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SUMMA

A System for Universal Multi Media Access

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CHAPTER 1

A PROPOSAL CONCERNING THE REORGANIZATION OF KNOWLEDGE

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1) Introduction

Imagine Mr. Gutenberg in 1450 going to the trustees of a large foundation with the proposal that manuscripts were an outmoded form of communicating knowledge and that one should, henceforth, publish everything in the form of books. It would have sounded highly unlikely, if not impossible. Yet, in retrospect, Mr. Gutenberg's idea was undoubtedly a necessary and important step in the development of Western culture.

Today the suggestion that books have become an outmoded form of communicating knowledge and the idea that one should, in future, turn to a combination of visual screens linked with computers, will sound as unlikely and well nigh impossible as Mr. Gutenberg's proposal was then. Such a proposal is not a negation the value of what exists. The invention of printing did not lead to manuscripts being abandoned. Indeed their value has, if anything, increased. Similarly the development of computer based knowledge will not lead to books being abandoned. By rendering more accessible the treasure of historical knowledge, computers will throw more light on the precious value of the book and manuscript traditions.

The costs of a new encyclopaedia of knowledge would be staggering. It is the purpose of this essay to outline some practical and philosophical reasons why such a project is, nonetheless, desirable and in the long run economical. In the second part of this essay we shall provide a preliminary sketch of the proposed encyclopaedia in terms of a) the natural world, b) the man-made world and c) the interaction of man and his world. This will lead to some reflections concerning concepts of theory and practice, and culture. In the concluding section some practical steps will be mentioned.

2) Practical Reasons

There are various practical, businesslike reasons that make the reorganization of knowledge a matter of increasing necessity. We shall consider five of these briefly: security, conservation, access, efficiency, and politics.

I) Security

A number of the most precious verbal and visual documents exist in single copies. In the event of a disaster, be it a flood, a fire or a war (cf. 1939-1945) such documents can be destroyed and lost forever. The idea of producing a secret library with microfilm copies

of all these works does not resolve the problem, because such a library could again be eliminated by a single disaster be it an earthquake or a bomb. If, on the other hand, this information were computerized and transmitted to at least 50 leading libraries of the world, plus a few secret places one would have, so to speak, an insurance against disaster.

II) Conservation

Historical scholarship has a built-in predicament. Every historian knows the importance of returning to the sources. Yet when the source in question is a ninth century manuscript or even an incunable, then each turning of its folios contributes to deterioration. Conscientious librarians, therefore, have very good grounds for wishing that their best books had no readers. In the case of outstanding works the advent of facsimile editions has helped resolve this problem. On the other hand it is clearly unthinkable that one would start producing facsimile versions of great collections such as the British Library (BL) or the Bibliothèque Nationale (BN).

If such collections could be computerized then the great wealth of information that they contain would be available to scholars without their needing, in most cases, to consult the actual books. Much of the wear and tear produced by readers would thus be avoided. In cases such as the British Library where 70% of the rare book collection is in urgent need of restoration, this is not an insignificant consideration. Some questions, particularly those relating to the history of book production will, of course, continue to require first hand study of the sources.

III) Access

A great many books and historical documents lie in the libraries and archives of Europe. Notwithstanding increased mobility, a majority of scholars living in the United States, Canada, South Africa, Australia, New Zealand etc. have no hope of extended stays in Europe and will therefore never have access to the majority of the sources.

One might reasonably argue that a scholar should spend at least 12 months in a great library in order to get beyond a superficial appreciation of its contents. Yet what percentage even of European scholars has the possibility of spending a year in each of the British Library, the Bibliothèque Nationale, the Vatican, the Bibliotheca Augusta in Wolfenbüttel and the Ambrosiana in Milan to mention only a half dozen of the greatest centres? At a certain level, access is as much a problem for Europeans as it is for those on other continents.

The existence of the BL, BN and NUC catalogues alone is so useful that one can hardly begin to measure the practical advantages that would accrue if one had a centralized index merely of the contents of all the great libraries. On computer this information would be equally available to scholars in Aix-en-Provence and Canberra.

IV) Efficiency

Scholars regularly work for an extended period of time on a single text in preparing a new edition or in developing a novel interpretation. Much of their work, however, involves checking references, hunting down quotes, illustrations etc. Here one typically needs weeks or months before one has received an obscure book or periodical via inter-library loan. Once in hand, a few minutes are often enough to trace the pages or lines in question. Getting there is not half the fun: it is ninety percent of the work.

If such materials were available by computer then a) the sources would be saved the wear and tear of travel; b) scholars would save a great deal of time now wasted on preliminaries, and have in minutes what now takes weeks or month.

V) Politics

There is a great danger in our times that computer technology is seen as an enemy of the human spirit and that technologists be seen as enemies of those in the humanities. The problem goes deeper. At the moment an estimated 70% of all computer technology is in the United States of America. There is a danger that the United States be seen as a symbol of technology and technocracy and that Europe, striving to maintain its traditional humanistic ideals, develops a policy of non-cooperation. Power politics could lead to confrontation that would be to the detriment of the entire civilized would.

The challenge thus lies with leading computer firms to invest in computerized study of historical materials which will result in new insights into the humanities and confirm that technology and freedom of the spirit can complement one another. Large firms such as IBM are at present concerned with showing that they are great firms. This would be an obvious project for such a quantum leap. It would attract the curiosity not only of scholars but also of all the media. Once sufficiently advanced the results of this project could be made accessible to the world in a manner comparable to cable TV. Eventually everyone could have their own home screens for the encyclopaedia of knowledge ranging from a single screen to multiple systems as described below. Hence while the initial investment costs will stretch far beyond the specialized tastes of university circles: it will include everyman. Thus in the long run the venture will be profitable contributing at the same time to the resolution of frictions between America and Europe.

Such a project could equally play an important role in gradually resolving political tensions between the advanced world and the developing world. At present developing countries may aspire to gain access to technical knowledge, but there is no hope of their ever acquiring the historical knowledge on which Europe has based itself. Given an encyclopaedia of knowledge developing countries would have new horizons of access to historical knowledge. This would introduce them to the complexities of the European tradition: it would dispel simplified images of Europe as a place with feudal lords and rulers. It would make clear that many of the problems facing developing countries today, have also plagued Europe in the past. It would make it available much knowledge about

other nations, would make clear the common humanity of man and thereby contribute greatly to remove many political animosities that arise purely out of ignorance.

3) Philosophical Reasons

In addition to these practical reasons there are also philosophical considerations that play a role. Here a brief detour into the realm of ideas will be necessary.

In Greek and Roman times science as we now know it was not possible because persons unconsciously imposed their verbal/mental-visual preconceptions onto their visual images, thus imbuing their records of the natural world with subjective aspects and precluding any clear distinction between subjective and objective reality (fig. 1. i).

This distinction between subject and object was made possible through the discovery of linear perspective whereby was introduced a systematic relationship between object and picture-plane independent of mental or other interference from the observer (fig.1.ii). This opened the way to objective science. But an apparent dichotomy now entered the scene. When the relation is between object and picture-plane, then the observer's role is excluded, and it is objective. When the relation is between the observer and the picture-plane it is subjective (fig.1.iii). The objective relation, linked with science thus appears opposed to subjectivity which is associated with art. Objectivity becomes an ideal and subjectivity emerges as something negative.

A quite different approach to the subject-object problem is possible (fig.2). The object in the natural world can be seen in terms of a spectrum including models, visual images on the picture-plane, abstract geometrical figures and algebraic formulae. In this spectrum objectivity is measured in terms of the accuracy of the fit between the various factors and the extent to which the relations established between them are reversible and repeatable. In this context the role of the subject, subjectivity, becomes one of construction and relation building, the accuracy of which is then tested quantitatively. Here, objectivity is the natural complement of subjectivity and the central role of the individual again comes into focus.

The problem in our day is that persons are working in each of these domains as if they were independent realities. There are model builders, geometrical figure makers and algebraic formulae constructors, but the relations between them are no longer apparent and the rhetoric of objectivity has set the role of the individual into the background.

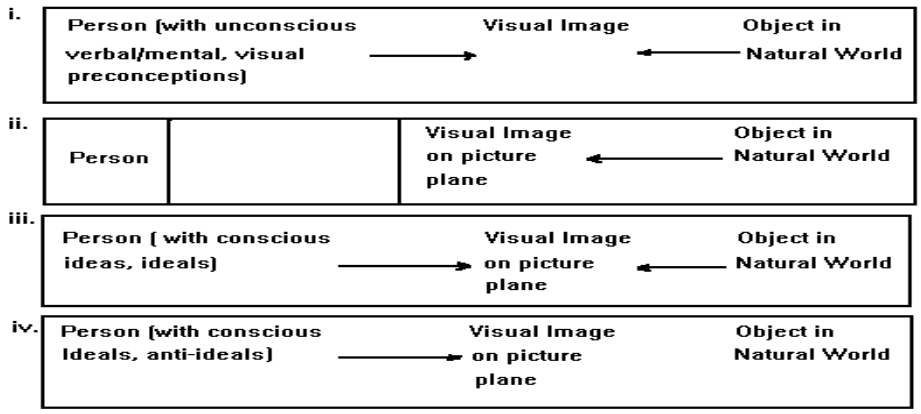


Fig. 1.i-iv. Different combinations of subject and object in the production of visual images. In Antiquity (i) subject and object remained intertwined. Renaissance perspective (ii) introduced the possibility of producing objective images geometrically even in the absence of an actual observer. It remained possible, however, to interpolate consciously onto this objective image subjective ideals (iii) or even to strive for a purely subjective image (iv).

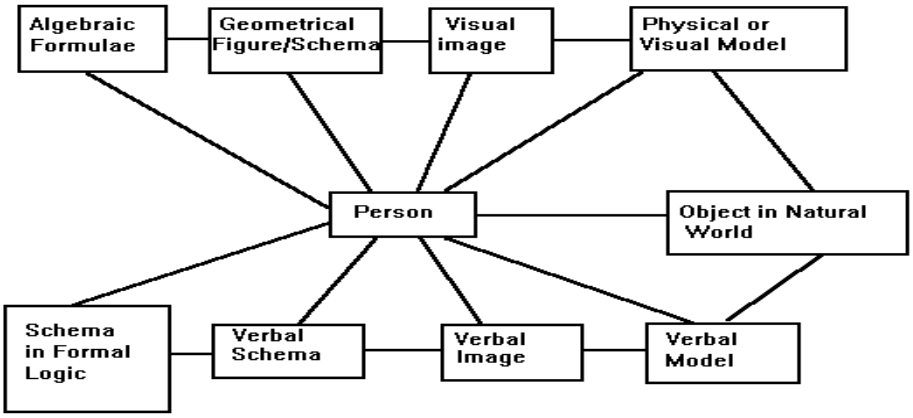


Fig. 2. An alternative approach to the subject/object problem. Geometrical figures, visual images, models and physical objects are seen in terms of the accuracy of the fit between various elements and their potential reversibility. The subject's role in this case becomes one of making models and geometrical figures as well as establishing relations. Hence subjectivity and objectivity emerge as interdependent activities. That which applies to images has parallels in the verbal image making process.

Approached in terms of such schemata there is an apparent opposition between subjective and objective activities (cf. fig. 2). A systematic reorganization of knowledge

in terms of different scales from micro-structures, through ordinary photographs to maps would serve to make apparent the nature of this spectrum from natural objects through concrete models to abstract formulae, and bring back into focus the central role of the individual as the builder of relations that can be tested quantitatively. Thereby the positive side of subjectivity will come back into focus. So too will the reason for many abstract levels of science, the relation of which to the visible world is often not clear at present.

Given such philosophical and practical reasons for reorganizing knowledge, we shall provide a brief sketch of what such an encyclopaedia of knowledge would involve, beginning with the natural world.

4) Natural World

Knowledge of the natural world can be subdivided into persons, things and places. We shall examine each of these in turn.

I) Person

At present bibliographical information about persons is scattered in national dictionaries of biography, dictionaries relating to fields of endeavour such as the *Dictionary of Scientific Biography* for historians of science and Thieme-Becker's *Künstlerlexikon* (fig. 3) for historians of art, biographical dictionaries ranging from Jocher's *Gelehrten-Lexikon* and Zedler's *Universal-Lexikon* to the modern *Who's Who*, as well as biographies devoted to specific individuals.

The problem with all these sources is that they provide primarily verbal information. The *Dictionary of Scientific Biography* discusses Hero of Alexandria but provides no diagrams or reconstructions of his automata. Thieme-Becker's *Künstlerlexikon* refers the reader to museums and volumes of illustrations but does not provide a single picture. To obtain such visual information often requires writing to the museums in question and may take weeks or even months.

If a visual television-like screen were linked with a computer then the information available from these various biographical reference works could be coordinated with the portraits, engravings, statues, medals and other visual records of a person.

The life of an outstanding person such as Erasmus would not be limited to a few paragraphs concerning birth, publications and death. A complete record of the visual images of the man, including the portraits by Holbein, would allow one to picture him. Visual information of the place in which he was born, the various places where he lived and worked, as well as where he died, chronologically arranged, would accompany the verbal records of his *curriculum vitae*. To the extent that the sources permit, visual

Fig 3. A page from Thieme-Becker's *Künstlerlexikon.*

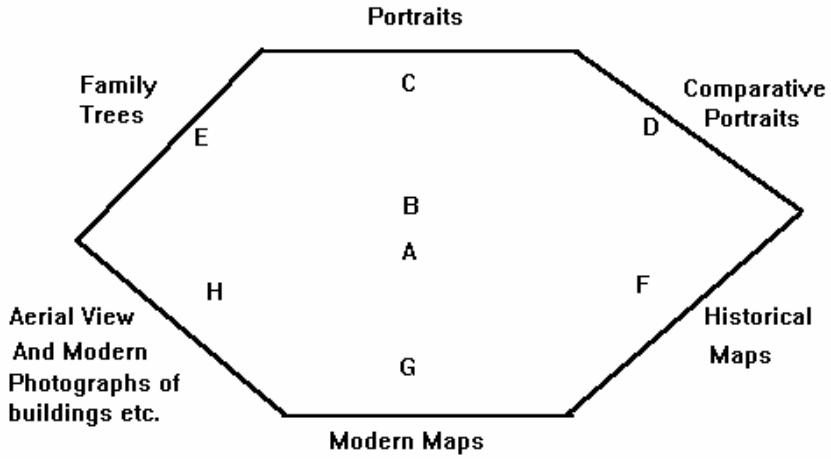


Fig. 4 **Ground-plan of an historical contextual study room applied to person**

information in the form of maps could help one to trace in detail his various journeys. In certain cases on could follow his journeys day by day, city by city, on a map.

At a further stage one might develop special study rooms in which this wealth of information could be presented more effectively (fig.4). The historian concerned with Henry VIII might, for example, sit at a desk (A) and have, in addition, to his given document (B) six screens, Directly in front (C) would be a portrait of the king at the time. To the right would be a series of other portraits for comparison (D). On the left would be a family tree to remind him of genealogical context (E). Let us assume that the document involved the Tower of London. A further screen would involve an historical map of London (F) showing the tower at that time. For purposes of comparison, one would have also both a modern map (G) as well as aerial and other photographs (H) of the same. A large version of such a room could serve as a classroom.

In the case of the writings and paintings produced by these individuals, a first stage would be to record these, so that one could, for example, systematically project onto a screen various paintings of Michelangelo, focussing on details at will. A next stage would be to trace the history of various motifs in the painting, both in terms of antecedents and subsequent copies or transformations and not just in obvious cases such as the *Mona Lisa.*

At a later stage one would wish to explore the extent to which national viewpoints have influenced biographical interpretation. For instance, how one’s estimates of Shakespeare's worth vary in England, France and Italy? In the case of the deeds of religious and political figures such as Mohammed this will become the more fascinating.

For what one source will describe as a triumphal victory, the opposition will record as a dismal defeat. What the West knows as the Fall of Constantinople was seen quite differently by the victorious Turks in 1453.

If all sources describing persons and the events they caused were translated and available for comparison, then the extent to which religious and nationalistic convictions colour the recording process would come into focus.

In addition to detailed records of individual figures a coordinated encyclopaedia of knowledge would open the way for larger questions. The verbal records of authors such as Pliny or Diogenes Laertius are basic sources for our knowledge of distinguished persons in antiquity. The statistics of these records could be studied to determine what percentage of the individuals described by Pliny are politicans, what percentage are military men, artists, philosophers, musicians etc.? How do these compare, in turn, with the percentages found in a mediaeval or, for that matter, a modern equivalent? If there are marked trends in biography, what can these tell us about trends in cultural history?

At the same time any number of possible correlations can be tested to determine whether or not they are statistically relevant: for example, whether a relevant correlation exists between great painters, poets etc. and given latitudes/longitudes; or between outstanding figures in one profession and a given sign of the zodiac. For the modern period, in countries with census records, the data potentially available is, of course, much greater.

Or more basic questions: how many doctors of medicine or theology published books in the 16th century? Where were they? In the case of treatises on perspective, for instance, 70% were published North of the Alps. With the aid of maps it would be possible to visualize patterns of publishing or shifts in areas of learning.

ii) Things

A similar means of classification could be introduced with respect to things be they a) animal, b) mineral or c) vegetable.

a) Animal

Animals would be listed alphabetically. In the case of given animal such as the lion the computer would record theories re: its development; a chronological list of literary and scientific descriptions and references and a corresponding chronological list of visual records. These would be stored in such a way that they would permit ready shuffling. Hence it would be possible to obtain in chronological succession pictures of all large-scale bronze lions known to have been produced in Europe between 1200-1250. Or, adapting the methods of pattern recognition, one could programme the computer to make a search for all lions of a given iconographical type.

With such a method, the problem of the historical influence of Dürer's engraving of a rhinoceros, which Gombrich has outlined with a few key examples, could be traced

comprehensively for this or any other animal within minutes. This would open the way for studies of the comparative influence of iconographical types.

At a later stage one would wish to supplement these macroscopic records with records at the microscopic level, thus providing information when the first known dissections of the animals were made and building up to what is effectively a historical case history of each animal.

b-c) A corresponding procedure could be used in classifying things mineral and vegetable.

iii) Places

In terms of places one would wish to coordinate satellite and other aerial views with the information on maps contemporary and historical. These would, in turn, be aligned with the visual records of man-made constructions such that a student of the 16th century could, for example, see in succession all world maps produced in that century, then all maps of Europe, then maps of Italy, then of Umbria, then topographical maps of Florence, then visual records showing battles, royal entries or pageants in the city, then pictures of individual buildings.

For a city such as Florence the computer would, moreover, have stored a complete set of historical records. This, combined with the detailed information listed under the category of persons would open up whole new approaches for the cultural historian. It would, for example, be possible to trace the journey of his battles, entries, pageants, and related festivities on the other hand. In assessing the significance of such entries etc., comparisons quantitative and qualitative, could be made with contemporary, previous, and subsequent examples.

In having access to visual records ranging from world maps to topographical maps and ground plans of individual buildings the way would be open to a historical approach that was international and yet retained the very detailed information that is usually restricted to local histories.

5) The Man-Made World

The encyclopaedia of knowledge would also reorganize verbal and visual information concerning the man-made world and this under two basic headings i) material and ii) mental /spiritual.

