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Hypermedia: New Approaches to Cultural Heritage and Knowledge

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1. Introduction

Initially, first hand visits were the only way to appreciate cultural sites. The advent of printing meant that some aspects of cultural heritage became accessible through catalogues, monographs, articles, postcards and posters. The excessive costs of printing meant that images in these publications were almost invariably in black/white photography. Serious colour catalogues of major galleries such as the Uffizi have only been introduced in the past decade. The idea of using maps to illustrate changing patterns of political and religious and cultural development over time was introduced in the nineteenth century. More recently this has been adapted to the history of art and offers new possibilities for museums also.

Many persons assume that multimedia and hypermedia are simply an extension of existing practices. This is only partly true. Their evolution is bound integrally with a series of new technologies which are rapidly transforming all our conceptions of the possible. This paper reviews some of these developments in terms of new methods to capture, archive, display and navigate through information. It explores implications and possibilities for cultural heritage and knowledge.

2. Capture

Until recently art historians and museum curators relied largely on black-white photographs, mainly because there were no systematic methods for colour calibration particularly retrospectively in the case of old photographs which had faded. Most of these problems are now being solved and high level images are now being scanned. The IBM Brandywine camera typically scans paintings at 50-100 megabytes. The Vasari scanner (used at the National Gallery, London; the Uffizi, Florence, and the Louvre, Paris, scans

at 1.4 gigabits per square meter). The National Research Council of Canada's laser scanner captures images of three-dimensional objects at 10-100 megabytes which can then be rotated on screen. In the near future, auto-stereoscopic and holographic methods will become more important. As a result even our basic conception of what constitutes an image is being transformed. Hypermedia will involve not only colour photographs, but also films, (auto-) stereoscopic images, virtual reality and holography.

3. Archive

In the past archives were storage places for books and documents. Storage was physical. Electronic storage is a rapidly emerging field. A generation ago the frontiers were limited to a few hundred megabytes in a given system. Today the frontiers are using terabytes and making plans for exobytes.

Electronic versions are much more than mere copies of the original manuscripts, books, paintings and objects. A project at the University of Southampton is scanning in the manuscript copies of Churchill's speeches, adding hypertext links which allow one to examine the alternatives he crossed out, see the references, allusions to and contexts of various political events of the day. A project at the Museum for the History of Science in Florence, which forms part of G7 pilot project 5 on museums, takes the notebooks of Leonardo da Vinci as a point of departure. Scientific devices in these notebooks are linked with images of physical models of these devices, films of these models in action, Computer Aided Design reconstructions of these models showing them in context. For example, a crane by Brunelleschi recorded by Leonardo in his *Codice Atlantico* is shown in action on a reconstruction of Brunelleschi's dome of the cathedral in Florence. This device is further linked to bibliographical references. Hence the electronic archive on this device is much more than the original: it entails reconstructions and literature which put it into context.

4. Display

Display methods are developing at an enormous rate. The computer monitor and television screen will soon be replaced by flat panel displays. These displays can be positioned on walls such that they effectively become frames for electronic paintings. Alternatively they can be positioned horizontally to function as a virtual work-bench on which a doctor can simulate an operation using a virtual skeleton, or an architect can explore the layout of a proposed building complex.

The GMD (Gesellschaft für Mathematik und Datenverarbeitung) is experimenting with collaborative walls, whereby an entire wall will effectively serve as a window into the space of another individual with whom one wishes to speak. In another experimental demonstration this wall becomes a landscape through which one can fly. A combination of four such walls produces a CAVE environment. In the United States some of the GII tera-flop test bed experiments involve CAVE to CAVE communication.

At the everyday level, the advent of Quick Time VR, Virtual Reality Modelling Language (VRML) and virtual reality means that one can reconstruct galleries, museums, churches and other cultural monuments and do virtual walkthroughs. If one consults the Uffizi home page on the World Wide Web one is able, already today, to "walk" through the rooms electronically with the help of QuickTime VR. Given the low bandwidth available to most users, the versions currently visible are in low resolution. However, high resolution versions already exist. The term virtual museums has multiple meanings. It can refer also to a reconstruction of an earlier version of a great gallery such as the Louvre. Or it can bring together in one virtual space all the paintings of a single artist such as Botticelli the originals of which would normally never be found in a single space.

