smell seems the inevitable consummation of the hypermedia concept.

Consciousness itself is a continuous linking and re-structuring of images selected from past, present and future; from the real and the imaginary; from the internal and external realms of experience. Current hypermedia programs have taken only a few, faltering steps towards electronic representation of human memory, fantasy and cognition. Nonetheless, hypermedia is, in conception at least, a much better model of the mind's typical activities than exists in the severely restricted code of linear prose. We can argue, therefore, for a natural progression from the printed word to hypertext and hypermedia—analogous to the

progression from painting to still photography, to silent movies, and now to movies with color and sound. This is not to claim that the newer media will altogether supersede the older ones. The black and white photograph remains viable, but is no longer the absolute standard of representation that it was in the nineteenth century. Similarly, the printed book will remain a central element of culture even as the new ways of interacting with texts make their own claims on our attention. . . .

RECONFIGURING THE TEXT

Dispersing the Traditional Text

Although in some not-so-distant future all individual texts may electronically link to one another, thus creating metatextual structures of a kind only partly imaginable at present, less far-reaching forms of hypertextuality have already appeared.[9] We already have works composed in hypertext that join blocks of text by electronic links to each other and to such graphic supplements as illustrations, maps, diagrams, visual directories and overviews. Second, there are the metatexts formed by interlinking individual sections of individual works. A third case is the adaptation for hypertextual presentation of material conceived in book technology. Such adaptations can work with textual units already given by the author, such as the individual sections of *In Memoriam*.[10] Conversely, one may, in the manner of Barthes's treatment of "Sarrasine," impose one's own *lexias* upon a work not explicitly divided into sections.

A fourth kind of hypertext puts a classical linear text, with its order and fixity, at the center of the structure. The composer then links various supplementary texts to this center, including critical commentary, textual variants, and chronologically anterior and later texts. In this case, the original text, which retains its old form, becomes an unchanging axis from which radiate linked texts that surround it, modifying the reader's experience of this original text-in-a-new-context.[11]

When compared to text as it exists in print technology, all these forms of hypertext evince varying combinations of atomization and dispersal. Unlike the spatial fixity of printed text, no one state of an electronic text is ever final; it can always be changed. Hypertext builds in a second fundamental mode of variation, since electronic links or reading pathways among individual blocks permit dif-

ferent paths through a text. The numerating rhetoric of "first, second, third" so well suited to linear text may appear within individual blocks of text but cannot control the unfolding of understanding in a medium that encourages readers to choose various paths, rather than following a fixed and linear one.

From a literary perspective based on book technology, the effects of electronic linking may appear harmful and dangerous. The notion of an individual, discrete work becomes increasingly undermined and untenable within this form of information technology, as it already has within much contemporary critical theory. Hypertext linking, reader control, and continual re-structuring not only militate against modes of argumentation to which we have become accustomed, but they have other, more general effects. The reader is now faced by a kind of textual randomness. The writer, conversely, loses certain basic controls over his text: the text appears to break down, to fragment and atomize into constituent elements (the *lexia* or block of text), and these reading units take on a life of their own as they become more self-contained because they are less dependent on what comes before or after in a linear succession.

At the same time that the individual hypertext block has looser, or less determining bonds to other blocks from the *same work* (to use a terminology that now threatens to become obsolete), it also can bond freely with text created by other authors. In fact, it bonds with whatever text links to it, thereby dissolving notions of the intellectual separation of one text from others as some chemicals destroy the cell membrane of an organism. Destroying the cell membrane will kill the cell; but destroying our conventional notions of textual separation has no fatal consequences. However, it will reconfigure the text and our expectations of it. As an individual block loses its physical and intellectual separation from others when linked electronically to them, it also finds itself dispersed into them. The necessary contextualization and intertextuality produced by situating individual reading units within a network of easily navigable pathways weaves texts, including those by different authors and those in nonverbal media, tightly together. One effect is to weaken and even destroy altogether any sense of textual uniqueness, for what is essential in any text appears intermingled with other texts. Such notions are hardly novel to contemporary literary theory, but here again hypertext creates an almost embarrassingly literal reification or actualization of a principle or quality that had seemed particularly abstract and difficult in its earlier statement. Since much of the appeal, even charm, of these theoretical insights lies in their difficulty and even preciousness, this more literal presentation promises to disturb theoreticians, in part, of course, because it disturbs status and power relations within their—our—field of expertise. . . .