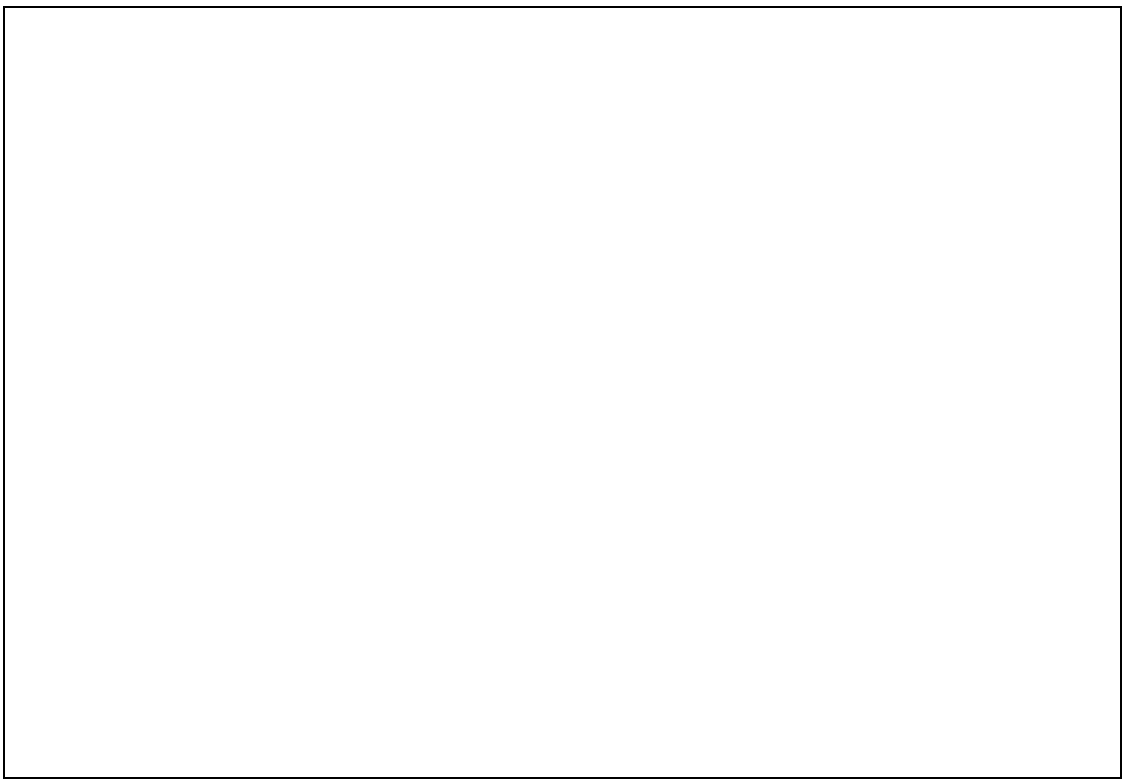
i) Material

Under this heading would come all the constructions, instruments and inventions of man, ranging from castles, temples and cathedrals to burning mirrors, cranes, eyeglasses etc. Each construction say, a castle such as Harlech, would serve a heading for information that would include ground-plans, historical pictures and modern photographs. As well as the relevant written documents there would in addition be cross-references to related structures. In the case of Harlech, for example, there would be reference to the other five castles constructed by Edward I when he was conquering Northern Wales (1270-1290), namely, Caernarvon, Beaumarais, Conway, Rudlan and Flint.

In the case of a building such as the Parthenon it would be desireable to coordinate knowledge from different levels and scales: a European map on scale of 1: 5,000,000 showing Athens; a topographical map of Athens on a scale of 1: 50,000; an aerial photograph on a scale of 1:50; a ground-plan; a plaster cast on a scale of 1:1 and archaeological samples of building materials involving microscopic scales.

In addition one would wish to have a systematic arrangement of all the knowledge concerning like structures and a means of cross-referencing this information spatially and temporally. Hence it would be possible to see where the Parthenon is on a map in relation to all other temples in the Greek world from Ampurias in Spain through Uzuncaburc in Turkey. Temporal coordinates could then be introduced to clarify which temples were built in the seventh, sixth and fifth centuries respectively.

Similarly a systematic arrangement of all knowledge concerning parts of temples would be needed, such that a figure on a Parthenon frieze could be compared and contrasted with figures on other Greek temple friezes, and ultimately with all other Greek sculpted figures.



Again one might have a special study room for viewing such information (fig. 5). A scholar could sit (A) in front of a control panel (B). In front of him they would have a picture of the Parthenon (C). Particular details such as columns, friezes etc. would be focussed on a second screen (D). For purposes of comparison either one large picture or multiple small pictures of other temples would appear on a further panel (F) and source material, i.e. historical references to the Parthenon in Greek and subsequent authors would be available on a further panel (G). A fourth screen would provide historical maps and topographical views of Athens (H), which could then be compared with both modern maps (I) and aerial views (K).

In the case of building such as the Colosseum which stands in a traditions of views of Roman monuments (*vedute*) by artists such as Martin Heemskerck, Francisco d'Hollanda, Androuet du Cerceau, Piranesi etc. the material would be all the richer and one could confront, in this study room, how perceptions of famous buildings have changed with time. Such a study room could again be expanded into classroom dimensions.

Besides such an historical contextual room one might at a later date also have a panoptical room (fig. 60). Here a viewer (at A) would sit in front of a

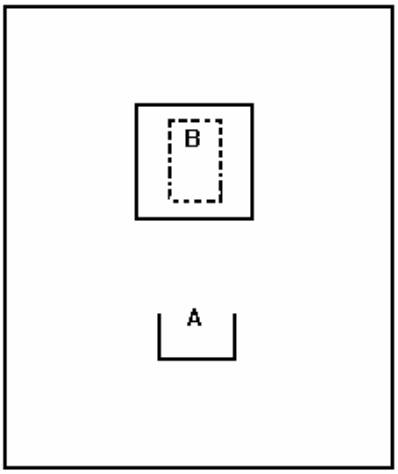


Fig. 6 Ground-plan of a panoptical study room.

ground-plan (B) of a building such as the Parthenon. On this ground-plan they would determine a viewpoint that interested them and projectors would then convey photos onto the walls and ceiling resulting in a panoramic view such as that available on the spot. With the rapid development of laser technology it is feasible that effects of spatial verisimilitude could in future be heightened still more.

The new encyclopaedia of knowledge, besides offering readier access to the myriad individual details, will also permit new surveys of general trends in human culture. With the aid of maps and pictures it will, for example, be possible to trace the development of the Greek temple as an institution of worship over time. The spread of this institution throughout the shores of the Mediterranean and to the limits of the Greek world can be followed, as can its demise as a basic place of worship. The architectural forms connected with religion (temple, synagogue, church, mosque), contest (hippodrome, colosseum), play (theatre) and other basic aspects of human culture can be examined and their evolution studied. One can trace, moreover, whether a civilization concentrated its building energies with edifices connected with the life after death of their key individual (tombs, pyramids), contest and play in the present life (colosseums and theatres), or future aspects of the present life (banks and insurance buildings).

In addition to alphabetical and chronological lists of man's material objects it would be useful to arrange instruments and inventions under categories such as extension of the senses, extension/intensification of the powers of nature and to correlate these geographically and chronologically to bring to light large trends in technology and culture.

ii) The Mental and Spiritual Man-Made World

Corresponding to the biographical list of real persons there would be a list of all supernatural, legendary or fictive persons/personifications, i.e. gods, heroes, literary figures and allegories. Each of these would again serve as headings for the relevant verbal and visual information.

In the case of an example such as Christ where historical reality combined with supernatural dimensions have generated a highly evolved iconography one would wish to introduce subheadings in the visual records such as Birth, Flight into Egypt, Virgin and Child, Presentation in the Temple, Last Supper, Death on the Cross, Taking Down from the Cross and Resurrection.

A geographical and chronological correlation of these themes would open the way to studies of iconographic trends, for example, whether birth, childhood, youth, death or resurrection received particular attention, These trends in the representation of the life of Christ could subsequently be compared with representations of the lives of various saints, heroes etc.

A systematic list of personifications, e.g. war as Mars, love as Venus etc. bringing together both verbal and visual records would open new avenues of study for comparative ethnology. Trends to verbalize certain themes and visualize others could also be identified.

That which applies to persons could be applied equally to imaginary things be they animal, such as the phoenix; mineral, such as the philosopher's stone; or vegetable, such as the elixir of life, or places, such as Atlantis or Mount Meru.

A similar method could be introduced to record the mathematical tradition. If the corpus of classical geometry were stored along with the various mediaeval manuscript versions it would be possible, through an adaptation of simple pattern recognition methods, to begin with a geometrical diagram in say, the writings of Galileo or Leonardo and to determine a) whether it had a classical precedent and b) via which of the mediaeval manuscript traditions it came.

There has been much talk in recent times of what the French have coined, *histoire des mentalités.* We have not even begun, however, to map out the limits of man's consciousness as recorded in the sources and to trace this change historically. To take a simple example: how many animals were known in *Old Testament* times? How many more were know by Aristotle, by Pliny, by Vincent of Beauvais, by the eighteenth century encyclopaedists and so on? One would wish to trace not only quantitative statistics but also to compare qualitative descriptions and to compare these culturally. Moreover, one would wish to compare the relative energies devoted to writing about different aspects of the natural world, showing, for instance, how one country is particularly concerned with flora and fauna while another is more attentive to minerals.

One could take modern classification tables of various genera and species and then trace temporally and spatially how knowledge of these was gradually acquired. This would not only apply to the perceived limits of everyday objects. In astronomy the changing limits of the universe could be reconstructed historically. With respect to religion one could catalogue descriptions of virtues and vices, as well as visual and verbal images of heaven and hell. Conceptual maps of legal consciousness could be developed showing the expansion of taboos and the proliferation of precepts both civil and penal as civilization expands.

6) The Interaction of Man and the Natural World

This heading could be subdivided into headings such as i) struggle/work, ii) leisure/play and iii) man en route.

I) struggle/work

This subheading would be further divided into persons and things. Struggle with persons would include records verbal and visual of fighting, battles, war. Among things animal, struggle would include hunting, the preparation of the thing hunted and the selling thereof. Among things mineral this heading would entail mining. Among things vegetable struggle/work would entail agriculture.

Such an arrangement would again open the way for studies in trends of expression, whether the emphasis of a period be on production/acquisition of a thing, on its preparation or on its consumption.

ii) leisure/play

This heading would include subdivisions as eating, drinking, dancing, singing, games and sport. Comparison with the previous category would reveal the trends whereby themes of struggle/work become themes of play/leisure: e.g. human fighting tends to become wrestling and play fighting; the task of hunting/fishing tends to become the sport thereof.

iii) man en route

This subheading would involve the theme of persons en route be it by foot, by horse, by carriage or more modern means.

7) Theory and Practice Reconsidered

Such a fundamental reorganization of man's knowledge brings into focus the enormous spectrum of scales ranging from electron microscopic analysis on the one hand, through normal photographs and maps to geometrical and algebraic abstractions of reality. This spectrum does not merely reflect the theory side of practice. For as this spectrum has evolved we have come to distinguish ever more clearly between descriptions, technical

and imaginative explanations, prescriptions, proposals and creative conceptions. We distinguish between things that exist physically, between those that are planned to exist physically and those that are purely phantasy. We distinguish sharply between the structure of objects and their function.

All these are distinctions, which did not exist even 500 years ago. (In optics, for instance, Kepler first made the distinction between real-imaginary images nearly four hundred years ago (1604). These distinctions are clearly linked with the development of the spectrum that we have just outlined, and raise the familiar chicken and egg problem: did the distinctions cause the spectrum or conversely? To answer this question will require a map of the entire spectrum and a sense of which aspects developed when and where.

Involved in these shifts is something very basic. Although the term "theory" is clearly derived from the Greek, literature devoted specifically to theory as opposed to practice appears to be another innovation of the Renaissance. In short man's awareness of the predictive and prescriptive dimensions of knowledge is closely bound up with this gradual discovery of a possible spectrum between the concreteness of everyday objects and the abstractions of geometrical and algebraic figures. To understand the spectrum is to discover the roots of distinctions that make distinctive the modern world.

8) Culture Reconsidered

There is much talk in our day of a superculture (Boulding) by means of which buildings are becoming standardized the world over: an airport in one country is effectively like an airport in another country. Culture, once a source of diversity, is now gaining overtones of monotonous regularity, becoming an offspin of regularized technology.

What is needed is a new survey of our historical heritage, which will provide insights into a more complex view of the cultural process. At one level every-man participates in culture. Local persons decide on local costumes, on special dances, on parades and festivities, on the facades of houses. These very carefully defined expressions give to persons in all walks of life a sense of distinction and importance. The shepherd, the milkmaid, the butcher, the shoemaker, all have a conscious sense of their role in the microcosm. Persons in one region consciously build differently than persons in other regions. Each town is convinced that its way of proceeding is the best in the world and this pride gives it enormous strength. At this level culture is decentralized, is regional and emphasizes diversity.

At another level there is an international culture which draws its strength from this very diversity of the everyday. When Justinian wished to build Hagia Sophia he persuaded Diodorus of Miletus, who had been directing the Platonic academy in Athens, to work with Anthemius of Tralles. He imported marble and other materials from places stretching from Egypt to the Pyrenees, and drew on building styles from all over the Rome empire.

An encyclopaedic approach to these dimensions of culture would confirm that the number of builders, building materials, methods or styles is far more dynamic than is usually imagined. Different styles need not necessarily conflict: they can be combined in creative ways.

A greater awareness of these trends would, moreover, bring back into focus the central role played by everyman in the great moments of mankind. The great cathedrals of the Middle Ages were not built solely by great experts: for the most part they were built with the help of the average man.

In the last century it has become ever more the fashion to argue strictly in terms of economics: it being held that modern architecture needs to be ugly, because one cannot afford beauty. And yet we are living in an age where the average man has more free time than ever, to reconstruct his microcosm, the town, in the image of his ideals, such that the advantages of modern technology need not impair the expression of aesthetic and personal values, whereby the amazing and beautiful variety of the human spirit comes into an international sense of the human community.

9) Practical Steps

A project that may well take a few generations at least to accomplish must begin with caution. Perhaps even greater than the technological barriers are the psychological barriers that stand in the way of such a venture.

Ideally a chair in visualization might be established. The holder of this chair would be concerned with the problem of restructuring traditional approaches to history and seek to encourage students to explore new horizons using such techniques.[1]

Ideally, the holder of this chair would gain the full cooperation of a major European (Siemens, Philips) or American (IBM) computer firm. Guided by their expertise they would make a fact-finding tour around the world, accompanied by one or more computer and or visual/electronics experts. With a clear knowledge of the present state of technology, one could then determine what technological advances or adjustments in equipment would be needed before embarking on a pilot project.

This clear one might begin with a relatively small project: coordinating various maps of Rome and photographs of Rome with the numerous books on Roman Antiquities (*vedute*) in the Renaissance.

Once the basic principles of recording and recall were clearly established one could develop sample packages of knowledge for the future encyclopaedia. These could then be judged by experts in various fields who would propose improvements.

A next stage might well be to tackle the challenge of recording all books under a subject heading such as *Geometria* or *Physica* in a library such as that at Wolfenbüttel, the result again being assessed by experts in the respective fields.

The way would then be set for the computerizaton of an entire library[2]. The computerization of major European libraries would follow. Thereafter it would increasingly become a question of coordinating various national projects and developing computer facilities sufficiently large and complex to record the sum of this information and analyse it in fresh ways, cooperating with bodies such as the Gesellschaft für Information und Dokumentation in Germany and similar bodies elsewhere.

Once the major Western European collections have been systematically coordinated within a master programme, the project can be extended to include Eastern Europe. Here the stipulation can be made that future access to the West-European encyclopaedia requires present access to the present body of East-European knowledge. Mutual interest will thus serve to overcome ideological and political obstacles.

Meanwhile various related projects in the United States, Canada, Japan can be adjusted and fed into the master programme. Branch projects will spread to other advanced, developing and underdeveloped countries, probably co-ordinated under the auspices of UNESCO.

The procedure here outlined with respect to libraries applies equally to museums, galleries, archives etc.

As the project progresses an enormous amount of effort will be needed simply to supply the computers with the information at hand. Here an amendment of university promotion policy may prove of great use. At present tens of thousands of academics throughout the world write articles for specialist magazines, which remain readily accessible to only a few in a narrow area of scholarship. If the academic value system awarded more points for pertinent contributions to the computerized encyclopaedia than for obscure articles, then the combined energy and expertise of the world's academics would become focussed on a single project.

The project might even catch the popular imagination. Then literally everyone could contribute. To find some item not yet recorded in the encyclopaedia might become a game, perhaps even a contest with honours and prizes. With everyman's cooperation, everyman' encyclopaedia would become reality much sooner.

Wolfenbüttel 1 December 1981

CHAPTER 2

REALITY, KNOWLEDGE AND EXCELLENCE

1) Introduction 2) The World of Ideas and Reality 3) Creatural Realism 4) Idealized Creatural Realism 5) Materialist Creatural Realism 6) The World of Ideas and the World of Humans 7) Creatural Realism and Human Beings 8) Idealized Creatural Realism and Elitism 9) Materialist Elitism 10) Knowledge and Excellence Re-defined.

1) Introduction

This essay provides a sketch of different definitions of reality. It examines how these definitions affect concepts of knowledge of the physical world and human excellence. This leads to a critique of contemporary elitism and proposals for a fresh approach to excellence.

2) The World of Ideas and Reality

Plato associates reality with the world of ideas. In the case of an object such as a temple he would hold that it is the universal idea of a temple that is real/true and that actual, individual temples merely constitute imperfect copies, which are less real/true than the archetypal idea.

At a rhetorical level knowledge of this world of ideas is visual, but on closer examination it is so only in a restricted sense. Persons may claim to be able to visualize the idea of a temple in their heads, but any attempt to make an actual drawing or other visual representation of such a temple would involve a particular structure rather than a universal idea. Hence if the universal idea can be mentally pictured it cannot be physically drawn. No objective model or standard is therefore possible.

Plato might agree that the Parthenon on the Acropolis of Athens offers a good example of a temple. Nonetheless, because this example is ultimately only an imperfect copy of the real, details concerning this structure fall outside the scope of Plato's concept of knowledge concerning temples.

In the absence of a physical drawing or a concrete example that could serve as a visual standard, Plato is constrained to fall back on verbal formulations. At best he can hope, through discussion with others in universal terms, to arrive at a verbal consensus concerning the idea. Thus knowledge of the ideas inevitably becomes expressed verbally not visually and the encyclopaedia of Platonic knowledge becomes the dialogue.

Given that reality is in the world of ideas, all that occurs in the physical world is ultimately outside the scope of both reality and knowledge. All human effort in producing new temples, all experience is ultimately of no interest. All particular examples of temples are insignificant.

The reality of the world of ideas is held to be eternally true. The idea of a temple must therefore remain static. Within Plato' framework there can be no development of the idea of a temple in the course of time. A history of temples is thus precluded.

By definition the idea of a temple concerns the temple on its own, independent of any context. Whether a temple is built on a hill or in a valley, whether it dominates its setting or is subordinated to a minor role, whether it is large or small, all these are questions which do not fit within the Platonic knowledge of temples. A geography of temples is thus also precluded.

While making claim to knowledge about the eternal ideas of objects such as a temple, Plato cannot hope to explain why the temples as a context for worship should have developed at a given time or place in history or why it was subsequently replaced by other constructions such as the church or mosque. Indeed his static concept of knowledge of temples precludes any dynamic knowledge of the function of temples and without this the story of their changing importance escapes him. In short, Plato's approach to reality and knowledge may theoretically promise everything, but in practical terms it provides very little. In focussing on a theoretical world, it ignores the world of practice. It is a deductive framework capable of being discussed but incapable of being tested or verified. Hence it is not surprising that Plato has had a constant stream of critics through the ages (from Aristotle through to Popper).

3) Creatural Realism

The Judaeo-Christian tradition with its concept of creation out of nothing (*creatio ex nihilo*) introduced a fundamentally different approach to reality (Auerbach, Foss, Polka). Created by God the physical world was no longer an imperfect copy of a world of ideas. It could now be considered as fully real, as could the man-made objects therein.

Neither mental picturing nor verbal images alone could hope to provide an accurate record of this physical reality. Actual visual images in terms of drawings (ground-plans, elevations etc.), pictures, photographs, models-- possibly complemented by verbal images--, constituted the medium of knowledge. As a result any claim concerning knowledge could now be objective.

Given creatural realism the abstract idea of a temple as such no longer constitutes an essential aspect of knowledge. Hence discussions about universal characteristics ultimately become secondary. Of primary importance now is the particular example of a temple and its individual characteristics. The Parthenon in Athens is no longer an imperfect copy of the real: it is a real example worthy of detailed study. The scale of this particular temple, the measurements of its various parts, the type of marble from which it is made, the sculptures it contains, are all aspects that now fall within the scope of knowledge.

This applies not only to the temple at Athens. It applies equally to the temple at Segesta, Agrigentum, Paestum, Didyma and Uzuncaburc. All experience is now of interest. Each further particular example of a temple introduces a new variation of reality and is, therefore, significant.

Since experience and particular examples are assigned an essential role, the concept of a temple cannot remain static. Temples change with time. When a given temple was built therefore becomes important. A need for a history of temples thus follows directly from a belief in creatural realism.