High level virtual reality permits one to create completely realistic simulations of historical buildings and trace how these change over time. Hence one can, for example, see a reconstruction of Saint Peter's Basilica as it exists today and then switch to see what the ancient, no longer extant basilica, looked like. Infobyte is extending this reconstruction to include the Stanze of Raphael, the Vatican library and Vatican museums. Since IBM is gradually scanning in all the manuscripts and books of the Vatican library, it will eventually be possible to walk through simulations of the rooms of the library in virtual reality and then consult electronic versions of the books on its walls. The number and position of the books in the Vatican library has changed considerably in the course of the past five hundred years. One could reconstruct these earlier versions such that a future reader could trace these changes over time, thus making virtual visits to no longer extant arrangements of books: virtual libraries in another sense.

In a number of monasteries, old catalogues allow us to reconstruct the history of their collections with some degree of accuracy. In the case of particularly famous manuscripts we can even trace how they were copied by scribes and sent from one monastery to another. Hence, in addition to virtual visits to major religious institutions one could trace the spread of Homer, Virgil, the *Book of Job* or the *Apocalypse* across Europe. So displaying an old text on screen is but one aspect of the electronic revolution: other aspects include tracing its various versions both chronologically and geographically.

These developments in reconstructions are effectively at the level of computer Aided Design (CAD) which, besides becoming one of the four C's along with Computer Aided Manufacturing, Computer Integrated Manufacturing and Computer Aided Engineering (CAM, CIM, CAE), is becoming more systematically linked with Area Management and Facilities Management (AM/FM) and integrated with various levels of satellite imagery and Global Positioning Systems (GPS). A project sponsored by DeTeBerkom in conjunction with Art+ Com entails going from a satellite image, zooming down to a local aerial view at a scale where one can distinguish individual buildings and then zooming inside a given building. Telecom Italia has constructed a similar arrangement with respect to global emergencies for Italy. ENEL has constructed a hypermap for educational purposes. A synthesis of these approaches will be the next step, possibly in the context of the European Commission's Trans European Telecommunications Networks (TEN) project on virtual networked museums.

As the convergence continues between satellite photography, cartography, AM/FM, CAD and Global Positioning Systems (GPS) one will be able to move seamlessly from a view in space, through different scales to go successively to a world map and then to a local view. Recent films such as the *Shadow Conspiracy* show this principle in action right down to the level of reading the licence plates of cars on the street from space. This material will be accessible on line. It can also be given temporal dimensions. Animations can show how the boundaries of a given province or cultural movement change with time, can trace the travels of a particular artist or humanist, follow the influence of a specific motif, or style such as the Romanesque or Gothic, and even explore the parallel evolution of pilgrimage routes and new styles, e.g. how the route from Vézalay in France to Santiago da Compostella in North-Western Spain played an important role in the spread of Romanesque and later Gothic art.

Companies such as Autodesk have extended the notion of object-oriented programming to the building blocks of the man-made world through what they term industry foundation classes. Hence a door is now treated as a dynamic object which contains all the information pertaining to doors in different contexts. Hence if one chooses a door for a fifty storey skyscraper, the door object will automatically acquire certain characteristics which are very different from a door for a cottage or for a factory warehouse. This is leading to a revolution in architectural practice because it means that those designing buildings will automatically have at their disposal the "appropriate" dimensions and characteristics of the door, window or other architectural building block which concerns them. There is a danger that this could lead to stereotyped notions of a door, window etc., a McWorld effect, whereby buildings in one country are effectively copies of those in other countries, and travel loses its attractions because everywhere appears the same.

It is important to note, however, that the same technology can be used with very different consequences if one extends the concept of foundation classes to include cultural and historical dimensions. If this occurred, an architect in Nepal wishing to build a door, in addition to the universal principles of construction applying to such objects, would be informed about the particular characteristics of Nepalese doors, perhaps even of the distinctions between doors in Khatmandu or near Annapurna. Similarly an Italian restorer would be informed about the particular characteristics of doors in Lucca in the fifteenth century. All this may seem exaggerated. But after some of the key historical houses with elaborate ornamental carvings in Hildesheim were bombed during the second world war, a small group of carpenters worked for several decades to reconstruct the original beam by beam, carving by carving. They did so on the basis of detailed records (photographs, drawings etc.). If this knowledge is included in the cultural object-file of Hildesheim doors, windows and houses, then rebuilding such historical treasures would be much simpler in future.

At stake is something much more than an electronic memory of cultural artefacts which would serve as a new type of insurance against disaster. The richest cultures are not static. They change with time gradually transforming their local repertoire, often in combination with motifs from other cultures. The Romanesque churches of Northern Germany adopted lions from Italy for their entrances. The church of San Marco in Venice

integrated Byzantine, Greek and local motifs. The architecture of Palermo created a synthesis of Byzantine, Norman, Arabic and Jewish motifs. The architects in Toledo and at Las Huelgas near Burgos created their own synthesis of Jewish, Arabic and Christian motifs. A comprehensive corpus of variants in local heritage can thus lead to much more than a glorification of local eccentricities and provincialism. It can prove an inspiration to multi-culturalism in its deepest sense. It can include basic building styles, ornament and decoration.

These combinations were successful because they were guided by culture and taste. Combinations per se do not guarantee interesting results. If taste and sensibility are lacking the results are merely hybrid versions of kitsch. So the technology must not be seen as an answer in itself. It offers a magnificent tool which needs to be used in combination with awareness of the uniqueness and value of local traditions.

These new possibilities of using technology to expand the vocabulary of cultural expression apply not only to the physical, built environment of the man-made world. The latest developments in digital technology entail the use of virtual sets. At the simplest level a television commentator in New York or Toronto, when speaking about Paris, stands in front of a blue screen and using chroma-key technology has their image standing in front of a view of the Eiffel tower or some other Parisian scene.

The Distributed Video Project (ACTS 089) is taking these basic principles much further such that chroma-key principles can be applied to all four walls of a room, the perspectival space of which adjusts as one moves around. Hence a person in one city can be virtually placed within a different landscape or cityscape in another city. This technology has tremendous implications for the study of culture and history. To take a concrete example, Professor Iwainky (Berlin) has used Softimage (a Canadian CAD program now owned by Microsoft) to reconstruct the great Pergamon Altar in the Bode Museum in Berlin. The original altar stood on a high hill in Pergamon in western Turkey. The new technologies will permit one to take a film or video of the original location, combine it with the reconstructed model of the altar now in Berlin and allow a scaled image of an actor in another city to walk up the stairs of this altar.

Such reconstructions of historical monuments and sites represent an emerging field. IBM (France) has created a model of the Abby of Cluny complete with electronic monks to give one a virtual tour. IBM (Germany) has reconstructed the church of our Lady (Frauenkirche) in Dresden. Infobyte, (working with ENEL and the Banca di Roma), has recreated the Roman Coliseum and there is discussion, in conjunction with the University of California at Los Angeles, of reproducing the whole of ancient Rome. The National Research Council of Italy is also sponsoring a reconstruction of ancient Pompeii.

It is quite likely that within a few generations all the major cultural monuments of human culture will be available in reconstructed form. In the past, any historical film entailed a) expensive travels to the original site and b) the construction of complex models of key buildings in real or scale size. In future, as these new technologies mature, scenes from

all over the world will be available on line. Such scenes will be used by actors of historical films and fiction involving historical characters.

While all this introduces wonderful possibilities, it also poses tremendous dangers. There is a concern that the development of new technologies with its quest for standards leads to new kinds of cultural imperialism, whereby the uniqueness of any particular tradition will be rendered bland, anonymous, and general. In European film production this has led to what some call "Euro-pudding". In Canada, there is great concern that international viewers will not be interested in the details of local culture and "wish" instead to see towns which could be anywhere, be it in the United States, Britain or elsewhere. According to this view, the new technologies eliminate uniqueness and in so doing destroy local, provincial and national traditions of culture.

This is not necessarily the case. A recent conference in Seville (November, 1996) sponsored by the W3 consortium stressed emerging standards in both internationalization (across all the borders) and multi-lingualism (in order to reflect the unique expressions within borders). This seemingly elementary distinction offers an important model for future developments. Some periods have emphasized the universals of culture. The widespread use of computers means that local villages can put the particulars of their culture on-line. The advent of networked computers means that persons throughout the world can study, compare and receive inspiration from this diversity.