Moreover, each particular example cannot be understood in isolation: it involves specific location, setting or context. Whether a temple is situated in a high or a low place, a dominant or a subordinate place now becomes important. Hence a belief in creatural realism also implies a geography of temples.

Knowledge is now potentially inductive, involving a visual record of all particular examples and a comparison/contrast of their individual characteristics, taking into account both the dimensions of time (history) and space (geography). In Plato's framework knowledge had been closed, finite. Given creatural realism, knowledge is open and potentially infinite; no longer a static given, but a dynamic, cumulative process.

4) Idealized Creatural Realism

Notwithstanding fundamental differences in the Platonic and Judaeo-Christian approaches to knowledge, there have been continuous attempts to synthesize and reconcile them (Augustine, Plotinus, Aquinas, Scotus, Whitehead). These attempts have been both philosophical and practical, conscious and unconscious.

At the unconscious level these efforts have had dramatic consequences for the approach to and organization of knowledge. With respect to temples, for example, there has been a tendency to accept the reality of individual examples, concentrating, however, on outstanding ones, treating these as corporeal manifestations of the ideal. Hence the importance of an example such as the Parthenon in Athens becomes emphasized beyond all proportion. This example often functions as an epitome of temples at Selinunt, Miletus, Ephesus or Aegina which are ignored. Indeed variations which occur in other temples in the course of time are overlooked. The history of temples becomes unimportant. Moreover, that it is the situated on a given acropolis, that it has a specific setting also tends to be overlooked. Context is ignored. The geography of this and other temples becomes unimportant.

In the case of the Parthenon, the problem of missing context goes deeper. Lord Elgin removed many of its friezes and deposited them in the British Museum in London. Others were removed to the Acropolis Museum. Individual parts of the Parthenon now function as characteristic examples of friezes, metopes etc. As a result a conception of the Parthenon as a whole is difficult, if not impossible. An individual standing before the British Museum has trouble in imagining the temple for which they were built, let along the actual setting of the temple in question. On the other hand, the person standing in front of the Parthenon itself has equally great trouble in imagining just how this temple would look if the original friezes were still in place.

That which applies to the Parthenon in particular applies to archaeological sites and museums generally. The sites confront the viewer with contexts devoid of individual parts and objects. The museums confront the viewer with individual parts and objects devoid of context. Nor does the process of compartmentalization of knowledge stop here: visual information about temples is stored in art galleries or photographic archives, while verbal information about the same temples is usually stored in books within libraries. The knowledge that exists about a given temple or any other object thus comes to be stored in so many different places that only the rarest persons can hope to have the know how to gain access to all these sources and develop a full catalogue of the knowledge concerning it. Most persons are doomed to having access only to isolated books or pictures which convey the knowledge in such abstract ways that one has the greatest difficulty in relating this to physical objects in space and time. Temples become reduced to lists of statistics about lengths of columns and sizes of stylobates, or learned patinage about the number of centimeters by which this column's entasis is at variance with another column in another country-- which one may well never have a chance of seeing. As a result the sensuous experience of seeing an actual temple is reduced to an intellectual game with figures and words. Knowledge, which involves lively objects, is reduced to lifeless facts. The connections between the sensuous column and the dry statistics concerning its *entasis* cannot be made with the statistics alone. Thus what was potentially fascinating knowledge is reduced to boring, bookish knowledge.

In classifying the various aspects of knowledge about temples in different places, thereby the sensuous dimensions of knowledge are lost. Knowledge may remain technically or intellectually valid, but it is doomed to unnecessary sterility.

5) Materialist Creatural Realism

Another variant of creatural realism concentrates on certain temporal and spatial dimensions of objects and employs these to emphasize the development of given key concepts. Here history and geography are assigned a causal role, such that all progress is held to be determined by these dimensions.

In this approach the concept of history itself is transformed, however. No longer a simple temporal record, history now becomes a story of abstract intellectual concepts in turn: freedom, liberty, equality etc. Concrete objects are subordinated to these abstract concepts. Hence a single fortress such as the Bastille may acquire enormous significance for the history of liberty. In such a case, the date when the Bastille was stormed may become crucial, but the date when it was built may well be forgotten. That the Bastille was situated in Paris may be emphasized, precisely on what street it was located, what building surrounded it, whether it was on level ground or on a hill are all questions which may well be ignored. Many details of history and geography fall outside the scope of this approach to knowledge.

For similar reasons, large questions of context, such as the position of a Bastille in the history of fortresses, tends to fall outside the scope of this approach. Indeed a history of

fortresses, temples or other concrete objects on the own is unthinkable. A conceptual teleology subordinates everything in ideas, ideologizes everything.

Behind a rhetoric of complete objectivity which considers all knowledge of all classes and all levels, this approach thus screens out most knowledge, focussing only on those objects which provide evidence for pertinent abstract concepts. With this approach, a record of all existing fortresses, temples and other objects becomes unnecessary. Knowledge cannot be cumulative in its fullest sense. Examples are not collected or studied for their own sake. Examples cannot be infinite. They must remain restricted if they are to illustrate efficiently *a priori* arguments.

6) The World of Ideas and The World of Humans

If the world of ideas constitutes the prime reality, then reality is limited to being theoretical, or spiritual. Within this framework a person is conceived as being a mixture of spiritual and material aspects and, for this reason, at best an imperfect copy of the real. A person is therefore of interest to the extent that they are not materially human rather than for their qualities of humanity as such. Analysis of persons tends to be in terms of the extent to which they reflect abstract ideals: beauty, the good etc. This analysis tends to be largely static. Either one is beautiful or one is not. Development of character is a phenomenon not built into the Platonic conception. Faults, failings, human weakness and error are either ignored or damned. That these dimensions of the human being could play a positive role in the development of personality is alien to the Platonic approach. Persons become acceptable to the extent that they possess divine qualities. That persons are actually human is an embarrassment and that most persons are all too human means that they must ultimately be excluded from consideration. Everyman may get a mention but he never plays a significant role on the Platonic stage: the scene is set for godlike persons but hardly for human beings. Spiritual and material remain in opposition: a notion of the whole man/woman who holds these aspects in balance is not possible within Plato's framework.

7) Creatural Realism and Human Beings

Since God created man/woman in His own image and likeness an opposition between spiritual and material dimensions disappears. Body and soul are now integrally related: wholeness is a norm.
If man/woman can be created out of nothing, change, development is also a norm. Far from being a static given the individual is a dynamic phenomenon. The dramatic implications of these basic principles have been studied in some detail (Auerbach, Foss, Polka).

8) Idealized Creatural Realism and Elitism

Idealized persons of exceptional beauty, intelligence, physical strength etc. are made the focus of attention. The average person lacking these exceptional qualities is given little attention or ignored altogether. The qualities and talents of these idealized persons serve

to set them apart from their fellow men. The extraordinary gifts of individuals serve primarily to exclude them and separate them from those with ordinary gifts. Indeed extraordinary talents are seen merely as means of gaining supremacy over those with ordinary talents. Supremacy ensures one financial and other means by which one can do as one pleases, concentrating on one's own advantage and ignoring others. A metaphorical ladder of success arises with a Darwinian edge of survival of the fittest.

The constant attention in mass media to idealized persons, even when everyday matters such as the advertisement of cigarettes are in question, makes the average man, everyman, feel excessively inadequate. Feeling hopelessly inferior he develops an inverted superiority complex. This seems to confirm the exclusive instincts of the few and the up-down class perception of humanity crystallizes to the point that generalizations become plausible and even convincing. The human aspects all persons have in common go by the board as a result. So too do the individual qualities of each individual. Personal differences thus explode into impersonal conflicts, which are the heritage of humanity as a whole. In self-defense the talented begin to retreat. In the eyes of the average man this amounts to a confession of guilt. The few now become scapegoats for all that is bad. An opposition between the bad few and the many good develops and with it the rhetoric that the category of the few should be destroyed altogether. Forgetting logic and practicalities of life the average man finds himself calling for, demanding, even fighting for an abolition of all that is extraordinary in his (fellow) men. Elitism now appears as a root of all evil.

9) Materialist Elitism

An alternative form of elitism works more subtly: Extraordinary talents are encouraged, fostered, rewarded but they are not publicized. Instead, attention is focussed on the ordinary. The importance of the average man, everyman, is emphasized. Universal equality is rhetorically asserted. The average man is encouraged to be self-satisfied about his mediocrity and is rhetorically assured that nothing better than average ought to exist.

This rhetoric is complemented by a particular interpretation of history analysed earlier (cf. 5 above), whereby all reality and truth are reduced to certain temporal and spatial factors, while all causality is reduced to material objects/events. Within this deterministic framework the spiritual dimension is denied entirely as is the value of all independent personal effort.

Such an explanation could well lead to utter despair were it not for one brilliant twist. The blind, materialistic course of history is perceived to have an inevitable happy end in which life will be ideal for everyman. But although supposedly deterministic, the goal is not held to be a matter of course: it must be worked for, struggled for, not individually but collectively. For the average man the promise of an abstract paradise now takes on a material form on earth. Unlike other ideals which include the extra-ordinary but exclude the ordinary man, this ideal has the attraction of including him and the particular attraction of ensuring him that he has an important role to play in achieving this goal.

To lend credibility to everyman's hopes that the promised ideal is actually drawing nearer, news, and information generally, is filtered in such a way that progress appears to be confirmed at every step. A rhetoric evolves which assures everyman that his earthly paradise is just around the corner. As an added incentive, everyman is given select information about those who are preventing the earthly paradise being established here and now. A class of haves in far away countries are identified as those responsible for everyman remaining a have-not. With both the goal in sight and the enemy clearly defined everyman becomes blinded by his ideals of equality and progress from looking into the matter more closely.

In this form of elitism extraordinary talent forms a criterion for entry. It takes more than great talent, however, to prevent everyman from uncovering the fundamental lie on which this system is based, namely, that the few who are in fact rhetorically helping everyman change his pitiable state, are precisely those who are in fact exploiting him and determined, moreover, to keep him there. This elite has what the have nots are lacking but hides the fact by laying the blame elsewhere. To maintain its invisible quality and to ensure its continuation, this elite takes at least four further steps. First, everyman is taught to think uncritically: i.e., not to doubt, to consider alternatives, develop a creative scepticism or to ask penetrating questions which might be embarrassing. Secondly, everyman's access to knowledge is severely restricted such that, even if he were to doubt a point of fact or some other claim, there would be no way in which he could check the information personally to arrive at an independent point of view. Thirdly, since materialist determinism can only remain convincing as long as there is no evidence to the contrary, spiritual realities must be eliminated wherever possible, or at least denied. Religion, where it is not suppressed must be discouraged. Culture may be superficially praised in general, but support for particular arts will vary considerably. Ballet, which can be passed as a dramatic display of material bodies, will receive heavy support. The playing of instruments, theoretically nothing more than the technical mastery of metal objects, can also be heavily supported. On the other hand, painting, except where it involves obvious material objects, is much more suspect, Musical composition, literature and poetry, where the spiritual dimensions regularly dominate over material ones are dangerous, and therefore to be restricted as much as possible. Thus, while everyman is assured that he may have his culture, the expressions of culture are nonetheless closely controlled. Fourthly, potential military force rises into conspicuous prominence. Guns and other instruments appear on the streets to inspire an unspoken insecurity into everyman and remove any thoughts of protest.

Hence once this form of elite has established itself the avenues of open knowledge and free expression become slowly, but systematically blocked. Technical inventions and even advances in isolated departments of knowledge may still be possible. But knowledge as a process of liberating the spirit or as a means of exploring creatively the potentials of humanity is impossible in such a context. Hence, even if such an elite may defend itself from present criticism, this cannot lessen the verdict of future generations.

10) Knowledge and Excellence Re-defined

Our knowledge about any particular object, such as a temple is, at present scattered, among a variety of verbal and visual media and to be found in a number of institutions ranging from the actual archaeological site, to museums, galleries, archives and libraries.

In the case of visual information alone this knowledge exists in various scales. With regard to the Parthenon of Athens, for example, a map showing Athens in the context of other European and Middle Eastern cities of the fifth century B. C. might well be on a scale of 1:5,000,000. A topographical map of Athens may be on a scale of 1:50,000. An aerial photograph of the Parthenon, an artist's conception of temple what the Parthenon looked like, a ground-plane of the temple or a photograph of the temple as it looks today will, in turn, all have different scales. A plaster cast of a given sculpture from the Parthenon may well be on a scale of 1:1, while an archaeologist's sample of the building materials will almost inevitably involve microscopic scales. All this would pose no problems were it not for the tendency to store each scale of knowledge by different means and in different places, without cross-references, such that there is effectively no place where all the modes and scales of knowledge about the Parthenon, or other temples is coordinated. Such a systematic coordination of knowledge verbal and visual will be a first prerequisite for any future synthesis of knowledge.

In addition to a systematic arrangement of all knowledge concerning a given temple such as the Parthenon, there will need to be a systematic arrangement of all the knowledge concerning like structures and a means of cross-referencing this information both spatially and temporally. Hence one could theoretically not only request to see where the Parthenon is on a map, but also where all the other Greek temples are, a question which could then be refined within temporal coordinates to reveal which temples were built where in the seventh, sixth or fifth centuries respectively.

Similarly a systematic arrangement of all knowledge concerning parts of temples will be needed, such that a figure on a Parthenon frieze can be compared/contrasted with figures on other Greek temple friezes, and ultimately with all other Greek sculpted figures.

This systematic arrangement of knowledge would require a computer in conjunction with a television-type screen. Were it arranged in book form a particular figure could normally appear in but one specific place in a series of figures. In a computer it can theoretically be so programmed that a single image recurs in a variety of specific places within different series of figures. For example, a statue of Diana might appear once in connection with the temple of Ephesus; a second time in a list of illustrations of Diana; a third time in a list of personifications of Mother Earth/Nature etc.

This systematic relation of knowledge of given objects to knowledge of the contexts in which they arise ought to lead to a re-definition of truth and reality itself. For the true temple can now no longer be held to be either some abstract ideal structure, or some ideologically significant temple. The truth of a temple will now be found to lie in its particular play with and combination of elements in a given place and time. Hence the truth and reality of the Parthenon is bound up with its having been constructed in the Athenian acropolis in the fifth century B. C. and the reality of the temple of Segesta is

bound up with its having been built on a hill in Northern Sicily in the sixth century B. C. The abstract idea of a temple is no longer the focus of truth or manifests itself in concrete form at a particular place and time. This makes the coordination of different scales of knowledge so important.

What happens in a given time and place is fully determined, some would claim. Theoretically an individual in Constantinople in the first half of the sixth century wishing to construct a cathedral is restricted to local builders, building materials, methods and styles. In practice, however, if the individual in question is Justinian and he decides to build Hagia Sophia he can persuade Diodorus of Miletus who has been directing the Platonic Academy of Athens to come to work with Athemius of Tralles. Moreover, he can import marble and other materials from places stretching from Egypt to the Pyrenees and draw on building methods and styles from all over the Roman empire. A related phenomenon can be observed in the construction of the Cappella Palatina in Palermo, the Alcazares Reales in Seville or the monastery of Las Huelgas in Burgos.

Such examples serve to throw light on a vital principle. The number of builders, of building materials, methods of styles is not a static given. This number can be increased, different building materials, methods and styles need not compete merely with a view to excluding one another. They are all factors which can be played with to include one another, and the more complex and subtle (is) this play of factors, the more subtly complex are the potential results.

In this context the historical knowledge of building materials, methods and styles takes on a new significance. The past is no longer merely a record of the given, but rather a repository of the possible. And if all is a play with various elements, then the cultural object of the past becomes one in which this combination or play of elements in a given time and place are particularly felicitous. These elements, if all recorded and then recombined in fresh ways thus offer an important source for new cultural objects. The past contains ingredients for the future.

Given this approach the criteria for excellence change also. Given the presence of examples, any claim can be tested by means of comparison and contrast. If claims are made about a temple being exceptionally large or particularly graceful, one can run through the list of all temples and see how this particular example compares with others. Excellence, that which stands out above the ordinary, is no longer based on deductive assumptions either about an abstract ideal or an ideological goal, but rather on inductive examples.

The new encyclopaedia of knowledge, besides offering readier access to the myriad individual details, will also permit new surveys of general trends in human culture. With the aid of maps and pictures it will, for example, be possible to trace the development of the Greek temples as an institution of worship over time. The spread of this institution throughout the shores of the Mediterranean and to the limits of the Greek world can be followed, as can its demise as a basic place of worship, The architectural forms connected with religion (temple, synagogue, church, mosque), contest (hippodrome,

colosseum), play (theatre) and other basic aspects of human culture can be examined and their evolution studied. One can trace, moreover, whether a civilization concentrated its building energies with edifices connected with the life after death of their key individuals (tombs, pyramids), contest and play in the present life (colosseums and theatres), or future aspects of the present life (banks and insurance buildings).

The encyclopaedia will offer insight not only into changing values, but also into conflicting values. For example, with respect to what happened in Constantinople 1453, what the Italians and the West as a whole described as the fall of Constantinople, appears as a triumphal capture when described by Turkish sources. If all sources describing events/objects are translated and available for comparison, then the extent to which religious and nationalistic convictions can colour the actual recording process will come into focus.

Hence, besides being a record of individual objects of culture, such an encyclopaedia of knowledge will offer a key to exploring their underlying cultural values. It will bring to light the way in which detailed knowledge ultimately points beyond the details to elusive questions of value; beyond the objective contents of knowledge, to its subjective containers; beyond the man-made objects and back to man himself. Thus, such an encyclopaedia will again remind us that knowledge is ultimately an active, dynamic agent and not just a passive instrument. A contemporary trend to perceive knowledge purely as a passive process, as a problem-solving tool which simply responds to exterior demands, will, thereby, be countered. And the focus of attention will again shift from things outside ourselves, to the source of all these exterior products, which lies within us. The great encyclopaedia of objective facts will thus serve as a tool for the greater challenge: understanding the subjective dimensions of man. Knowledge of temples will be the prelude to question why humans build temples during a few centuries of their long existence on a planet and then choose another form of expression for worship. Indeed why does man emphasize the religious dimensions of his being at one time and place and yet entirely deny these dimensions in another culture? What constitutes the phenomenon of man? How can one decide that constitutes excellence in man? What are the possibilities of man?

The encyclopaedia of knowledge will again prove an invaluable starting point for this study of man. As in the case of man-made objects it will provide a catalogue of examples wherein are illustrated the possibilities of the condition human. Some may consider such a catalogue as nothing more than a blend between a *Dictionary of National Biography* and a super *Guinness' Book of Records* and yet it will offer considerably more than either of these.

For example, the life of an outstanding individual such as Erasmus would not be reduced to a few paragraphs of notes concerning birth, publications and death. A complete record of visual images of the man, including the portraits by Holbein, would enable one to picture him. Visual information of the place in which he was born, the various places where he lived and worked, as well as where he died, chronologically arranged, would accompany the verbal information in his *curriculum vitae*. Moreover, to the extent that

the source materials permit, visual information in the form of maps could help one to trace his various journeys in detail. Hence, if one knew that he was travelling on his way to Venice in a given year, one could theoretically follow his journey day by day, city by city on a map.

In addition to detailed records of individual figures, a coordinated encyclopaedia of knowledge would open the way for larger questions. The verbal records of authors such as Pliny or Diogenes Laertius are basic sources for our knowledge of distinguished person in Antiquity. The statistics of these records could be studied: what percentage of the individuals described by Pliny are politicians, what percentage are military men, artists, philosophers, musicians etc.? How do these compare, in turn, with the percentages found in a mediaeval or, for that matter, a modern equivalent? If there are marked trends in biography, what can these tell us about trends in cultural history?

At the same time any number of possible correlations can be tested to determine whether or not they are statistically relevant: for example, whether a relevant correlation exists between great painters, poets etc. and given latitudes/longitudes; or between outstanding figures in one profession and a given sign of the zodiac. For the modern period, in countries with census records, the data potentially available is, of course much greater.

From the myriad details about politicians, generals, philosophers, painters etc., one could gain a sense of how these professions have changed in different times and places. The same principle could be applied to standard categories for describing persons: lover/beloved; enemy, great, excellent, elite etc. Past examples would thus provide a spectrum of possibilities which would open the way for fresh definitions in the future.