Some would use McLuhan's phrase the "medium is the message"¹ to claim that this trend towards universality is an inherent characteristic of the new electronic media. This is not true. Television, films, computers can document the particular and unique as well as the generic and universal. These alternatives are bound up with different definitions of knowledge. Does knowledge lie in the abstract generalities that all cultures have in common, or in the specific details which render them unique? These are competing approaches to the world, which affect both the exact sciences and the humanities. Those who favour abstraction emphasize physics among the sciences and fields such as sociology, social-anthropology and linguistics (as opposed to languages) among the humanities. They tend to use diversity as evidence that things are relative and that there is no such thing as a clear sense of truth. Accordingly, they tend to dismiss all subjects which depend on careful observation of individual data such as biology, botany, astronomy, language as topics for butterfly collectors, as if the details were a demeaning task rather than the foundation of true learning. This approach de-emphasizes the importance of history and focusses on the contemporary, the importance of now. Relevance becomes a key buzzword. In the context of business this means focussing on the last and the next quarter. In the context of information and education it means these concepts are subsumed under entertainment as info-tainment and edu-tainment.

By contrast, those who favour individual knowledge insist on a clear separation between entertainment (passing diversion) and education (enduring values and knowledge). They favour phrases such as "God (or even the Devil) lies in the detail" in order to emphasize the central importance of individual, concrete, empirical evidence which serves as the foundation of their approach to knowledge. As part of that quest for all the possible

evidence this second camp emphasizes the fundamental role of history, of a cumulative memory. This second camp continues to believe that the quest for truth, however difficult, lies somehow in the complexity of the details rather than in the universal generalizations.

The political consequences of the universalist approach are most obviously seen in the internationalist strands of communism and socialism and paradoxically in some new strands of right wing politics which favour international corporate interests over what they describe as narrow, provincial, parochial views. It is not our concern at this point to analyse in depth the complexities of these competing approaches to knowledge or to pass judgement on the relative merits of each. Here our purpose is simply to note that these political agendas which have fundamental implications for our concepts of knowledge and truth, especially in the universalist camp, frequently find it expedient to deflect attention away from their underlying assumptions and premises and point the blame on external factors such as technology, such that the unfolding events can merely be dismissed as inevitable consequences of the times.

To return to our main topic, the technological developments outlined above will also enable tourists interested in visiting Rome, to walk through the streets of the ancient city as it once looked. In some cases being a virtual visitor may be enough and may substitute the need to actually visit the actual site. This will apply particularly to environmentally sensitive sites such as the Tomb of Nefertari or the Caves at Lascaux, which would soon be completely ruined if they had millions of tourists annually.

Students and teachers at all levels will be able to use these new technologies to gain a new sense of history. They will be able to consult a map, choose a theme, such as Romanesque churches, then trace this either chronologically and/or geographically, decide they wish to see a particular church, say Vézalay, consult views of it, and experience a walkthrough in virtual reality. In future, auto-stereoscopic versions and even holographic versions of these objects are possible.

5. Navigation

From the above it will be clear that the computer revolution is about much more than simply recording existing objects. It entails reconstructing objects which no longer exist and to some extent exploring hypotheses concerning objects which are thought to have existed. How will we navigate through all this added information? Some believe that simple traditional lists will be sufficient, or that there will be new combinations of such lists. Nortel's Helmsman software includes features as Boolean searches and depluralization. Some assume that the geographical metaphor will be enough, that maps will help us find everything that we need. Others are exploring the use of spatial metaphors to arrange concepts.

The visible language group at MIT foresees the use of geographical maps and Cartesian co-ordinates for basic orientation, which would then be combined with different typefaces. More important concepts would be in bold script and use different typefaces.

Both Xerox Parc and the GMD have been exploring the potentials of three-dimensional spatial arrangements in the form of cone trees. Some favour a temporal metaphor, proposing that everything be organized in terms of time.

A number of persons are exploring cubes as a means of integrating time and space. The n-Power project (Toronto) is a simple example. Dr. Benking (Ulm) has a more complex version which relates three cubes to Sir Karl Popper's notion of the three worlds (subject, object, meaning), and foresees using perspective as a means of navigation.

Most of the above projects assume a solution that is either two-dimensional or three-dimensional. The System for Universal Media Searching (SUMS)² foresees a combination of these methods. In basic searches, such as looking for an author or title, a simple two-dimensional list is effective. Here the challenge is to be able to see the same basic facts in multiple ways: i.e., look at a bibliography alphabetically in terms of authors, editors, illustrators, publishers; chronologically, then geographically in terms of places and then view these trends as spreadsheets.