In the case of human excellence, for example, the encyclopaedia would confront one not only with the idea of Plato and Nietzsche, but also with those of the *I Ching* on the subject. According to this source of wisdom the excellence of a superior man is not to be measured by the amount he can set himself above, beyond or apart from the average man in furthering his own interests, but is tested instead by the extent to which his qualities serve further the interests of the average man. Human greatness, it is claimed, does not exclude the ordinary: it integrates the energies of the ordinary in achieving the extra ordinary. The superior man is one who sacrifices his own abilities in such a way that others discover and utilize abilities in themselves of which they had previously been unaware. If he becomes a ruler of men, the superior man rules by serving and teaching the average man how best to serve the interests of fellow men.

According to this view, the superior man is one whose chief preoccupation is to administer his special gifts for the common good, rather than regarding them as possessions to be employed merely for his advantage. If he has greater possessions, wealth, he uses these as instruments to integrate his fellow men, rather than as means by which to isolate himself from them.

In aiding fellow men to achieve heights of which they would have been incapable on their own, the superior man brings into focus not only man's greatness but the greatness

that is beyond man. Paradoxically in showing his dedication to everyman, the superior man proves his devotion to Heaven, Sky, God, Yahweh, Allah, or whatever name one may choose to give That Power That is Beyond.

Western examples could be used to illustrate this Eastern view. Brunelleschi's greatness lay partly therein that he was able to organize and coordinate the abilities of everyday workmen in providing Florence Cathedral with a dome which was anything but everyday. The same was true of the individual who coordinated the energies of average men on the street in building cathedrals as noble as Notre Dame, Chartres, York and Seville.

In our own day National Trusts and private organisations make faltering attempts to repair and maintain great monuments. In the past it was the average man who constructed these, and theoretically, in the future, the average man could repair them or build their modern equivalent. Perhaps all that is needed is that the average person's place in this national heritage must again be made clear. Perhaps the true function of great monuments is that they provide contexts wherein, whereby the average man's participation in an otherwise fairy-tale world of ideal glamour becomes a reality. Perhaps castles and palaces are ultimately less homes of kings, than places where ordinary mortals have a chance to meet regal splendour. A study of past kingdoms might even reveal that this is so: that manor houses are most tenable when ordinary tenants have a chance to meet their lord therein and that castles are more defensible as meeting grounds of a community than as a private dwelling.

But whatever evidence that the past in its richness of sources may provide through its examples, these, nonetheless, will need to be confronted with and challenged by present realities. Individuals wishing to explore the potentials of the human condition will require more than a computerized archive that serves as an encyclopaedic storehouse of knowledge. The record of examples of past masters is not enough. One needs opportunities to meet with present masters, live examples, individuals who are not just a staggering statistic or a blinding *curriculum vitae,* but persons who can challenge and encourage one, teaching one both through their words and their silence, their approval and their disapproval.

Similarly, individuals wishing to explore the potentials of the human spirit when applied to matter will require more than a comprehensive record of previous craftsmanship. The apprentice jeweller will learn much from Egyptian, Phrygian, Chinese and other precedents. But ultimately he too will wish to meet present masters, in order that past examples be complemented by living example. In the coordination of past and present example lies future knowledge.

The problem of the present is that a person in search of such exemplary knowledge finds himself running to libraries, museums, institutes, archives, universities, guild schools, polytechnics, private collections and a host of other institutes, that tend to horde their isolated examples in a possessive fashion, insisting on the reality of their little part, forgetting that it is a part of a single whole. Perhaps a systematic organization of

knowledge will be needed to confirm that examples in its past and present forms united are the only convincing way of establishing high standards and inspiring higher ones of gaining knowledge of excellence.

Istanbul, 21 June 1981

11) Postscript: Problems, Obstacles, Dangers

Many will object to the suggestion of such an encyclopaedia on the grounds that it is a luxury, merely a reduplication of knowledge already available in libraries and other institutions. Rather than competing with or tending to replace such institutions, however, the encyclopaedia will serve to increase their usefulness by providing more direct access to the knowledge therein.

An example will serve to illustrate this point. Let us assume that a scholar is interested in burning mirrors during the fifteenth and sixteenth centuries. By consulting the encyclopaedia it will be possible to view in chronological/topographical sequence existing visual/verbal images of burning mirrors, noting those which appear particularly significant. Equipped with this information the scholar can then return to a library to study these images in the context of the books in which they were printed. Hence, the encyclopaedia will show the parts in sequence and give their sources: books will therefore be desirable, ready access to historical sources being another not minor consideration.

The complementary function of the encyclopaedia is of some significance in resolving the problem of where such a project should be based. Some may argue that it must be in America, but while an American project would have the necessary optimism, it would not necessarily attain the sensitivity that will be required to gain the cooperation from European librarians and archivists that is imperative. A European based project might therefore be desirable, ready access to historical sources being another not minor consideration.

The base could be connected with one of their great libraries, e.g. London, Paris, Rome, Munich, Oxford, Göttingen, Wolfenbüttel. National libraries, both because of the excessive demands made on them, and because of nationalist/imperialist/colonial overtones they may evoke, are less desireable.[3]

Whatever its potential merits such an encyclopaedia will inspire *a priori* criticism from many scholars who base their reputation on rote leaning rather than on interpretation. They will fear that once all the facts have been entered into a computer, the actual limits of their knowledge will become painfully obvious and their future endangered.

While the encyclopaedia will eventually need to include knowledge in all recorded languages a single language, probably English, will be needed for purposes of comparison. Sources concerning the fall/capture of Constantinople in Italian, Greek,

Turkish, Latin etc. would hence all be available in English translation. This will enable an historian to examine various sides of a story without having mastered the diverse languages in question. The temptation to rely on translation and to ignore the originals will thereby increase. Even more efforts than at present will need be made to emphasize the importance of knowledge of as many foreign languages as possible.

Because it offers access to all recorded viewpoints concerning given events, such an encyclopaedia would ideally promote a sense of tolerance. It could, however, serve to undermine a sense of objective values and increase notions of relativism in the negative sense. In any case, various political systems will see such access to multiple viewpoints as a threat to their clearly defined ideologies and will therefore be at pains to control the input of multiple viewpoints and/or restrict access to such information.

Whether the full information is being restricted or not is a problem that will become the more difficult to determine as the encyclopaedia comes closer to being comprehensive. The assumption that the computer "knows it all" will threaten to become dominant. Many will see this as a reason for learning. The development of critically open minds, creatively sceptical, cognizant of the central significance of interpretation will, in such a culture, become all the more essential.

Ideally, the encyclopaedia will serve as a stimulus to discover the diversity of the natural and man-made world. There will be a number of persons, however, who lapse into passive roles as knowledge consumers. They will see in the encyclopaedia the possibility of living entirely in a reproduced would, where reality is experienced only second-hand through its copies. Remaining shut in one's room by choice may well become a type of disease and new means will need be found to recognize and to value original objects.

Over and above all qualitative considerations, apprehensions and misapprehensions there remains the purely quantitative challenge of how one ever hope to integrate the whole of existing knowledge within a single, massive computer system. It may seem impossible. But then it may prove helpful if one tries to imagine Gutenberg, around 1460, sitting before the committee members of an important foundation and telling them that he was now convinced how useful it would be if effectively all existing manuscript material were reproduced in published form.

At present there are tens of thousands of academics throughout the world whose main contribution is in terms of articles written for specialist magazines which remain inaccessible to most persons, their great investment of energies are guided largely by the fear of publish or perish, this activity being their key to promotion. A simple reform of the academic value system, which would award more points for pertinent contributions to a computerized encyclopaedia than for obscure articles, would serve to focus the combined expertise and energies of the world's academics on a single project. This, if supplemented by the energies of various assistants, students and other personnel would soon establish the limits of what seemed as endless task.

Looming quietly in the background above all these problems will remain the question of financing. The only long-term solution is international cooperation. Initial investments on the part of one, then several great foundations could serve to define precise technical needs and to begin exploring the methods these involve. The further investments of at least one major computer firm, such as IBM, would serve to see that technological equipment is developed which meets the very specific problems, needs, demands, challenges of the encyclopaedia. At a further stage, government funds, channelled via the universities could provide the necessary support.

Until it reaches a fairly advanced stage the project will involve investment without returns. The master programme of the encyclopaedia could be made available to major libraries where users could pay a fee for access to information. Eventually, this master programme could be made accessible through television screens in every home, for the use of which person would again pay rent which might be in terms of time and/or complexity of the information consulted.

12. Reflections on Practical Steps

Even if the goal of an encyclopaedia of the world's visual/verbal/mathematical/ musical images be accepted, the question remains where does one start?

At the outset one research person could be assigned to make a search of major firms, institutions at present engaged in problems of computerizing verbal and particularly, visual knowledge. With the aid of a secretary, this person could write to these bodies, requesting information and developing an itinerary of six months which would take persons around the world on a fact-finding tour. One of these persons should be historically trained; the other, familiar with technical frontiers. This tour would be followed by three months of evaluation. In the next month there would be return visits to places of particular interest, in light of which a final evaluation would be made, result in a major paper, or slender book, providing an assessment of individuals, firms and institutions concerned with computers and visual images.

A next step would be a colloquium to bring together representatives from foundations, grant giving bodies, national/international agencies and computer firms potentially capable and interested in funding the project.

With a financial programme clearly defined a provisional research team could be set up which would consist of perhaps eight persons representing key areas of knowledge and technique (cf. Table 1)

Knowledge	Technique
- librarian (verbal images)	- programmer (verbal images)
- museum person (visual images)	- visual aids person (visual images)

- historian	- electronics person
- historian of classification	- information/system person

Table 1. List of various individuals one would need for a provisional research team.

This team would work together for 3- 5 years and be responsible for the development of sample knowledge packets illustrating the various problems and potentials of this encyclopaedic approach with respect to a biography, an historical document/monument /event, a solid/liquid natural object, a chemical, a micro-structure in biology/medicine etc.

With these programmes at hand a colloquium could then be organized in connection with each individual sample package. Here, experts in the respective fields would assess the results, bring to light problems in presentation and propose the criteria for an improved version.

Technical problems concerning quality having been mastered, one could turn to the challenges of quantity. At this stage it might be wise to begin by recording all books in library such Wolfenbüttel under the heading(s) of *Geometria* and/or *Astronomia*. The results of this project would again be assessed by various experts in the given fields.

The way would then be set for entering into the computer the entire collection of a library such as the Herzog August Bibliothek. The results of this project would be assessed by representatives of major European libraries such as Göttingen, Munich, Rome, Paris, Madrid, London, and Oxford. This would introduce further problems relating to their particular collections.

Various national projects to record these and similar collections would now be initiated. The resulting information would be accumulated at the libraries themselves.[4]

Once the major Western European collections had been systematically coordinated within a master programme, the project could be extended to include Eastern Europe, particularly cities such as Budapest, Prague, Cracow, Warsaw and Leningrad which have very close historical ties with Western Europe. Ideological and political differences, potentially a hindrance with respect to such countries, could be overcome on the basis of mutual interest. It could be stipulated that if these countries wish to have future access to a master programme of the Western encyclopaedia, they will first need to make their own collections entirely available for inclusion. By cooperation, these countries will profit from Western research experience and thus save such expenses. Hence, even libraries in places such as Moscow and Peking will find it useful to cooperate.

Meanwhile various related existing projects in the United States, Canada and Japan could be adjusted, coordinated and fed into the master programme. Branch projects could be spread to other advanced Western countries, e.g., New Zealand, Australia, and India. Developing and underdeveloped countries would come next.

The procedure outlined above with respect to libraries would be applied to museums, galleries, archives etc.

The time scale of the project must remain an open question. With present technology it could take 50-60 years. Taking into account the speed of technological advance, however, it is thinkable that the task could be accomplished in half the time. Ultimately, even more important than technology or money will be the question whether the project catches the popular imagination. If this occurred, literally everyone could contribute. The challenge of finding some item of information not yet recorded in the encyclopaedia could become a game, perhaps even a contest with honours and prizes. With everyman's cooperation, everyman's encyclopaedia would become a reality sooner.

Amsterdam, 16 July 1981

12. Post-Postscript: Fifteen Years Later

When this was originally written the author was living in Germany and this seemed the most logical country form which to base these activities. Since then it has become clear that there should be no single centre for these activities and that there needs to be co-operation among a number of centres. A few very specific comments written at the time have therefore been relegated to footnotes.

In the meantime some of the ideas which seemed far fetched fifteen years ago now seem perfectly reasonable. For instance, IBM's Digital Library Project is digitizing all the manuscripts of the Vatican Library, the Luther Library, the Edo Museum and other collections. The Bibliothèque National de la France is scanning in 400,000 books in full-text form. Libraries and museums have been designated as two of the eleven G7 pilot projects, thus creating a context for international co-operation.

Indeed all the technological hurdles that loomed a generation ago have effectively been overcome. The memory capacities of advanced computers now begins with 50 gigabyte segments to create many terabytes of storage space. With new holographic methods this capacity will increase greatly. Speed of transmission is also developing at enormous rates. ATM demonstrations at 35 megabits per second are common. Public experiments at the OC12 (622 gigabits per second) rate are about to occur. Lab experiments using OC128 (6.2 gigabits) are occurring and work is underway on terabit transmission. The latest developments in pattern recognition through software such as IBM's Query by Image Content (QBIC), or by Excalibur and Illustra permit one to search in terms of visual shapes. The only challenge that remains is to co-ordinate energies in actually making the new encyclopaedia.

Toronto, 23 December 1995.

CHAPTER 3

THE CONCEPT OF KNOWLEDGE PACKAGES

Abstract

The lecture corresponding to this paper demonstrates a database on perspective copyrighted in 1988, which integrates ten different levels into a coherent system. It is offered as an example of a new approach to knowledge.

Introduction

Perspective has been described (Edgerton 1975) as the most important discovery of the West. In the fifteenth and sixteenth centuries it involved many of the key individuals in Renaissance art and architecture, notably Brunelleschi, Alberti, and Piero della Francesca. The projection methods of perspective were linked with astronomy (astrolabes and sundials), cartography, stonecutting, and surveying. Leonardo da Vinci linked perspective with physics and made it one of the cornerstones in his new approach to science through his pyramidal law, a principle that also inspired the first universal analogue reckoning instruments: the sector and proportional compass. Since the seventeenth century, the development of perspective has entailed some of the leading mathematicians: Desargues, Pascal, Euler, Monge, Poncelet. In its metaphorical sense, perspective has been explored by philosophers such as Leibniz and Nietzsche; played a fundamental role in the work of Schutz, one of the founding fathers of modern sociology and has affected profoundly most major disciplines, including anthropology, ethnography, literature, psychology and even theology.

To date material on perspective has usually been studied in terms of a given discipline. Art historians study its use in paintings; geographers study cartographical projection, but ignore projections in stage scenery, stonecutting or sundials. Moreover, levels of knowledge are traditionally treated separately. Classifications are found in one kind of book; definitions in dictionaries; explanations in encyclopedias; references to literature in bibliographies; lists of contents in synopses; actual texts are scattered in various libraries; while analyses are found in scholarly studies. The idea of creating a databank which will integrate these disparate levels into a coherent knowledge package arose from a desire to study the interrelationships among these elements; to study perspective as a universal problem rather than its narrow application in a single discipline. This is a quest to extend earlier ideas of the encyclopaedia using the potentials of electronic media (computers, graphics systems, CD-ROMs).

The project began while preparing a bibliography commissioned by the organizers (Marisa Dalai Emiliani at the suggestion of Eugenio Battisti) of the first world conference on perspective (Milan, 1977). Work continued on this while in Germany from 1977 to 1984, with the support of the Volkswagen, Humboldt, Thyssen and Henkel Foundations. In 1986-1987, the titles of 8,000 primary and 7,000 secondary sources were entered into a computer (IBM compatible AT, with DBASEIII PLUS) with the support

of the Getty Center for the History of Art in Santa Monica[5]. Since then, with support from the Social Sciences and Humanities Research Council of Canada, the bibliography has expanded into a computerized data bank or knowledge package (of 1 gigabyte) with ten levels, which include the following: 1. Classifications; 2. Definitions; 3. Explanations; 4. Bibliographies; 5. Partial Contents; 6. Full Contents; 7. Internal Analyses; 8. External Analyses; 9. Restorations and 10. Reconstructions. There are also indexes. The scope and function of each of these will be considered in turn.

Level One. Classifications

Classification systems reveal the different cubbyholes in which knowledge is arranged. At present, level one of the databank contains relevant sections from eight major systems: (Getty) Art and Architectural Thesaurus, Bliss, Dewey, Göttingen, Iconclass, Library of Congress, Ranganathan and Riders. One can choose a term such as inverted perspective or conic sections and see in how many systems it is classed and where it is classed in any particular system. Alternatively one can go to an alphabetical list of terms from all eight classifications combined, which introduces one to related terms. Either approach can serve as a point of departure to other levels.

Level Two. Definitions (Dictionaries)

This contains definitions of 747 basic terms relating to perspective. Translations for terms are being prepared in Dutch, Italian, French, German and Latin, and are planned for other languages. Terms can be accessed using variant names, including those in the basic languages. A person who types in prospettiva tolemaica learns that this is a variant Italian name for inverted perspective. A person who types in prospettiva rovesciata learns that this is a regular Italian name for inverted perspective. In both cases a definition of inverted perspective appears on the screen along with a numbered series of related terms, definitions of which are obtained by pressing the number. To obtain an illustration of a term, one can press a button for an Example (which gives a colour picture), Diagram (which shows a diagram drawn in Auto-CAD) or Animation.

Level Three. Explanations (Encyclopaedias)

If more information is required one enters Explanations, which takes one down to level three and provides an animated version of the principles involved. This is extremely helpful didactically because it helps the viewer to relate frontal and lateral views of a spatial situation and also traces the sequence of steps taken in arriving at a complex result. (All too often in the past textbooks have given the end product of some construction with little hint of the intermediate steps). The drawings for the definitions and explanations have been created by Mr. Eric Dobbs. If bibliographical information is required concerning either the definition or the explanation one enters Bibliographies; one is given the choice of primary or secondary literature and is then taken down to level four.

Level Four. Titles (Bibliographies)

Persons not concerned with classifications, definitions (the level traditionally found in dictionaries), or explanations (the level traditionally found in encyclopaedias), can enter the databank directly at level four. Unlike traditional bibliographies this level contains a series of access points in terms of either names or subjects.

In terms of names there are several options. If one knows the function of the individual in question one can search for it directly in the lists of authors, editors, illustrators, translators, (persons) printed for, publishers and sellers. If a person's function is not known one can check the name in a master list of names and variants. If a variant spelling is entered one is taken to the corresponding standard name. For example, if one enters Viator one is given a screen with the name of Jean Pélerin, his dates (1435?-1524), his role (as a theorist he was an author), plus a list of all his variant names: Péregrin, Peregrinus, Viateur, Viator, Gast, Gastius etc. From this screen one can choose to explore Pélerin's books, which presents one with a screen with seven choices in terms of texts (standard titles, variant titles, languages, editions, manuscripts, locations, other subjects) plus further choices in terms of secondary literature, notably general articles (about Pélerin's work on perspective), articles on specific editions, manuscripts, bibliographies, and biographies.

Level Four.1. Standard Titles

If standard titles are chosen, one is given a list of titles on perspective. In the case of Pélerin there is only one work: De artificiali perspectiva. To learn more the user can choose Editions. This provides a numbered chronological list of dates and cities of publication for all known editions, in this case 27. By entering the number alongside, say, the 1521 Toul edition, the screen provides a regular bibliographical record of the book including its format and, where possible, two locations, one in North America, usually National Union Catalogue volume and page number, and one in Europe. If one wishes further historical information, one enters History which, in turn, permits one to check which of the 36 earlier bibliographies cited the text. In this case six bibliographies cite the 1521 Toul edition: namely, Scheibel (1778), Murhard (1805), Cicognara (1821), Poudra (1864), Schüling (1973) and Vagnetti (1979). This feature amounts to an historical citation index. In future the historical option will be expanded to include references to secondary literature on a specific edition, attributions, owners and restorations. If instead of history, the user is concerned with contents of the book, then Partial or Full Contents is entered. This will take one down to level five or six which are discussed below.