Geographical searches are very effective when searching for physically based objects. These can vary tremendously from simple maps with hyperlinks (as in Microsoft's Office 97) to the complexities of real-time fly-throughs requiring high-end Silicon Graphics machines. Eventually there will be a series of different versions of the same information and the system will adjust automatically to provide the level of complexity appropriate to the machine at hand. Hence a student working at home on a relatively simple machine will have access to a simplified version of the material, while a researcher at a major library will have access to a much more detailed version of the same material.

Spatial searches are particularly appropriate if one wishes to visualize relations between concepts as they evolve over time. The concept of perspective offers a case in point. When it was developed in the fifteenth century, it was typically classed under traditional subjects such as optics, geometry and architecture. As perspective evolved and became a subject on its own, titles which had previously been listed under the more traditional topics migrated to the new subject of perspective. If one conceives of the field as a circle, then a number of closely related subjects such as optics, scenography and architecture will be represented as a series of circles, portions of which intersect with the perspective circle. This configuration represents a two-dimensional slice at a given time. Just as amoebae cluster and join in the organic world, the advancement of learning can be seen as a history of clusterings of ideas. Viewed chronologically a subject such as perspective begins as a series of round dots in other fields which become funnel shaped as the subject grows, then converge into a new funnel as the subject becomes an independent field of study.

The size of a subject's circle and the size of the related subjects' circles vary with each classification scheme and with the holdings of a given library. In future, a student will be able to explore how different classification schemes affect a given field. It will also be possible to visualize different perceptions of a field, to see how a scholar using the

Göttingen library in 1730 had access to a given corpus when he studied geometry which was quite different from that of a scholar working in the British Library in 1930.

Some will object that these may well be amusing academic exercises, but they have nothing to do with the frontiers of knowledge and learning. Knowledge is changing at an incredible rate. There are an estimated 14,000 new chemical combinations found every week. A committee at the Library of Congress meets once a week to discuss changes to its classification system to take account of the latest changes in subjects. Hypermedia needs to provide us new means of mapping these changes, new ways of cataloguing clusters of important topics in order that we can know more effectively which are the subjects worth pursuing.

In business, data-mining has become one of the latest buzzwords. Data-mining is like moving to a new order or level of abstraction, not looking at the data in isolation but for patterns in the data, for instance, not looking only at how many persons bought vans, but how many of those persons had children who played hockey, owned their small businesses or also owned camping equipment. Hypermedia will allow new applications of data-mining to the world of knowledge, such that we can see patterns in the evolution of knowledge, recreating the ingredients which led to greater understanding. Are there patterns in Nobel prizes in terms of subjects, places, scholars of particular traditions? Are there significant co-relations between the topics of Nobel laureates and fields of research which are funded? How do we learn to recognize the fields which do not seem important at the time and yet emerge as those which change the world?

6. Agents.

Some futurists such as Nicholas Negroponte assume that agents will soon be the equivalents of electronic butlers doing much of our research for us. According to this vision machines will do the active searching and human scholars will be reduced to passive observers of the results. In our view agents which search out everything on a topic of our choice from a series of news-papers and other news-sources represent only a first generation of possibilities.

In future, one branch of agents might be trained specifically to explore our libraries and archives for patterns in knowledge, in order to understand, for example, why one country led research in a given field at one time, which then shifted to another country in a later generation. The agents could combine variables systematically, highlighting those which are statistically significant such that scholars can then study these areas.

7. Outer and Inner

For all their wonderful potentials computers also introduce fundamental problems. This is particularly true with respect to computer interfaces. Individuals in the physical world in front of the screen are trying to interact with words and images behind the screen. A standard mouse reduces the three-dimensional experience of physical space to the two-dimensional space of the flat screen. New devices, still at the experimental stage such as

the rocking mouse allow three-dimensional physical space in front of the screen to be coordinated directly with a perspectival version of three-dimensional space behind the screen. Other new input devices, still too costly and wieldy for everyday use, such as body sensors, allow the physical movements of a person in front of the screen to be coordinated directly with the movements of an animated figure behind the screen. New developments in virtual sets are increasing making it possible for a person outside the computer to interact directly with images and scenes inside the computer. For some years, science fiction films have been playing with the idea that a person enters into the computer. *Tron* was one of the early examples. Conversely, the film *Virtuosity*, explored the possibility of figures behind the screen escaping into the physical world.