Level Four.2. Variant Titles

Variant titles provides a list of all the alternative names under which a treatise has been catalogued. In the case of Alberti's Della pittura, for instance, this includes De pictura, On Painting, O Malarstwie, Traktat von der Malerei, Trattato della pittura. Each of these variants is numbered, and if they are chosen one is taken back to the standard title.

Hence, a person confronted by a title in an unfamiliar language can use this to confirm its standard title.

Level Four.3. Languages

This provides a list of all languages into which works on perspective by a given author have been translated, which is of interest because it gives some sense of how influential a work has been beyond the local context.

Level Four.4. Editions

This is a list of all editions of works concerning perspective by a given author. In the case of Alberti, this includes editions of *Della pittura, Elementa picturae*, and the *Ludi Matematici.* This list provides another indication of how influential an author has been. By contrast, if one is concerned strictly with the editions of a given text such as Della pittura, this is accessed through the standard titles list described above.

Level Four.5. Manuscripts

Similarly, this gives one a list of all manuscripts pertaining to perspective produced by a given author. If one wishes only the manuscripts of *Della pittura* these are again found under that title through the standard titles route.

Level Four.6. Locations

This function is designed to link the databank with catalogues in local libraries, indicating what subset of the corpus is available in these local libraries. It is foreseen that it will eventually link with national and international library catalogues in order that one can determine the number of known copies of a given text as well as their precise locations and call numbers.

Level Four.7. Subjects

To understand an author requires an awareness of all their writings. Frequently an author who writes on perspective will also write on mathematics, astronomy, surveying, geography and related subjects. Understanding this nexus of interests helps one to assess their activities in perspective. Hence it is foreseen that the databank on perspective will eventually also become a databank of the complete works of all the authors on perspective, thus providing a conceptual map of how perspective relates to a nexus of other topics.

Meanwhile, the user wishing to explore level four may wish to do so in terms of subjects rather than names. One is then presented with seven other options: bibliographies, chronological lists, key words, languages, multiple search, places and titles. If bibliographies are chosen the screen provides a numbered chronological list of authors, plus the number of texts recorded by each author: e.g. 1791 Comolli 78. This permits a

survey of how the field has grown from seven titles of primary literature in Lomazzo (1590) to 1283 in Vagnetti (1979). If one enters the number alongside Comolli, the screen gives a regular bibliographical reference to Comolli, followed by a numbered list by year and author of all works found in Comolli's bibliography. A print function allows one to acquire a printed copy of Comolli's or any of the other bibliographies. Choice of the accompanying number in turn gives one a regular bibliographical reference to the work listed by Comolli, usually including two modern locations of the book.

If one chooses chronological lists, one decides whether one wishes primary or secondary titles. A time span from year a to year b is then entered. All works within that time span are again displayed in a numbered chronological list by date and author. Entering the number alongside any of these again provides a regular bibliographic reference. If one chooses keywords as a point of access one begins with 38 disciplines as headings. Two options are then open. One is to proceed hierarchically. If, for instance, one chooses mathematics, there is a choice between geometry and measurement. Geometry in turn is subdivided into analytic geometry, conic sections, descriptive geometry, projective geometry, proportion and quadrature, each of which will provide one with lists of pertinent titles. Alternatively one can abandon the hierarchical search by simply choosing Index which presents an alphabetical list of all keywords.

If one chooses languages the screen presents a numbered alphabetical list of 29 languages along with the number of books which have been published in that language. For instance, Italian books are 854. If Italian is chosen, works are displayed in a numbered chronological list by date and author and entering the number alongside any of these again provides a regular bibliographic reference. Multiple search, as it suggests, allows one to specify more than one criterion in a search: e.g. editions of Alberti published in London between 1700 and 1800. Choice of places takes one to a screen with 59 countries listed alphabetically with the number of books published in each country alongside. France, for instance has 1185. If one chooses France, one receives a list of French cities connected with publications on perspective again with the number of works produced there: e. g. Angers 6, Annecy 2, Arras 1 or Paris 1050. If one chooses Paris one again specifies a time span from year a to year b. All books published in Paris within that time span are then displayed in a numbered chronological list by date and author. Entering the number alongside any of these provides a regular bibliographic reference as usual. The final option in the subject approach is by title. This is simply a numbered list with year of publication with short titles in alphabetical order. Entering the number alongside, provides the usual bibliographic entry. This option includes a find function which permits one to type in a title, a first word or merely a first letter.

Level Five. Partial Contents

Levels five to ten are being developed using Leonardo da Vinci as an example. At level four (the bibliographical level) one can choose a list of Leonardo's manuscripts. These are presented in a numbered series, alphabetically on the screen. When a number is entered, a description of the corresponding manuscript appears. In the case of Manuscript A, for instance, one is told that it is in Paris at the Institut de France, that it is unsigned

etc. One is given a choice to learn more about this text in terms of bibliography, contents or history. Choice of contents first presents one with the following options: Abstract, Description, Note, and Pages. These are variations on the theme of a summary. An abstract summarizes an entire manuscript or book. Abstracts are subdivided into three categories: a) less than 200 words; b) 200-500 words; c) over 500 words. Longer treatments are also searched under reviews. Description refers to a non-published outline of contents usually by a scholar in the field. Notes refer to non-published comments about a specific page.

The fourth choice, gives a page by page, or in this case a folio by folio, survey of contents using key words. One can scroll through a book or manuscript page by page, and then choose a given page or folio. Alternatively, there are four other options at this point: Chronology, Index, Details, Text. Chronology provides a record of different claims about the dating of a given folio. Index gives access to the key word descriptors for each page through an alphabetical list. Details provide a corresponding survey of contents at the level of individual paragraphs and drawings. Text allows one to call up a specific page or folio. If this is chosen one is taken down to level six.

Level Six. Full Contents (Texts)

Choice of texts gives one a standard transcription of the text in its original language. Three further options are available at this point: Original will present a digital image of the original manuscript folio on the screen. Translation will give an English translation of the folio in question. Interpretations takes one to levels seven to ten.

Level Seven. Internal Analyses

The level of internal analysis is used when one studies a text or picture in its own right as in the case of close reading in English.

Level Eight. External Analyses

External analysis is used when one compares a text or picture with other texts or pictures.

Level Nine. Restorations

Books or pictures which have been restored contain the interpretations of the restorer and are therefore at a separate level.

Level 10. Reconstructions

Level ten records different interpretations and/or reconstructions given to a text or diagram. For instance, a two-dimensional drawing by Leonardo of a perspectival situation will be reconstructed three-dimensionally. An animated version will retrace the steps he took in reaching this diagram. If there is controversy about a diagram and there

is more than one reconstruction, as in the case of Alberti's *costruzione legittima*, the alternative interpretations will also be available. This does not mean that every page of every text will be interpreted and reconstructed. History has decided which pages receive more interpretations than others: the Bible, Aristotle and Leonardo are in a different category than minor authors.

Indexes

Indexes provide addresses of institutions and scholars and offer further access points to the knowledge in the above levels.

Future Plans

The system described above exists. What follows is a description of future plans. It is foreseen that original texts will eventually be stored on a CD-ROM and available directly on the Internet. The latest technology permits storage of 350,000 pages on a single disc. The full texts of all primary sources on perspective could be stored on two discs, while all secondary literature on the subject could be stored on another two discs. Hence the idea of a knowledge package which will collect all that is known in a given field on four or five discs, which can be accessed in series using the juke box principle. Given developments in miniaturization, specifically in terms of new holographic methods, it is likely that one will be able to store all this material on a single disc in the near future. Hence the knowledge package on perspective can serve as a model for other disciplines.

Thus far the databank has emphasized concepts and texts rather than their locations. It has focussed on verbal means of access particularly with respect to written documents on perspective: i.e. theory. The challenge remains of how to link theory and practice: how to relate discussions in books with actual examples in paintings and drawings. A recent contract (December 1990) with the Generation 5 Cartotechnical Corporation, which includes a link with Autodesk, and makes the perspective databank at the McLuhan Centre a research station for their software, has opened new possibilities for solving these problems. An access or entry level to the databank is planned. This will have names, objects, subjects, titles, chronology, geography language and multiple search access points, reminiscent of what already exists at the bibliographical level, but differing in two respects. First, these categories will apply to the entire databank: i.e. art and instruments as well as books. Second and more importantly, the concept of geographical access will be greatly developed.

If this geographical access is chosen one will be given a list of all countries involved. If one chooses a country, say, Italy, one is asked to decide between maps and cities. If one chooses maps, a world map appears with Italy framed and highlighted, with an alternative to see contemporary maps or historical maps. If one decides on contemporary maps one is offered a series of scales, chooses one and obtains the corresponding map of Italy. (Or one might window a part of the map and let the computer determine the relative scale). If one decides on historical maps, one is given a chronological list of

dates when Italian maps were produced, chooses one and again obtains the corresponding map. From the world map with Italy highlighted, with either the contemporary or the historical map of Italy one can go to a list of Italian cities used in the knowledge package.

If one chooses a city such as Florence from either a national map or from a list of cities, one has an alternative between city maps of Florence and its institutions. If one chooses institutions, one must decide whether one wishes art galleries, churches, libraries, museums or a combined list. Alternatively, if one chooses maps, the screen presents a standard map of Florence with each of the major institutions numbered, plus choices to see further contemporary or historical maps or a list of Florentine institutions. If one wishes to go directly to a given institution one simply enters the number on the map corresponding to this institution. If, for instance, the Uffizi is chosen, one can again decide whether one wants to see maps or learn about art, books or instruments contained in that institution. The maps option introduces a choice between exterior views and interiors, the latter of which offers a choice between ground plans and rooms. Ground plans of the Uffizi are coded with numbers for each room, and entering that number takes one to the corresponding room which can be viewed in terms of elevations of the four walls and ground plans of the floor and ceiling. Choice of say the North wall in a room will give one a modern photograph of that wall on which all the paintings are numbered as are the sculptures, vases and other works of art along the walls of this room. In cases such as the Uffizi there is also a historical dimension to the disposition of these rooms. Hence the enterprising student can call up a list of earlier engravings and drawings showing what the room looked like in earlier centuries and which again have corresponding numbers for the works of art on and along each wall. Choice of a number from either a modern photograph or an historical engraving takes one to information about that painter. The more thorough student will be able to go to a screen about the artist in question, giving his dates, variant names and indicating whether the individual produced only art (e.g. Botticelli), or was active on several fronts, producing art, books and instruments (e.g. Leonardo da Vinci).

Let us say we are in the room of the Uffizi with Botticelli's *Adoration of the Magi*. We enter the appropriate number, and get Botticelli's dates, then a numbered list of all his paintings which again has the option of maps. If we choose maps we are asked to decide between (original place of) production and (present) location. Production gives us a map with places where the paintings were produced accompanied by dates. In the case of Botticelli, who spent most of his time in Florence, there would be an additional map indicating when he worked in Santa Croce, Ognissanti, the Duomo etc. Precisely when an artist executed a painting, or even which paintings he produced is not always clearly documented and hence there is frequently considerable debate amongst scholars on these questions. Accordingly the databank will indicate that there are different lists of complete works and alternative chronologies for these works, and will note which of these is the currently accepted standard. For some purposes the standard list will suffice. A serious scholar in the field will wish to study the various alternatives, weigh their merits and possibly add his own version. If, on the other hand, one chooses locations one obtains a map of those museums where paintings by Botticelli are now stored. Since

there is an historical dimension to these locations, one will also be able to see where works were in an earlier period. In the case of famous paintings one will have an animated map which allows one to trace their movement from the time of their production in Italy to their present location, say, in Washington or elsewhere in America.

Instead of choosing maps, one can choose a particular painting by entering the number accompanying it on the list. Say one chooses The Adoration of the Magi. The menu now allows one to choose subjects, elements or techniques. Subjects gives one a chronological list of all treatments of The Adoration of the Magi as a painting, fresco, drawing, sculpture etc., which can be studied in its entirety or in subsets, e.g. Italian examples from 1450-1500, either in list form or with the aid of maps. Elements identifies stock motifs in the painting. The knowledge package on perspective will focus on spatial elements, which will be a collection of basic forms, hierarchically arranged such that one begins with general shapes such as building which are then subdivided: triangular building, square building, pentagonal, hexagonal, heptagonal, octagonal etc.; or vaults which are then subdivided into barrel vaults, cross vaults and so on.

An extension of the principles used in the AUTOCAD camera function[6] should allow the creation of an historical repertoire of representations of basic architectural elements, such that one can trace how spatial forms such as a vault or a niche were gradually mastered, and who copied directly from whom. Indeed if a series of tolerances are defined for variations on a basic form, this will introduce a quantitative approach to traditional discussions of influence. Moreover, the representations in drawings and paintings of a vault can be compared with corresponding representations in treatises on perspective and architecture. This will transform the age old abstract discussions concerning interplay of theory and practice to a quantitative realm of study. Most of the basic architectural forms are constructed in real architecture and not just outlined in treatises or painted on canvases. So there are further dimensions to this interplay, namely, how real and fictive architecture interact, how the exploration of possible worlds plays its part in transforming the physical world. Where once there were maps of Europe with locations of major Romanesque or Gothic churches, there will now be maps which allow one to follow the tradition of an architectural element, be it a portal, a niche or a vault; to witness its interplay with corresponding forms as spatial motifs in paintings and treatises; and in some cases how this interplay leads to an evolution in the complexity of a form.

This will lead eventually to an understanding of the history of art and architecture that is profoundly different from that which has traditionally been possible. At an intuitive level it has long been apparent that theory follows practice, that motifs are mastered by an architect in a building or by an artist in a painting long before there is a theoretical discussion of that form in a treatise on architecture, art or perspective. But how long? And what stages occur between a mere collecting of isolated examples in the catalogue style of mediaeval sketchbooks and Renaissance how-to-do-it books, to the development of an integrated theory concerning the cumulative meaning of these isolated elements? How many elements are needed before their integration can be considered a theory? Indeed what is the history of the concept of theory in these terms?

In a related way the knowledge package will allow one to trace the history of perspectival methods and techniques, such that one could follow, either with lists or with the help of a map, chronologically, examples of one-point perspective, spherical perspective or applications of various projection methods in cartography, sundials etc.; how these methods evolve from simple rules of thumb to clearly stated examples, to principles which have quantitative parameters. Animations would be used to recreate the steps that are required in the execution of any particular method. The role of such techniques and principles in the history of theory could also be explored. The number of paintings which use a method such as one point perspective completely accurately are remarkably few. So there is another story to be told: how artists deliberately used the rules imprecisely as the rules became more precise; i.e. the paradoxical interplay between rules and licence with the rules. The use of maps in tracing developments in both motifs and techniques will also permit one to see which of these are strictly or mainly local phenomena and which of them become of national or international significance.

The detailed paths described above are intended to give readers a clear view of possibilities. It would be idle to pretend that these are the only paths or even that these are the best paths. Some individuals will be more visually oriented and prefer iconic markers and maps. Others will be more verbal and prefer lists. Traditional forms such as books required that a library be organized using one method to the exclusion of others. The revolutionary potential of computers lies therein that the same machine can have many paths to the same set of facts. These paths can entail different media and various levels of complexity. Thus knowledge packages involve two distinct tasks. First there is the challenge of collecting all the knowledge pertaining to a field or discipline, which will lead to collecting materials in closely related fields. Second, there is a challenge of creating ever more access points to this corpus of knowledge. As these access points become more complex it will be useful to add conceptual maps of the paths such that a person can at any stage step back as it were by pressing a button and having a "You are here" sign to indicate where they are, and allow them to move elsewhere in the system. Getting there is proverbially half the fun, but great care must be taken lest the new paths for access become labyrinths which prevent users from getting to knowledge.

It is possible to foresee a series of software tools that will aid greatly in the use of these knowledge packages. These would be in the form of scaled levers. One is an animation speedometer which allows one to speed up or slow down an animation used to demonstrate the steps entailed in a given perspectival technique, or even aspects of building practice. Another is a chronologometer which permits one to identify the year or span of years of interest in the query. Similarly a scaleometer will allow one to choose which scale of map or drawing interests one; while a microscaleometer will do the same for microscopic levels. A dimensionometer will permit one to define relative scales of height, width and depth in representations of a building. The advantages brought by such and similar technological aids are obviously exciting, so much so that a certain number of persons refer to these as if they were all that mattered. To do so is misleading because the deeper value of these developments lies elsewhere.

In the past scholars inevitably tended to base their claims on the materials available in their local libraries and museums. The Italians, who are famous for this tendency, even have a word for it: cameralismo, which is more neutral than the English term provincialism. Scholars who chose to go beyond this usually spent most of their lives collecting materials from disparate places, only then to be dismissed as compilers. Serious scholars have been heard to say that it took 90% of one's time to acquire documents, 5% of one's time to read it, which left 5% of their time for original work. A systematic collection of materials in a field as knowledge packages will remove the need for unwanted provincialism. Local history will of course always have its value. But claims for universality based on a single region will no longer be tenable. By increasing enormously the size of the sample on which claims are based it will change the writing of history in a basic way.

Larger patterns of artistic, scientific and cultural development will become visible. It will be possible to explore a series of new questions. The interplay of theory and practice has already been mentioned. Related to this is the paradoxical way in which the rise of systematic rules and laws goes hand in hand a) with the use of instruments, tools, and machines; and b) with the spread of a man-made, built environment, an artificial landscape in which geometrical regularity threatens and often replaces organic complexities of Nature. Is each step towards scientific mastery therefore a step towards being surrounded by mechanical devices, towards greater isolation and alienation from Nature? Are these or are they not irreversible trends? The knowledge package will give no simple answers to these or any other complex questions. It will not be a package in the simple sense. Rather it will be a tool to reflect upon our activities as human beings and the meaning of that to which we devote our lives. Indeed if the approach to perspective here outlined is extended to all realms of knowledge, then perhaps there will be less parcelled knowledge, more synthesis, a greater sense of interrelatedness, more awareness of the vast domains of matter and spirit which await exploration.

Since giving this lecture in 1991 the project has received further support from the Canadian Heritage Information (CHIN) and the Dutch software firm BSO/Origin. The principles used in the perspective project are being developed into a System for Universal Media Searching (SUMS), which has since been described in a series of articles[7]. At present SUMS is being designed as an electronic bucket which can be used for producing knowledge packages on any subject. This will be expanded into an authoring system for CD-ROMs. With the aid of Hyper Text Markup Language (HTML) and Standard Generalized Markup Language (SGML) connections with the Internet will be established to allow on-line conceptual navigation of databases in libraries, museums and other institutions at a distance. It seems fitting that the visionary suggestions of Eugenio Battisti should have led to so international a vision.

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CHAPTER 4

ELECTRONIC MEDIA AND LEVELS OF INTERPRETATION

1. Introduction 2. Internal Analyses 3. Identifications 3. Internal Interpretative Modes 4. Internal Linguistic Analyses 5. External Analyses 6. Restorations 7. Reconstructions 8. Implicit Interpretations in Pointers and Objects 9. Problems of Truth 10. Conclusions.

1. Introduction

There is much talk of an electronic highway whereby persons will have unlimited access to television stations, have video on demand and eventually have electronic versions of books, paintings, and other materials from the great libraries and museums of the world in every household. There is talk of convergence as various problems of pipelining resolve themselves. This emphasis on form means that many questions of content remain unanswered. For example, how will users navigate among millions of records without getting hopelessly lost? One solution is a System for Universal Media Searching (SUMS, Copyright 1992) which is being developed at the McLuhan Program. This entails a principle of three basic domains of knowledge: namely, pointers, objects and interpretations. Pointers are the tools to get at knowledge, i.e. classification systems, dictionaries, encyclopaedias, bibliographies and partial contents in terms of abstracts, tables of contents and indexes; the kinds of materials which we usually find in reference sections of libraries. Objects entail full contents, namely electronic facsimiles of books, paintings, instruments and other sources of knowledge. Interpretations are various attempts to describe and analyse those contents, namely the subjective dimensions of knowledge ranging from well based claims to conjectures and opinions. Four kinds of interpretation are distinguished, internal, where the focus is on the object itself; external, where an object is compared with other objects; restorations, where an object already has built into it the interpretations of a restorer and reconstructions where an object has built into it the interpretations of those who reconstructed it (fig. 1).

Pointers	1. Classification Systems
	2. Dictionaries
	3. Encyclopaedias
	4. Bibliographies
	5. Partial Contents (Abstracts, Indexes)
Objects	6. Full Contents (Books, Paintings, Instruments etc.)
Interpretations	7. Internal
	8. External
	9. Restorations
	10. Reconstructions

Fig. 1. Basic domains and levels of knowledge.

Basic characteristics of these three domains have been discussed elsewhere[8]. This paper focusses more specifically on problems of interpretation and explores how these will be transformed by the advent of computers. Out concern is not with obvious claims that the speed of computers will inevitably make electronic versions of materials much more accessible, but rather with a paradoxical suggestion: that the impact of computers lies not so much in translating what exists in analogue form (print, video etc.) to digital form, but rather in generating unprecedented amounts of interpretation in the form of additional description and commentary, thus bringing to these fields new levels of systematic study. There are precedents for this phenomenon. As Giesecke[9] has shown conclusively, the advent of printing in the West was much than a simple process of translating manuscripts into printed books. Printing meant that authors could no longer predict their audience and hence needed to make explicit many more things. Thus what began as an attempt to translate knowledge from one medium to another, led to a transformation of knowledge. Description established itself as a conscious activity.

Why should translation from print to electronic media introduce a new transformation in knowledge? A simple answer would be that we only organize and treat systematically that for which we have tools to organize. In oral cultures a librarian could scarcely catalogue ideas in the heads of local chieftains. In manuscript cultures without a standardized system of spelling there were limitations to how effectively things could be catalogued alphabetically. In print cultures standardized spelling permitted alphabetical lists, but the linear nature of print meant that multiple access through variant names remained tedious, and often difficult or infeasible. Electronic media enable standardized names and lists of variants to be fully integrated[10]. In print culture, lists are typically limited to card catalogues with names, titles and places. Hence lists are effectively pointers. Actual contents are elsewhere in separate books which need to be consulted one at a time. In electronic culture, digital lists contain not only pointers but also full contents. Hence the amount of material that can be systematically accessed and arranged is much larger. How will translation from print to electronic media transform knowledge in the realm of interpretation? Examples will be considered in terms of internal and external analyses, restorations and reconstructions. Implicit interpretations with respect to pointers will also be examined.

By way of introduction it is useful to note that the term interpretation means a number of things. In general it is used loosely as synonymous with analysis, insights, commentaries or hermeneutics. In the thirteenth century four types of interpretation were identified: literal, metaphorical, allegorical, and anagogical. To avoid confusion we shall refer to these as interpretative modes, using interpretation as the general term within which a variety of types are identified.

2. Internal Analyses

Internal analyses focus on trying to understand the object itself. In this context the most basic type of interpretation requires describing contents, i.e. identifying persons and objects, their characteristics and their contexts in a book or a picture. Another approach

1. Who?	Names etc.
2. What?	Positions
3.	Actions
4.	Motions
5.	Emotions
6.	Relations
7.	Narrative Contexts
8.	Costumes
9.	Ornaments
10. Where?	Places
11. When?	Events

Fig.. 2. Eleven kinds of identifications.

lies in interpretative modes. A third lies in analysing grammar and other linguistic features. Each of these will be considered in turn.

3. Identifications

For the purposes of this paper eleven kinds of identification are outlined (fig. 2).

Names

Basic identifications entail the name of an individual or object, plus their gender, size, age, etc. In the case of literature such identifications can in large part be automated. For instance, in the case of the *Old Testament*, one might begin with Christian biographical dictionaries and encyclopaedias, collate these to create a master list, check for each of these names and the number of occurrences thereof in the *Old Testament*. Hence a person wishing to identify Moses would be told which biographical dictionaries describe him, how long each description is and permit the user to consult any or all of these. In terms of basic domains and levels of knowledge (fig. 1) this entails linking a subset of names and their accompanying descriptions (in levels two and three) with corresponding names found in the full contents of a book (in level six) to arrive at preliminary lists (for level seven). If a user wished to pursue this question of identification, the computer could check for the existence of this name in classification systems (level one), bibliographies (level four) and partial contents, e.g. key words, (level five). This approach could be adapted for any fictional or historical name in any type of literature, be it Shakespeare or Churchill.

In the case of paintings, identifications vary enormously in level of difficulty. Some paintings have the name of an individual written beside their image such that it is merely a question of reading the name. Often context makes identification easy. If a Christian sees a painting of a man on a cross surrounded by two other persons on crosses on a hill they will quickly recognize this as Christ on the Cross at Golgotha. Saints in Christian paintings typically have attributes. Some of these are well known: e.g. St. James has a

scallop shell; St. Roch has a plague wound on his leg.. Others require experts to consult their copy of Reau[11].

At least some of these identifications in paintings are recorded in titles such as *Virgin and Child surrounded by Saints John the Evangelist and John the Baptist*. Others are recorded in the catalogue cards of galleries and museums as well as in specialized databases such as the *Princeton Index of Christian Art*. If these identifications in titles, catalogues etc. are correlated with names in various types of pointers then these connections can again be automated. The sceptic will note that titles are not always accurate or may entail controversy. In such cases scholars have usually suggested alternative titles with different names. So one simply needs to add a function whereby users are apprised of controversies and provided with alternative readings.

In the long term the computer can be taught to recognize the kind of name that is involved: e.g. David and Jonathan are (originally) *Old Testament, Patroclus* comes from Homer and thus automatically provide basic facts and take the reader into narrative context (see below) if they so desire.

Positions

As is the case throughout various levels of SUMS, individual sections reflect different forms of the basic questions who?, what?, where?, when?, how?, why? Hence having identified names (who?), the next identifications entail characteristics of the person (what?). The first of these is positions. In the case of literature the positions of persons are traditionally identified using simple prepositions such as: front, back, above, middle, below, facing right, facing left. In the past scholars might comment on the exact position of Achilles at a crucial moment in the story but the task of recording every position of every figure described in the *Iliad* would have been much too tedious to make sense. In the case of art the development of specialized systems such as *Iconclass* (Leiden, Utrecht) are providing a context for systematic descriptions of this kind. So too are major projects such as the *Lexicon Iconographicum Mythologiae Classicae*. In future, computers can automate aspects of this task and thus open up a whole range of new questions. Are the positions of Greek heroes and heroines fundamentally the same as those of mediaeval romances and renaissance stories? If there are changes to what extent do these vary culturally, from country to country and continent to continent? Are there parallels between European, Chinese, Indian, or North and South American positions or are they different? In what ways are they different? What do these differences mean?

Actions

That which applies to positions applies also to actions such as dancing, drinking, eating, fighting, playing, reading, singing, sleeping, thinking, working. The computer could again record automatically which actions are used to describe individuals in a story. Various forms of verbs could also be recorded , such that one could study not only trends in actions described but also trends in the use of tenses. Do given cultures focus on certain action verbs more than others? Do some focus on past or future as opposed to

present tenses? Do they focus on active rather than passive tenses? If so what might this mean?

Motions

This same approach can be applied to basic motions of an individual such as carrying, kneeling, leaning, lifting, lying down, pulling, pressing down, running, sitting, standing, supported, suspended, thrusting . Are heroes and heroines in epics given different motions from others? Do these vary culturally and /or historically? What can one learn from these changes?

Emotions

One could also use this approach with respect to the inner emotions, or passions as they are called in French, such as anger, ecstasy, fear, joy, sorrow, suffering. In the case of art, there is a tradition of illustrated texts showing images of these passions which could be scanned in and then used as a basis for pattern recognition.

Relations

Knowledge concerning relations between persons could also be automated by computers by searching systematically for propositions such as against, at, away from, from, to, towards, and with. In the case of paintings one can also search for these prepositions in titles and catalogue entries.

Narrative Contexts

Literary allusions, especially classical allusions have traditionally been a basic characteristic of cultured persons. In certain circles one could take for granted that a reference to David and Goliath, or even David and Jonathan would evoke events from those stories in the *Old Testament*; that references to Icarus or Tantalus, to Francis of Assisi or Saint Vincent Ferrer would not require explaining their stories. All this has changed, partly because persons no longer view reading a corpus of great literature from Homer through Sartre as a necessary dimension of being civilized and this for at least two reasons. First, the traditional corpus has been recognized as sadly Eurocentric, such that one should theoretically expand its scope to include the great literature of China, India, Japan, Iran, Iraq, Turkey and many other countries. Second, sensitive readers have discovered that study of the greats has overshadowed the achievements of many other authors with their own intrinsic worth. As a result some would now have us study everyone. This is beyond anyone's capacities and as a result there are a myriad answers as to what the reading list should include. Net result: even scholars no longer have a common corpus that they can assume their colleagues will have read.

1. Bible
2. Fairy Tales (e.g. Grimms)
3. Historical Figures
4. Iconclass
5. Lives of Saints (e.g. Da Voragine)
6. Legends
7. Mythologies
8. Patrologia Latinum
9. Patrologia Graecum

Fig. 3 . Nine examples of narrative contexts.

Much of the knowledge concerning this lost common corpus can be automated. A number of basic sources ranging from the *Bible*, *Patrologiae Latinum*, *Patrologiae Graecum* and Kaftal's *Lives of the Saints* have been or are being digitized. If this list is expanded to include fairy tales, legends and mythologies from all countries, not just Europe, then these materials can be arranged (in levels two and three) and linked to names in full contents of literature (at level six) to provide narrative contexts (at level seven). If, for instance, a person is reading a text and comes across a reference to Socrates, the computer would know that Socrates was an allusion to an historical figure in Ancient Greece, provide his dates, references to descriptions by Plato and other classical authors (e.g. Diogenes Laertius) and a list of secondary literature on Socrates (e.g. Jaspers). Hence far more than simply identifying a figure the computer would provide readers with their full narrative contexts (cf. fig. 3). This would prepare the way for studies showing the extent to which a given narrative context and cultural heritage influenced a literary work.

Costumes

Records of costumes are another feature that can be partially automated such that one could study their continuity over time, how they become linked with local, regional and national sentiments, how the detail with which they are described varies tremendously from one culture to another.

Ornaments

Descriptions of ornaments (jewelry, armour, shields) are yet another characteristic that can be partially automated. What jewels are described? What combinations of jewels? In what detail are they described? How much do these descriptions change from culture to culture and from one period to another?

3. Internal Interpretative Modes

Dante defined four basic interpretative modes, namely, literal, allegorical, moral, anagogical. A series of other possibilities bear attention (fig. 4) including, equivalence, substitution, euhemerism, symbolism, guisal, (when the Duchess of X is represented in

1. Equivalence	statue equals god	
2. Substitution	statue represents god	
3. Euhemerism	painting represents man as if god	
4. Symbolism	"	"*a* but means *b*
5. Literal	"	"*a* and means *a*
6. Allegorical	"	"*Old Testament* and means *New Testament*
7. Moral	"	"Christ's actions in relation to man
8. Anagogical	"	"Christ's actions in relation to eternity
9. Guisal	"	"*a* in the guise *a1*
10. Playful Guisal	"	"*a* in the playful guise of *a1*

Fig. 4 Ten basic categories of interpretative modes.

the guise of the goddess Diana) and playful guisal, (when this is done in a playful way as when Boucher paints a man in the guise of Mercury and depicts small wings at his feet tied on by ribbons).

Each of these interpretative modes can be seen in terms of increasing levels of abstraction, from cases where an object is identified with the god or goddess it re-presents (as in totemism), to cases where this link between represented object and original is purely playful. Some of these aspects are evident from the titles of paintings or descriptions in texts and can hence be recorded automatically. Many of these modes cannot be analysed automatically with present tools. Insights from secondary literature could, however, be collated and used for this purpose.

4. Internal Linguistic Analyses

In addition to characteristics which can be automatically computed or collated from existing secondary literature, there are other grammatical and linguistic characteristics which can be explored in accordance with a user's individual interests using software tools such as Freebase, Collate, Micro-OCP, and Tact. The extent to which these analyses remain as personal notes, comments shared on a bulletin board or become part of the accepted corpus of commentary and interpretation will depend on peer groups within various specialized fields.

5. External Analyses

There is a basic difference between internal and external analyses. In internal analyses the primary reality of the person or object lies within the book or painting. In external analyses the figure is related to other literary, historical or artistic sources. These external characteristics can again be seen in terms of basic questions, namely, who?, what?, where?, when?, how?, why? (fig. 6).

Who? Persons

What?	Objects	
		Comparisons
		Development
		Practice-Theory
		Abstract-Concrete
		Universals-Particulars
Where?		Places Locations
		Scales
When?	Events	
How?	Instructions	
Why?	Reasons	

Fig. 5. Some examples of external analyses.

As some examples of these have been considered elsewhere[12], they will not be further described at this point. As in the case of modes of interpretation these characteristics will need to be gleaned from existing secondary literature. In future a revision of rules for scholarly publications will be required, whereby electronic versions of articles and books become an integral part of scholarly activity. In so doing hitherto isolated insights concerning a particular book or painting will become part of a cumulative corpus.

6. Restorations

Restorations are included as a level of interpretation because these objects have built into them often tacit interpretations of earlier restorers. Some of the tools used in distinguishing originals, restored versions, simulated and actual interventions are listed below (fig. 6). The details of this level will be the subject of a later article.

1. Written Descriptions
2. Drawings
3. Photographs
4. X-Rays
5. Ultra-Violet Rays
6. CAD
7. Virtual Reality

Fig. 6. Some basic tools used in restorations.

7. Reconstructions

Reconstructions may be described as visual interpretations. These are of two basic kinds: a first where the original object is intact and the role of the reconstruction is to provide new dimensions of analysis; a second where the original object is no longer intact and the reconstruction suggests how it might have looked when it was still intact. Intact reconstructions include a) critical versions, in cases where the actual diagram is Intact
1. Critical Versions
2. Proportions

3. Perspective

Non-Intact
4. Ground Plans
5. Models
6. CAD
7 Virtual Reality
Fig. 7. Examples of reconstructions.

considered incorrect or where reconstructions are used to interpret ambiguous aspects of a diagram; b) cases in which the proportions implicit in a diagram are added and c) in which the perspectival lines are superimposed on a picture.

Non-intact reconstructions include cases within objects, between objects, and sites. They may also involve existing elements in context, as in the case of the Roman Forum where some buildings are still partially standing. Sometimes these existing elements have been moved elsewhere, as in the case of the Elgin Marbles now in the British Museum which were originally part of the Parthenon on the Acropolis at Athens. Here the challenge lies in showing where and how the parts in London would have fitted into their original location in Athens. Sometimes these relationships are best revealed through hierarchies of related parts, i.e. showing how a base and capital relate to a column and how these relate to specific parts of a Greek or Roman temple or other buildings. A more difficult case, of course, is when the elements being put into context no longer exist in their original form. The columns may be strewn all over the ground as with the temples in Selinunte or the original(s) may have been carted away and used for other buildings as in the case of parts of the Coliseum.

8. Implicit Interpretations in Pointers and Objects.

Levels seven to ten in our basic schema (fig. 1) entail cases of explicit interpretation, i.e. where a scholar or individual is consciously describing, commenting on or analysing a passage of text, a painting or other object. These constitute the most obvious kinds of interpretation. In addition to these there are implicit interpretations which apply to all levels. For example, systems of classification entail different philosophical and psychological assumptions about how knowledge should be cubbyholed. A librarian and more so a reader using a particular system may well forget that this is but one of many possibilities of organizing the genera and species of knowledge. In the case of explicit interpretations an attentive user would be expected to write a new commentary or make a fresh analysis to demonstrate the limitations of the existing system. In the case of classification systems, only the rarest of individuals such as Bliss or Ranganathan will take it upon themselves to create an alternative system. A few librarians may write specialized articles suggesting emendations to a system such as Dewey or Library of Congress especially in the case of new topics such as virtual reality which did not exist previously. Most persons will content themselves with becoming conscious that the categories which seemed unshakeable are in fact provisional at a higher level. Similar principles hold with respect to definitions and explanations in dictionaries and

encylopaedias as well as partial contents in the form of abstracts. These too are implicit interpretations.

With respect to these implicit interpretations in the realm of pointers, computers may well stimulate many new classifications, definitions and explanations and abstracts. But their more immediate role will be to make accessible the many alternative versions that have hitherto not been widely known, thus allowing users to recognize more clearly the implicit interpretations and limitations of any given system, definition, explanation or partial contents in the form of abstracts etc.

Even in the case of full contents there are implicit interpretations insomuch as many representations of original objects are taken from a specific point of view which brings some aspects into focus and leaves other aspects out of focus. Here computers can play another role. For if hitherto isolated views are co-ordinated such that one can reconstruct what an object would look like from all sides the limitations of a single viewpoint at a time would be overcome.

9. Problems of Truth

Many recent developments in electronic media seem to be undermining our criteria for veracity and truth. This is particularly evident in recent films. In *Jurassic Park* it is well nigh impossible to distinguish dinosaurs based on mechanical models from those created by computer graphics. In *Last Action Hero*, the young protagonist moves seamlessly back and forth between the physical world and the fictive world of the screen. In *Cliffhanger* the scenes move constantly between the Rocky Mountains in Colorado and the Dolomites in Italy. These examples could be seen as part of a larger trend characterize by new terms such as *info-tainment* and *edu-tainment* whereby boundaries between realism and phantasy are being eroded such that documentaries and situation comedies are becoming indistinguishable; whereby the CNN report of a war is just another form of diversion and entertainment. Some might see developments in interpretation outlined above as yet another manifestation of these trends. In this view computers would be a culmination of trends towards seeing knowledge in terms of psychology and sociology which began seriously in the late nineteenth and early twentieth centuries. Hence computers would primarily be instruments of a new relativism.

These developments can, however, be looked at in a quite different light. Persons accustomed to only one language, classification system, definition, explanation, version of a title etc. are likely to assume that there is something ontological and absolute about their univalent framework for analysis. To give such persons access to different versions of each of these tools could appear as an admission of purely subjective relativism , but it is not. The existence of different definitions for a term does not remove the need to record and reproduce accurately and truthfully the contents of those definitions[13]. Indeed persons can become more conscious that their own approach is but one of many genuine alternatives.

By distinguishing clearly between different domains of knowledge, namely, pointers, where interpretations are implicit; objects, where interpretations enter through the viewpoints from which the object is recorded and interpretations where the subjective element is explicit, the computer can play a vital role in organizing knowledge such that we can keep separate objective and subjective aspects. Hence instead of threatening our sense of truth electronic media can potentially be vital tools in upholding and fostering it. To achieve this requires an electronic equivalent of footnotes which will document the sources of texts, pictures, videos and other media, the precise conditions under which they were recorded and edited.

10. Conclusions.

Most of the elements of interpretation outlined above are not new. They have been known to and used by sensitive scholars over the past centuries. Even so the ways in which these elements are used is changing radically. Traditionally a scholar focussed on isolated elements making no pretense that these were in any way comprehensive or exhaustive. The results were recorded in a study. For a time these studies became learned letters which were sent to a small circle of friends. In the eighteenth century as the notion of a republic of letters spread, these learned letters became a starting point for the *Acts of the Erudite* (*Acta eruditorum*) and similar collections which evolved into learned journals. While this had the advantage of publishing many insights which would otherwise have remained in manuscript, it meant that specialized insights were scattered throughout these journals and that potential cumulative effects thereof remained invisible. New microfiche versions of some of this literature in the past generation did not change this pattern in a fundamental way.

Many persons see the computer revolution in terms of increased efficiencies which come with translating existing materials into electronic form. This paper has argued that the greater part of the revolution lies elsewhere. First, some aspects of interpretation which previously posed too daunting a task to researchers, can now be organized more efficiently while others can be automated. Second, the translation of these materials into digital form means that isolated insights of scholars which hitherto remained dispersed will become accessible in cumulative form. Third, and by no means least, in providing tools which allow interpretations of these materials to be largely automated, computers will create a whole new corpus of commentaries. In short the computer revolution is not about form. It is about new content.

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CHAPTER 5

SIX STEPS IN THE DEVELOPMENT OF SUMS

Introduction

The vision is simple: to have the ability to search for information and knowledge in libraries, museums, archives and other repositories throughout the world systematically so that one can organize, archive, retrieve, re-arrange, re-structure materials at will. This will include both static knowledge (the corpus of traditional facts stored in libraries, universities and academies) and dynamic information (ever changing data in new fields such as satellite photography, weather, news, stock markets etc.). The System for Universal Media Searching (SUMS) offers a first prototype of such a tool. At present it effectively functions as if one had a number of bookmarks and organized these systematically. This preliminary version has a number of limitations. It uses only two subjects (Leonardo and perspective). It is largely hard-wired. It cannot do automatic searching. It applies only to static knowledge. This paper outlines a series of seven steps or stages which will take this software from a hard wired prototype to a fully operational, multi-valent product that is largely automatic in its search strategems.