Other researchers are exploring more radical means of overcoming this barrier between outer physical world and inner computer world, the challenge of entering through the window that separates the two. At the Human Interface and Technology (HIT) lab, Tom Furness III is using lasers which project images directly onto the back of the retina such that the eye itself becomes the projection screen. At the University of Tsukuba in Japan, there are experiments with what has been dubbed "robo-roach". He has removed the antennae of a roach and replaced them with electronic sensors such that a remote operator can send impulses for the roach to turn left or right. In the case of humans, the possibility of somehow plugging directly into neural paths has been considered by futurists such as Professor de Kerckhove in *Brainframes* and in science fiction films such as *Total Recall*.

Underlying the entertainment value of such possibilities are deeper questions concerning outer and inner, external and internal. In the past individuals had an inner world of experience which was personal. Expression and communication consisted of externalizing that inner world in the form of spoken or written words, gestures etc. Computers complicate this process. On the one hand they allow an individual to communicate in writing without the intermediary of the physical world. This may well be one of the fascinations of e-mail. I have a sense of sharing my inner thoughts without having to put them out into the open in the form of oral speech, or physical letters. It is as if my inner world were being connected electronically with the inner world of the person to whom I am writing: as if because there is every possibility that my message is intercepted by others and even printed or otherwise publicized without my knowing it .

Nonetheless, the very experience which may seem to be an inner one, entails an externalization of my inner person, and paradoxically the efforts to bridge the gap between the inner and outer, to link the user in front of the window with the images behind the window, the whole quest to journey through the window, or somehow remove it, is effectively an invasion of the outer into the inner, personal, private world. Is it a coincidence that the United States, the most advanced country in terms of computer technologies is undergoing a crisis concerning privacy to the extent that some now claim that privacy, a personal view in the old sense or personal privacy are all outmoded concepts? In a world where everything is expressed, where everything is externalized there is no inner world that remains.

In the outer, public world we have a whole series of mechanisms designed to limit the degree to which our personal affairs remain private, ranging from Personal Identification Numbers (PINs), passwords, encryption codes, confidentiality and non-disclosure agreements and even oaths to secrecy. Visible and invisible electronic watermarks allow copies of images and texts to be traced. The V- (Viewer Control) Chip allows censorship of things deemed unsuitable for our children. Curiously enough there is no corresponding set of tools in place to protect our personal, private worlds. An e-mail message can at any time be read by system administrators. We need new ways to protect our privacy, new ways to ensure that we continue to have a sense of privacy.

8. Immaterial Objects vs. Spiritual Subjects

Related to questions of outer and inner and their implications for our sense of privacy is an even deeper problem. As was noted above, the principles of object-oriented programming are increasingly being applied to all realms of the digital world such that even images of doors and windows are now being treated as objects, the properties of which adjust automatically to the context in which they are being used. Some describe this feature as intelligence in objects, or even as intelligent objects. We noted that this concept of objects could be much richer if it included cultural and historical dimensions.

For all its power this concept of objects entails subtle dangers. There is a danger that everything be treated merely as an object. Hence the computer shows images of objects, in isolation or in context. It provides lists of objects. It may even produce relations between objects. But somehow it deals only with objects. Objects can be inspiring paintings, beautiful statues, important monuments, majestic churches. Yet all of these are only external expressions of a creative spirit or a religious belief. So the function of the computer paradoxically lies in taking these external objects in the physical world and in a sense internalizing them on a computer screen or similar display panel. Whence there is a danger that the computer will foster only an electronic version of materialism, or immaterialism.

We need networks which will convey also the internal creative spirit and/or religious belief which inspired these works of art and culture. One way to approach this challenge is to catalogue the classics of spirituality. This will include the great religious texts such as the *Vedas*, *I-Ching*, *Talmud*, the *Analects*, *Bible* and *Koran* as well as the whole tradition of meditative texts. For the modern period it will include in electronic form Gurdijeff's *Meetings with Remarkable Men*, interviews with Carl Gustav Jung and others who have devoted their lives to studying sources of spiritual subjects rather than immaterial objects. Related to this will be electronic discussion groups on these topics.