Step One. Preliminary prototype with basic examples in one subject: education

Basic materials on education are collected manually and organized in terms of questions: who, what, where, when, how, why. These connections are hard-wired but words in the server can be linked to an on-line dictionary such as Websters and find that term automatically. The presence of the Z39.50 protocol means that any person listed in SUMS under "who" can be searched in the author catalogues of a Z39.50 library, museum or archive.

This is still limited access because there is no inherent knowledge about what is found at the remote site. For example, if the user looks for Leonardo da Vinci in the University of Toronto Library with this version of SUMS, they will find all titles that happen to be in the library. They will still need to organize that material manually. To achieve this there will be some elementary templates.

Step Two. Prototype with detailed example on one topic of education: mathematics.

To show the full potentials of making detailed cross-referenced links on the basis of who, what, where, when, how, why, will require a labour intensive proof of concept by an individual. To achieve this John MacDonald (MSSB) will relate course work in mathematics to the curriculum in the academic year 1996-1997. To help him in this process, various additional templates will be produced such that the process requires very little effort on the part of a new teacher.

Eventually many of these links can be automated with the help of mature natural language and neural network tools. Rather than wait a few years before these are in place, it is necessary to make a seeming detour by doing the labour intensive work of creating working prototypes manually or semi-manually. These prototypes can then be used as a standard when testing the ability of natural language techniques which make claim to be able to create all the desired links.

Step Three. Integration of detailed examples on various topics

Step three will extend this principle to a series of subjects to show that the same principle becomes more powerful when this cross-referencing is extended across the curriculum. In addition to going horizontally across different subjects there is also a need to go vertically among different categories of knowledge: from a general corpus, to a curriculum, a course, texts, and tests. Entailed in all this is an integration of access not just to individual facts of knowledge but links between the training, testing and evaluation thereof.

Step Four. Coordinate with individual content providers

Once one can show the full potentials of this re-contextualization of knowledge, it will be important to enlist the co-operation of major content producers to organize their materials in ways that are compliant with the SUMS framework. To achieve this the various fields in the SUMS system can be made available to an institution in list form. The institution in question will then add their equivalent fields in a parallel list such that materials from that institution can readily be mapped into the SUMS framework. For example the SUMS framework has the heading "Name". The institution in question may call this "Author", or "Creator" or "Artist" or even "Person". As soon as the equation Name in SUMS = Person in institution A has been made, then the SUMS server will know where to look for the materials. While this represents a considerable advance towards automation it means that searches remain limited to institutions who are members of the club.

Step Five. Integration of Static and Dynamic Knowledge

Traditionally those concerned with static knowledge (the corpus of accepted knowledge which does not change except that it becomes larger) have remained very separate form those concerned with dynamic knowledge. Librarians have tended not to interact with news reporters, stock market followers and the like. If my search is about something that happened in the last 24 hours, it will often be enough to limit myself to new sources such as Reuters and the like. In some cases, when I ask about a city in Bosnia, knowing something of the history of that city will be extremely useful to me. So an integration of dynamic and static streams of knowledge is necessary. Names, subjects, places in the two systems need to be integrated. In terms of media this entails integrating information from video and film with knowledge from books.
This will also bring changes to the way we look at traditional knowledge. Statistics concerning publications can be transformed into charts such that one can see patterns in the form of spread sheets.

Step Six. Universal Reference Data Base of Names, Subjects and Places

To become universal requires an ability to access libraries and museums at random, which means that this basic knowledge of fields be extended everywhere. This will require a whole series of further initiatives.

First, one will need to introduce standards for each type of institution, such that libraries all conform to one set of protocols. The Z39.50 protocol is an important step in that direction. The standards among different institutions will then need co-ordination. Groups such as the Research Libraries Information Network (RLIN) have been moving in this direction.

Second, a system of aliases for names is required. If I am looking for a name such as Hondhorst I will not always find that Dutch painter under the standard version of their name. In Italy he is catalogued as Giovanni delle Notte. We therefore need to have a universal reference base of alias names such that if I am looking for Hondhorst the system also looks under Giovanni delle Notte whenever it is in an Italian database. That which applies to persons (who?) applies equally to subjects (what?), places (where?), times (as in different calendars; when?), and even techniques (how?). The way of restoring a painting in Italy may be different than in France or Germany. I may think I am looking for technique A but need also to look under technique B. So a centralized database of references and aliases is required even though the knowledge concerning those references may well be distributed all around the world.

Initially one would begin with various tools that exist already. In the field of art history for example there are standard reference works such as Thieme-Becker's *Allgemeine Künstler Lexikon* and the Getty AHIP's Union List of Artist Names (ULAN). Such basic works exist in all the major fields. In addition, at the national level there are national biographies, national bibliographies etc. Similar tools exist in all the major disciplines. In some branches of science, notably chemistry, physics and medicine, very significant steps towards an international framework have already been achieved.

Third, there will need to be another layer, probably distributed, to deal with the details of individuals, subjects and places. Let us take the example of Leonardo da Vinci. When a user makes a request from a local machine it goes to one of the mirror sites of the centralized reference base to acquire all the variant names, dates etc. It then goes to the standard database on Leonardo to get all the names of his paintings, manuscripts, instruments etc. Equipped with this context it can interpret the details of the question and know in what locations databases on Leonardo are found and/or likely to be found.

Fourth, the centralized database will entail a series of layers. Sometimes the question at hand will entail an idea that changes from culture to culture and/or a concept that changes historically. The term "perspective" in the sense of "linear perspective" is "perspectiva" in Latin. But the Latin term could also mean "vision". In such cases a simple mapping of one term to its translation in another language is not enough. We need to trace the etymologies of terms, culturally and historically. Such searches are much more intensive, even if much of the searching can be relegated to an agent. This is a very different layer than one which is asking for the location of Paris on a modern map. It is a level that is very much associated with the frontiers of scholarship, which is precisely that sector of society which can most help us in gaining a better understanding of the frontiers of knowledge.

In addition to various levels of knowledge, what may be needed therefore is a series of kinds of searching. Members of the general public will be discouraged from searching everything to the deepest level unless they wish to pay for it. On the other hand any scholar or even any member of the public (an amateur in the old sense of the term), as long as they have a demonstrable field of research where they are likely to make some contribution, will be free to search however much they choose, much in the same way that entrance to the British Library is effectively free, but only serious readers have free access.

Fifth, in order for the universal reference base to become fully sensitive to cultural and historical complexity will require the inclusion of major classification systems systems such that one can move readily from the mental cubbyholes in one culture to those of another.

Sixth, one will wish to complement verbal search techniques with visual methods such as those being developed in the Query by Image Content (QBIC) software of IBM. In elementary applications this entails a user drawing a shape which is then searched for among the images in a database. Such a strategy makes the search dependent in part on the user's ability and skill in drawing accurately. In future it will be desireable to combine verbal and visual query techniques. For example, a user is interested in the *Annunciation*. They choose this theme in a verbal classification scheme such as Van der Waal's *Iconclass*. The verbal classification has linked with it a series of basic types of *Annunciation* in the form of thumbnail images. The user decides which of these basic types interests them: e.g. *Annunciations* in a closed room or in a garden. The system then searches for that type.

Seventh, there will need to be new projects to translate materials into a common language. At present there are a series of impressive projects to scan in materials from the great collections of the world. IBM has begun to scan in the complete texts of the manuscripts of the Vatican Library. At present their purpose in so doing is to make the contents of this great library available to scholars able to read the manuscripts in their original state. These manuscripts are in a number of languages: while Latin and Greek may predominate there are also works in Arabic, Hebrew, Sanscrit, Russian and many obscure languages such as Babylonian or Assyrian which are accessible to very few scholars indeed. It is true that many of these works have at some time been translated into modern languages such as German, French or English. But many have not. Hence the quest for complete accessibility will require a complete translation of all works into at least one world language. This will take many years, especially in a world where there are forces at work to destroy almost systematically the heritage of libraries and museums in some cultures (e.g. Tibet, the former Yugoslavia and now Afghanistan).

Conclusions

While the notion of an electronic butler as described by Nicholas Negroponte is a very attractive one, the possibility of achieving search mechanisms that truly reflect the

complexities of cultural and historical change is not nearly as simple as it seems. Moving from static to dynamic links is feasible, but will require at least a generation or two to achieve in more than a superficial sense.[14]

In the United States the notion has emerged that one can own content. This may be feasible as long as content is defined in terms of Hollywood films or television. In the grand scheme of things this material is relatively small. In the case of the libraries and museums of the world, the amounts of material are far too vast and no single company can hope to own it all. Companies such as Microsoft which began with that assumption have predictably been ridiculed by the major cultural forces of Europe. Needed therefore is a different approach.

Having abandoned the illusion of owning the content, the major players might fruitfully begin with a quest to own the references to the content. To achieve universal reference tools on a global scale will require many more resources than any single company or group of companies could ever hope to muster. It will require institutes dedicated full-time to developing the methodologies to make this possible. It will require a consortium of major players and international co-operation linking both the public and private sectors. Some of these initiatives dovetail with the goals of the G7 pilot projects which offer points of entry into the kind of global approach that must go far beyond the G7 if it is to become truly international in scope. The six steps outlined above offer some clear steps for making that future which still seems distant to many come closer to reality.

Perspective Unit, McLuhan Program
5 March 1996.

CHAPTER 6

FRONTIERS IN ELECTRONIC MEDIA

1. Introduction 2. Recording Devices 3. Replacing Traditional Writing and Drawing Devices 4. New Liberties in Editing 5. Revision Control 6. Collaborative Work and Design 7. Advertising and Selling 8. Computers, Smart Objects and Ubiquity 9. Space and Geography as Integrating Metaphors 10. From Packaged Software to

On-Line Applications 11. From Quantity to Quality 12. Universal Libraries 13. Translation, Reconstruction and Interpretations as New Industries 14. Interfaces and Conceptual Navigation 15. Agents 16. Transformations in Publishing, Entertainment and Knowledge 17. Conclusions.

1. Introduction

In the film, *Disclosure* (released December 1994), the production manager of the high tech firm, Digicom, provides an intriguing glimpse into the potentials of new media. He stands in a space between two posts, puts on a head-mounted display and enters into a virtual reality environment called the corridor that bears an uncanny resemblance to Saint Peter's Basilica in the Vatican recently produced in virtual reality by Infobyte (Rome) with support from the Italian electrical company, ENEL. He then moves into a room with a series of virtual file-cabinets built into the wall as shelves, each of which lights up in turn to indicate different centres of operations, notably, Seattle and Malaysia. He touches the cabinet marked Malaysia, which opens to reveal a series of virtual documents each of which he then reads in turn. The documents include video clips of video-conferencing as well as electronic copies of letters.[15]

Is this truly a model for the future? Will the new technologies merely translate traditional methods of storing information into a new medium? Or will they bring completely new approaches? This paper offers a survey of some present trends, notably in the realm of new recording devices; collaborative work and design, universal libraries, translations, reconstructions, interpretations, conceptual navigation and agents, before suggesting how new media will transform publishing and entertainment.

2. New Recording and Presentation Devices

A series of new cameras are transforming the scope of what is recorded. The IBM "Brandywine" camera typically scans a painting or a manuscript at 20-50 megabytes a page. The VASARI scanner scans images at 1.4 gigabytes per square meter. Such cameras provide new levels of detail which can then be used for problems such as retrospective colour conversion. The Canadian National Research Council (NRC) laser camera typically records images from 1-50 megabytes which can be rotated on screen such that one can see all aspects of a three-dimensional object in a way analogous to that which VRML is doing with 3-D models. The NRC camera can be linked with stereo-lithography to produce completely three-dimensional reproductions. Sculpture on demand at any scale is now possible. Meanwhile the National Research Council of Italy (*Consiglio Nazionale delle Ricerche*) has designed a special portable camera that fits into a suitcase and can be used for quick inventories of materials. A net result of these new technologies for capturing images is that almost any object in the natural world can be recorded digitally. Once in digital form the images of these objects can be reproduced in almost any other media.

3. Replacing Traditional Writing and Drawing Devices

The first phase of the so-called computer revolution was largely in the realm of replacement technology. Computers replaced typewriters but continued essentially the same functions: typing became work with electronic word-processing packages. Some persons assumed that computers would in turn replace secretaries but forgot that secretaries are much more than word-processors. Their key role lies in filtering persons and information for their employers. And although there may be a great deal of rhetoric about personal digital assistants and electronic butlers, the likelihood of such an electronic device seriously serving as this kind of filter has yet to be demonstrated.

Meanwhile, many architects have been replacing drawing instruments such as the rule(r), compass and other drafting tools with Computer Aided Drafting (CAD) tools. At the higher levels CAD became one of the four C's, along with Computer Aided Engineering (CAE), Computer Aided Manufacturing (CAM), and Computer Integrated Manufacturing (CIM). More recently these developments are becoming part of a larger trend whereby space and geography are becoming integrating metaphors (see 9 below).

At the same time, there are still enormous discrepancies between that which is claimed possible and that which actually functions in this domain. For at least three decades we have been told that electronic dictation machines were coming. We have also been assured that voice-activated computers were imminent, and that translation devices into multiple languages were nearing a practical stage. Recently there seems a trend to re-emphasize pen based assistants, notwithstanding the obvious shortcomings of the Apple *Newtons*. Complete integration of voice and translation still needs to be done.

4. New Liberties in Editing

One of the main reasons why computers replaced typewriters was because they made the editing much simpler. One could correct errors without the fuss and bother of erasing originals. This applied not only to words (e.g. *Word, Word Perfect*) but equally to charts (*Excel*), drawings, pictures and photographs (*Photoshop, Photostyler*). In studios this extended to photo-finishing. In the realm of television and video-conferencing it meant that sequences could be edited more readily (non-linear editing). There is presently much research on extending the concept of chroma-keying to produce blue rooms[16] and virtual sets, such that an actor in one site can be integrated with scenes at other sites.[17]

The advent of desktop publishing soon revealed that not everyone who is presented with 200 fonts becomes a serious publisher. The same will prove true in the case of desktop film production as users try to become instant producers and directors. Yet some fascinating products will undoubtedly emerge from these new tools. All of which has introduced new problems: how can one know which version is an actual one, a correct one, the accepted one? The need arose for an electronic equivalent to footnotes, for new tests of veracity.

5. Revision Control

To answer these needs the leading vendors introduced revision control. At the simplest level this merely entailed a clear record of which version was done earlier or later.
The introduction of object-oriented programming and dynamic link libraries meant that in cases where there were multiple copies of a record, correcting a chart once led to its correction across the board. In a networked context this meant that correcting a spreadsheet in one office led to spreadsheets in other cities automatically being updated even if they were embedded into letters, reports or other documents. This amounted to an automatic comparing of notes, texts, tables and even databanks. It also introduced hierarchies of users, some authorized, some not authorized to change existing documents. As the functionalities of object-oriented programming expand it will be possible to include ever more complex materials in the packets which can be updated simultaneously. Companies such as Digital were among the first to introduce this approach into business office software. AutoCAD extended the notion to the offices of architects, engineers and town planners. Scholarly equivalents for revision control are still lacking.

6. Collaborative Work, Training, and Design

The early stages of this computer revolution were effectively about documents which were static, or at least aimed at being static in spite of changes introduced through editing and revisions: letters, charts, pictures, photographs etc. The trend has been in the direction of dynamic situations where the information is constantly changing, where interactivity is essential to the process. Tele-conferencing is the simplest example of this kind of activity, followed by boardroom-conferencing and multimedia-conferencing. Here the challenge is not only to communicate at a distance, but also to record the proceedings of important meetings in ways such that individuals unable to make a given meeting will be able to make sense of them afterwards. IBM's *We-met* still in prototype at Yorkton Heights is an example. One of the most impressive free tools in this context is Web4groups.[18] The basic elements of these technologies are summarized in figure one which shows the cumulative nature of the process.

audio	telephone
video	video camera, TV
audio-visual	tele-conferencing, (audio-)video-conferencing
audio-graphic	smartboard, Vis-a-Vis
audio-visual-graphic	virtual reality

Fig. 1. Types of distance communication

A next stage in complexity lies in working together on a problem at a distance. Simple video contact is the most primitive version thereof. Audiographic packages such as *Vis-a-Vis*, which use smart boards represent a next stage in complexity. These permit persons in two centres to make written comments or markings on a common image together in so-called real time. A further stage in complexity is offered by Hiroshi Ishii 's clearboard at NTT, which extends the basic principle of the window and permits persons to mark things together while still maintaining eye contact.[19] Projects under development include collaborative decision support[20] and the collaboratory notebook which fosters learning through collaborative visualization (CoVis)[21]. Such projects are transforming a well

established tradition of distance education into the concept of an interactive classroom[22] also being discussed in other versions as an electronic classroom, a classroom without walls, a virtual campus and a virtual university.

One problem with these new technical possibilities is that they are often being applied in conjunction with traditional teaching models, which rather cancels the innovative dimensions they could potentially have. Video-conferencing offers an excellent case in point. The fashion is to link up two or more sites and then have students in these sites listen to a lecture at a distance. Such an on-line approach has the disadvantage of being very costly without bringing special advantages. It would be much more efficient to tape the lecture, simply send this by mail or asynchronously, and then use the live video-conference experience for discussion periods in groups small enough for real interaction Practitioners in Utah and elsewhere are "discovering" that 9 to 12 persons is pretty much the maximum for a serious exchange: i.e. the distance education class ironically has the same internal characteristics as the real classroom. New technologies do not change fundamental dynamics of human communication.[23]

Intimately connected with these new initiatives in distance education is a feature of computer programmes which permits one to trace a user's path. This is giving computers new roles in assessing the extent to which alternative features are employed by different users. This is also proving useful with respect to testing and goal assessment, which is of particular interest in the field of training where rote memory plays an important role.

Training is being extended to just in time on demand learning (JITOL), cases where a person only learns about a feature on the spot as it becomes necessary. A possible scenario is the following: a repair person is in a remote site and encounters an unfamiliar problem. They contact an expert at head office who identifies the problem and guides them to a solution.[24]

Similar scenarios are being discussed in the context of tele-medicine. In Tokyo ambulances typically require up to two hours to return from the site of an accident to a hospital. Hence ambulance drivers are being equipped with head mounted displays which permit a doctor in a hospital to examine a patient at a distance and offer provisional advice before the patient is moved. In the LargeNet programme which links the University of Western Ontario with seven local hospitals and other institutions, there is conscious work on Interactive Collaborative Information Services (ICIS). Tele-presence, which was initially developed in the context of the military with respect to operating robots at a distance, is finding new applications in medicine. A doctor in one site is now able operate on an animal in another site. There have already been some experiments where this is extended to humans. So an ophthalmologist in London could do surgery in Hong Kong without either the doctor or the patient having to travel half way around the world.

In the realms of design and architecture, there is a quest to make the working environments for software packages such as 3-D Studio, Alias, and Softimage interactive, such that individuals in two different cities can collaborate in the simultaneous design of a

product or a building. Following the early examples of ART+COM at CEBIT in 1990, the Department of Information Science at the University of Milan (Statale,1993) produced a "Virtual Space/Place Editor".[25]

This approach is also being extended to engineering. Companies such as Boeing are using a virtual reality wind tunnel which permits interactive study of scenarios of possible wind stress. Thus far most of these initiatives remain largely isolated efforts. A training package is designed to produce a short term result in a given discipline, or rather section of a discipline. There is generally little or no awareness of activities in other fields. A medical doctor will seldom be aware of developments in biology, law, French or history, although in many cases similar or analogous technical methodologies are involved.

As in the case of video-conferencing the various scenarios for tele-presence and collaborative work often assume traditional synchronous environments[26] when some combination of asynchronous and synchronous links would prove more fruitful. We probably need a whole new field of study to assess criteria for these alternatives and their various combinations. Else what could be a great contribution risks being just a greater technological encumbrance.