Another way to do so is to use computers to link major spiritual impulses with the artefacts which they inspired. For example, one would link Greek drama with all the Greek and subsequent Roman theatres which resulted. One would link new impulses in Christianity in the eleventh century with the rise of Romanesque painting, sculpture and architecture. Similarly one would link twelfth century developments in Christianity with Gothic art and architecture. The cathedrals at Chartres, Cologne and Burgos are only the

objects of an idea, of a spiritual subject. Yet some ideas remained only vague phantasies, mere wish-lists, whereas others led to the construction of hundreds of new churches, thousands of monasteries or in our day thousands of banks. Computers can help us map the effects of the human spirit as a first step to exploring and understanding the sources of the spirit.

The spirit is universal. The expression is particular. To the person living in Chartres, the Chartres cathedral was that which we now call the Gothic. In Germany, the citizens of Naumburg, Magdeburg and Cologne added their own particular, local versions of the Gothic. In England, the citizens of Winchester, Salisbury, Peterborough, York and Canterbury added their own, individual, local versions of the Gothic. Indeed one could argue that ultimately the richness of the Gothic lay not so much in the original abstract ideas as in the resulting concrete expressions which embodied the local inspiration of individuals spread throughout the Christian world.

That richness was so spread out and so diverse that hardly anyone today has had a chance to see its diversity. Books on the subject typically deal superficially with a representative sample or in depth with a single church. Very few libraries have comprehensive collections of all the literature. If these materials are digitized, networked computers will offer new potentials for examining the links between universals and particulars. Far more than merely listing objects they can lead us via the expressions of the spirit to the spirit itself.

9. Conclusions

Hypermedia is too often hype or hyper and too seldom about new media. Potentially, however, it represents fundamental changes in our conceptions of knowledge. Putting that which we have in traditional books into electronic form on-line is only the beginning of this complex process. Hypermedia will change the way we capture images of books, paintings, museum objects and things in general. It will change the way we archive these materials. It will change the ways we display knowledge. It will change radically the way we navigate through our corpus of knowledge, teaching us not only to look anew at the facts but also to discern new relations among them.

These changes are not inherent in the new technologies themselves. There are competing approaches to knowledge which entail radically different agendas. On the one hand there are political agendas which favour a universalist approach to knowledge which undermines the uniqueness of the local, which destroys cultural diversity and erodes detailed historical awareness. If this strand triumphs it could result in a universal homogenization whereby culture is reduced to mere banalities. On the other hand, these same tools can be used to introduce a new contextualization of knowledge, to discover links between abstract ideas and their concrete, particular, individual expressions. Studying the particulars of the past, can inspire us to create a richer vocabulary of particulars in the future, which in turn will be more universal. By opening new windows into the external products of culture, they can help us, ultimately, to better understand their internal, spiritual sources. Thus the study of culture's objects will take us back to

study ourselves and the powers that be beyond ourselves. Paradoxically the very methods which threaten to undermine our distinctions between outer and inner also promise new insights into our inner being.

Notes

¹ Marshall McLuhan's interest in this phrase stemmed from his study how different media led to differing amounts of emphasis on the subjects of the trivium: grammar (structure) , dialectic(logic) and rhetoric (effect). Those who take the phrase without this context and treat it at face value, tend to look to other thinkers. See, for instance Rick Salutin, "The media and the messages have equal importance," *The Globe and Mail*, Friday 31 January 1997, Section C, p. 1, who, for this reason prefers Harold Innis to McLuhan.

² For a basic introduction to SUMS see:

"A Front-end for Multi-valent, Multi-cultural Searching", *ALT News 04, Applied Learning Technologies in Europe*, (February 1994), pp. 8-9, 14.

"Knowledge package construction and conceptual navigation using a System for Universal Media Searching, *Writers at work: professional writing in the computerized environment*, ed. Thea van der Geest, Mike Sharples, Chris Neuwirth, Norwood: Ablex, 1996, pp. 207-215. Publication linked with: *Writing conferences, European Association for research on learning and instruction. Special interest group writing and 7th European conference on writing and computers, Utrecht, October 19-21, 21, 1994, Abstracts*, Utrecht, p. 181.

For applications of SUMS to education:

"Electronic Media in the Study of Alberti", *Actes du Congrès International Leon Battista Alberti*, Florence: Olschki, 1995, (In press).

"Databanks in Education", *The 12th E.C.O.O. and the 8th I.C.T.E. Joint Conference*, Toronto, (May 1991), pp.412-418.

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