There is also a danger that this leads to an ever more piecemeal approach, when the technology holds within it a capacity for a re-contextualization of knowledge. Any test reflects material in a textbook which is part of a course which is part of a curriculum and in turn part of a corpus of knowledge. At present a person may get 100% on a test which represents only 20% of the textbook, 10% of the course, 2% of the curriculum and only .005% of the corpus of knowledge in that field. Using hypertext it is possible to make systematic links between these various subsets and thus make visible the connections between a given question on a test and the corpus of knowledge on which it is ultimately based. A systematic approach linking different curricula in various countries would provide an international framework for this recontextualization, such that an educator in India and the United States can make fair assessments of the relative preparation and achievements of students in their respective countries.[27]

These trends towards ever greater collaboration can be seen as part of a seemingly inexorable wave towards global connectivity, whereby anyone can be reached anywhere, at anytime, if not by video-conference, telephone or computer, then by cellular phone, satellite linked personal digital assistant or some related device. While these developments clearly have profound consequences, they also entail fundamental problems which require much closer attention.

In the past a person worked for a number of hours, a teacher taught for a set number of hours and then went home to relax. With the advent of the telephone and e-mail, employers, colleagues and students often expect that they can use these tools to contact others at all hours of the day and night. A person who spends the day working, teaching, answering phones and writing letters, usually does not want to spend evenings answering

phones and e-mails. Those that do find they no longer have any private space. Work becomes a permanent mode.

Being able to extend the range of one's teaching beyond the classroom via video-conferencing and the Internet is often attractive to administrators who see this as a source of savings by increasing the student-teacher ratio and thus decreasing the numbers of staff. This argument is all the more seductive in the case of less popular subjects. In a networked environment, why have three professors of an obscure language such as Persian or Assyrian when one networked individual could serve everyone? What is usually overlooked is that very specialized subjects require equally specialized attention, which distance learning does not help and large numbers usually destroy. The challenge is not merely to increase quantity but rather to maintain a maximal level of quality (see 11 below).

In the realm of research where collaborative work is also becoming the fashion, another issue needs attention. Some fields are more conducive to collaboration than others. The Hubble telescope required the collaboration of 10,000 scientists throughout the world. An encyclopaedia or an Oxford English Dictionary require teams of scholars working together. On the other hand many studies require the careful, painstaking analysis of a single person. Most major monographs in the humanities, precisely because they entail a synthesis of facts and claims seen from a given viewpoint, are almost necessarily the work of one individual. We need to be careful that our enthusiasm for new collaborative methods does not suppress areas where collaboration is neither needed nor useful.

7. Advertising and Selling

While some pessimists claim that the notion of the world wide web as a money making venture is naive and doomed to failure, most believe that computers linked by the Internet will have a great impact on advertising and selling. Precisely how they will do so is a matter of considerable debate. Some are convinced that the secret lies in creating virtual worlds for shopping on demand. Some are confident that it simply requires putting up a web-page. Some believe that fancy web pages with clever advertising trap doors will do the trick.

Underlying all these solutions is a traditional view of advertising as something that interrupts a person while they are doing something else: a billboard while a person is driving, a page which they are reading in a magazine or a commercial while they are watching something on television. By these standards the more popular the thing one manages to interrupt, the more valuable the advertisement: i.e. a billboard on an expressway is better than on a regular highway; a page in a national magazine is worth more than a local one; a minute on prime time is worth more than an early morning spot.

Using this logic, many hits on web site make it more valuable than one with less hits and if one can trace how many times users went from such a site to the home pages of the vendors, then this is a more effective site. Yet the purpose of the Internet is to find things, not to be distracted along the way. Search engines and agents are being designed

to make this process more direct. As this happens there will be fewer stops along the way and so hits will increasingly be at the destination. So the more effective the search engine, the less effective will be advertising along the way. Another alternative is proposed by Nicholas Negroponte who foresees the use of object-oriented television whereby "touching an actor reveals that his necktie is on sale this week."[28] Perhaps such salespersons and theoreticians are falling into the same traps as some educators who are trying to use new technologies to solve old problems, rather than examining how these technologies are transforming the problems themselves in the process.

Interestingly enough one alternative approach is offered by traditional yellow pages. Companies pay to be included in a readily accessible list to which a user instinctively turns the moment they need anything. An Internet equivalent might simply be one of the options whenever the user reaches an destination in their search. Just as users have a print function, there would be a product/buy function. This would be linked with the user's purpose and the topic searched. For instance, if a person chose tourism in Brazil then hotels and appropriate tropical camping materials would be advertised. If their purpose were university education, there would be lists of appropriate apparel, books etc. Advertisers would be given local, regional, national and international options. Hence a family business might choose only to appear in local directories, whereas a multinational company would wish to advertise globally.

Researchers at what were the Bell-AT&T Labs have been exploring knowledge representation in advertising using a home entertainment application as an example. A potential client is asked to define their budget and specific requirements. The programme then guides them through a series of alternatives within that range, pointing out potential interoperability problems, thus illustrating that it is not so much individual items as integrated solutions that are important. This basic approach which contextualizes one's purchases will probably become increasingly important as more and more items become interconnected. There are some efforts to link this approach in turn to data-mining such that a persons' financial scope and purchasing tendencies are used in defining areas where they are likely to buy things.

8. Computers, Smart Objects and Ubiquity

Computers have evolved from bulky mainframes to personal computers, portables, laptops and ever smaller versions. In addition to the now familiar Personal Digital Assistants, (PDA)[29], The National Research Council of Italy (CNR) has developed [30]a telephone-like device, whereby dialing a three digit number provides information about individual tourist sites. A San Francisco based company called Visible Interactive is developing museum tours on Newton Messagepads designed not to distract other museum visitors[31]. In Bologna personal digital assistants are being equipped with tourist information through wireless Internet connections.[32]

Some see these individual gadgets becoming completely pervasive and networked. For instance, Dr. Weiser, at Xerox PARC, has been preaching a notion of ubiquitous

computing. Instead of a single machine on one's desk there will be hundreds of gadgets throughout one's home and office which are connected with the system. A number of these "connections" would be wireless. For example, a sensor might recognize my entrance and adjust room temperature, lighting and music accordingly. If my job took me to various points in a building, a sensor would, for instance, interact with the phone system and help it to decide which phone it should have ring with a personalized dial tone. Alternative models have been offered by Baudel and Beaudouin-Lafons; Feiner, MacIntyre and Seligmann as well as Fritzmaurice.[33]

In the sixteenth century an ever greater proliferation of measuring devices led gradually to the proportional compass or sector, a device that integrated all known measurement problems at the time. A similar synthesis seems called for in communications devices. Computers already send fax and e-mail messages, can act as phones, radios, cd-players, televisions and connect with printers. We already have remote gadgets for operating our televisions and video cassette recorders. Why should these capabilities not be consolidated into a new hand held device which combines these functions? Worldspace, working in conjunction with Alcatel and others, is already designing a satellite linked device that will have both a radio receiver and a low resolution monitor aimed at third-world countries which will start at $100 and go down to about $20. A more advanced version could contain a few gigabytes of space, separate programs for which would be downloaded from the Internet on arrival in each town. For example, a medical doctor visiting Rome on business, on arrival at his hotel, could download relevant information about local hospitals, clinics, doctors, and medical conventions. The same doctor arriving in Rome as a tourist could download information concerning the sites to be visited. Persons wishing to have this material in advance would pay the appropriate long-distance charges. Whereas persons now rent headsets in museums they might in future take their multi-valent equivalent of a cellular-computer-fax-o- phone and simply download tour information suited to their depth of interest and the time they have available, like an advanced approach to ideas introduced by Minitel. Such a device might also be equipped with some global positioning system (gps) functionality (see below).

9. Space and Geography as Integrating Metaphors

At least since the time of Aristotle, philosophers have recognized that space was one of the fundamental categories of human thought. Kant allotted space a special role in terms of conceptual as well as physical orientation. There is something almost intuitively obvious about the idea of using maps as a means of finding one's way. In the past decade a series of new technologies have been moving towards convergence to transform the traditional senses of maps as metaphors. First, satellite images which were almost solely the domain of the military, are becoming accessible for everyday purposes: e.g. weather, geological features, vegetation and crop patterns. These satellite images are becoming available in different scales and there are new methods for co-ordinating these and linking them systematically with maps at different scales. The Xerox map introduced a very simple method.[34] The Argus Map viewer linked maps of a city to different purposes: e.g. business, health, tourism[35] etc., while the University of Pennsylvania has

created a more advanced viewer.[36] Such maps, in turn are being linked via global positioning systems such that one can start from any point on the earth, use satellites to provide one with co-ordinates which, in turn, serve to provide one with appropriate maps of where one is. In this context one should never really be lost, especially if this became part of a new universal communication device outlined above.

In the case of urbanized and industrial areas, attention to mapping has for some decades continued at a macro-level using Geographical Information Systems (GIS) and at a micro-level using Area Management/ Facilities Management (AM/FM), which goes down to the most immediate level of individual video cameras positioned at strategic points in rooms and buildings. All these hitherto isolated efforts are moving towards integration. A demo reel (1995) of *Terravision* (Art + Com, working with DT Berkom (Berlin), shows a near synthesis between satellite images, GIS, AM/FM such that one goes from images in space to maps, photographs of buildings, their CAD reconstructions and then to strategically positioned cameras within the spaces. This reel was one of the points of departure for Marc Pesce's spatial goals in producing his Virtual Reality Modeling Language (VRML).[37] A copy of the demo also went to the Mountainview headquarters of Silicon Graphics, who have taken the Berlin approach one step further in developing their demo (March 1996) with the attendant slogan: "From outer space to slam in your face". The innovation here lies in going from two-dimensional satellite photographs which, as one approaches the earth, dissolve into three-dimensional terrain maps such that one can then do fly-throughs of valleys in the Alps.

Where this is leading is a new global network connecting satellite data, GIS, AM/FM, GPS and local video cameras such that a user could begin with a view of the United States from space, zoom down to the street level in Los Angeles and then use one of the traffic cameras to check congestion on the freeway at first hand. The potential uses of such integrated systems are being explored by police officers, particularly in Germany. While the danger that such networks could also be misused is beyond the scope of this paper, it is definitely within the scope of possibility.[38]

Considerable attention is being given to combining information from twin satellite images to create a 3-D stereographic image, as Page has done in the case of the Camargo Syncline in Bolivia.[39] These developments in satellite images are paralleled by others in regular photography, particularly with respect to combining stereo images in the context of photogrammetry in order to translate two-dimensional images of buildings into their three-dimensional equivalents as models. Companies such as Vectar have produced *Real View*, a software which permits translation of such two-dimensional photos into a three-dimensional CAD environment. Experiments at the ETH (Zurich), in conjunction with the Centre for Landscape Research (Toronto) are exploring how such 2-D photos can be mapped unto complete 3-D environments.

One of the best examples of this approach is found in Infobyte's reconstruction, with support from ENEL, of the *Tomb of Nefertari*, using photographs of the original as it looked at the time of excavation (1905), when it was restored by the Getty Conservation Institute and as it appears now in a state of considerable degradation. This example is the

more interesting because it illustrates how one can move seamlessly between the monument as it appears today and other states at different times. In the case of Infobyte's reconstruction of Saint Peter's Basilica one can move seamlessly between the existing structure and the no longer existing previous basilica. This same approach could be used to review key interpretations of major sites such as the *Roman Forum* and the *Parthenon*.

The frontiers of the military are working on analogous methods which will effectively make it possible to translate any two-dimensional stereographic photographs in order to arrive at a full three-dimensional model which can then be viewed from all viewpoints at will. This same principle is being considered for film and television. Theoretically one could take an existing scene shot from one position, reconstruct the scene in a virtual three-dimensional space and then be free to move to any other viewpoint in that space. This has enormous implications for those concerned with interactivity, because it means that scenes could effectively be re-arranged to produce plots on demand.

In the near future there should be a synthesis between these micro-experiments and the macro-versions mentioned above using satellite images. We are approaching a time when moving from any two-dimensional to its three dimensional equivalent will become a matter of course.

Shared Virtual Spaces

The continuing convergence of methods is also evidenced by recent trends to combine collaborative tools with virtual spaces. An early example occurred in the game world with the Habitat project, where Lucasgames and Quantum Computer Services set up a multiple participant environment in the San Francisco region (1985). This basic approach was popularized through games such as *Doom*, where players at different stations could be connected in a single virtual space, each individual represented by a symbolic image known as an avatar. One of the latest fashions has been to combine this concept of avatars with virtual malls so that I can "see" and communicate with the image of a person who is physically in a remote location but is sharing my virtual space. While this is conceptually intriguing, why one would want to interact in this way on a long term basis is not clear.

A second scenario of shared virtual spaces is provided by the German National Institute for Supercomputing (GMD, i.e. Gesellschaft für Mathematik und Datenverarbeitung, Sankt Augustin), who foresee a Communication wall.[40] If one wishes to meet with others, one enters a special room, onto the wall of which is projected a mirror version of the room in which one is situated. This mirror version has life-sized video images of the persons with whom one wishes to speak, both facing one. If these two individuals wished to speak to one another they would in real life turn to face one another. In the case of a video image such a 90 degree rotation would normally reduce the images to lines (because one is merely looking at the side of the video clip). So the GMD researchers project this image onto a three-dimensional CAD model of a head which thus maintains the proportions of the speakers even as they turn.

A third scenario is being explored by Philippe Queau, at the Institut National de l'Audiovisuel, one of the leading pioneers in this field. At the IMAGINA exhibition in 1993 he:

> organized the first tele-virtuality liaison in Europe, allowing a virtual meeting of two persons, physically present in Paris and Monte-Carlo, but linked by an ISDN 64kbits/sec liaison, in a real time 3D simulation of the Abbey of Cluny. These two people wearing virtual immersion helmets and represented as clones could walk together in the virtual abbey, speak to with each other and point at architectural details.[41]

This has tremendous implications for teaching. Instead of showing a slide of the Abbey of Cluny or Saint Peter's Basilica, the teacher takes his students on a personal tour through a virtual reality model, pointing out architectural features as they go. A student wishing to learn more about clerestories would return after the lecture examine this feature more carefully and then study earlier and later examples in other churches.

In a recent article Philippe Queau outlined a dramatic vision of things to come,[42] thereby tele-virtuality offers an economical alternative to tele-conferencing. He predicts that there will soon be interactive games where one can don the costume of any character as they set out to fight or play with/against friends and adversaries who are wearing electronic costumes of their own and thus appear as clones of other beings on my screen. These figures may or may not bear any resemblance to the way one actually looks and they can play out their games in models of real places or imaginary spaces.

Various alternatives for achieving full immersion effects are being developed. The most elementary approach is simply to display this virtual world on a monitor which can range from a simple desktop size to a large television monitor. A second entails stereoscopic glasses. A third alternative combines a head-mounted display with gloves which permit the user to navigate freely within the space. A fourth alternative uses a BOOM (Binocular Omni-Oriented Monitor) which is effectively a head mounted display on a balance so that the weight is not all on the user's head. A fifth alternative places one into a special theatre and projects images on large curved screens or all round to create a complete illusion of being surrounded. These were developed by the Canadian IMAX Co. which in turn has a series of variants. The simplest version is a large curved screen. A second version increases the field of the screen. A third version changes places the audience on transparent seats and adds a further screen below to give an illusion of a flying carpet. A fourth version includes stereoscopic glasses to produce three-dimensional images. Plans to link this with three-dimensional audio effects are being developed.

The Goto Optical Company[43] has developed new technologies for projecting images onto the walls of a planetarium to create an even more vivid sense of immersion which they term a *Vivarium*. This will allow audiences to share the experience of a trip through the body as shown in *Fantastic Voyage*, or walk through Infobyte and ENEL's reconstructtions of Saint Peter's Basilica or the Roman *Colosseum*.

As fascinating as they are, all these developments raise more questions than they answer. Some enthusiasts argue that virtual communities have enormous potentials for extending human experience.[44] When should a person focus on real communities and when should they turn to virtual communities? Does the appropriate balance differ from person to person? What are the consequences? Spatial intelligence is but one of seven basic intelligences identified by Sternberg. Should individuals with spatial intelligence focus specifically on this mode of cognition, or should it rather be the case that precisely those with other kinds of intelligence are encouraged to use spatial approaches.

Landscapes as Metaphors

Early notions of conceptual navigation simply translated the experience of physical walkthroughs into metaphorical walks through a virtual environment. For instance, a video by Northern Telecom on a virtual mall for a shopping network showed a person going down an aisle with various consumer goods, coffee, cereals etc., being reminded of what they had chosen last time with an option to see alternative brands, before ordering electronically what they wanted. Variants of this were developed in Time-Warner's Orlando Trial and in IBM's latest versions of the virtual mall. This same idea is being applied to the idea of navigating through information[45]

Companies such as Silicon Graphics are exploring other potentials of using landscapes metaphorically as in their 3-D Fusion Information Landscape Prototype. Essentially this transforms a multiplicity of two-dimensional windows to objects in a three-dimensional landscape. The effect is impressive but does not solve the basic problem. A multiplicity of windows overloads the mind with an abundance of choices. Moving from two to three dimensions increases rather than decreases the problem of visual overload. Purely technological solutions do not solve more basic needs of human communication. In most cases we need interfaces which only present us with the information we need at a given moment. Hence the assumption that everything should be translated into virtual landscapes is almost certainly misleading.

10. From Packaged Software to On-Line Applications

In the early days of computers there was a mainframe to which a series of dumb terminals were linked. The advent of the personal computer brought with it the rhetoric that each man's computer is an island unto itself and some companies prospered by selling a separate copy of their software for each machine, or at least aimed to do so.

In the past few years the largest computer firms have returned to, or one could argue, have extended the earlier model which they never really abandoned. This uses the mainframe model, with its distributed terminals, now on a global scale. This has two fundamental consequences. First, in terms of hardware it means that the client machine can be considerably simpler than if it were trying to be an island unto itself. Whence the recent talk of a new wave of $500 computers. Second, in terms of software, it means that there is essentially no longer a need to produce shrink-wrapped products. A new

application can simply be made available on-line. While this might still seem futuristic to some, it is sobering to realize that the 12,000 employees of Silicon Graphics Inc. receive all their software in this manner. A majority of IBM's world wide operations use the same method. The Ford Corporation, which has 50,000 networked computers is adopting this process. While some companies are assuming that the future lies in selling individual software, a number of major players assure us that we shall soon be able to download everything as and when it is required.

In terms of regular consumers this revolution has already begun. Internet software such as Netscape, VRML, Java and other applications can be downloaded free of charge when used for educational purposes. Transferring individual applications or applets is no problem. There looms a larger problem of offering integrated solutions. As noted earlier, in industry there are now so-called office packages which combine word processing, spreadsheets, fax, e-mail capacities and revision control. Scholarly and everyday equivalents of such tools are still lacking. Needed are integrating solutions with coherent interfaces (see 14 below).

11. From Quantity to Quality

Early discussions about computers often resembled locker room discussions where size seemed to be all. How big is your hard drive? How many megabytes do you have? And so on. These discussions were very legitimate given the enormous discrepancies between the multimedia aims of users and the limited capacities of products offered by vendors. Most machines had hard disks of a few hundred megabytes or a gigabyte, whereas many applications require terabytes. Most machines have 8-64 megabytes of RAM (Random Access Memory), while powerful applications such as the *Virtual Human* or Infobyte's reconstruction of Raphael's *Stanze* require a gigabyte of RAM.[46] Machines with several gigabytes of RAM exist. There are now storage devices with 50 gigabyte cartridges combined in a juke box with 1000 cartridges to produce a 50 terabyte container. The technology is beginning to exist: it is not yet readily available at reasonable costs.

A glimpse at some of the leading projects today gives some hint of the magnitude of the challenges involved. As mentioned above, the VASARI scanner presently being used at the Uffizi Gallery (Florence) is scanning paintings at a rate of 1.4 gigabytes per square meter. There are only some 1300 paintings in the Uffizi. Even if they were only one square meter on average that would mean 1820 gigabytes or 1.8 terabytes. Major photographic collections such as the Marburg Archive have 1.5 million images. To digitize all of these paintings and objects with the VASARI scanner would entail 2,100,000 gigabytes or 2,100 terabytes. IBM's Vatican Library Project entails scanning manuscripts at an average of 20 megabytes per page. An average manuscript might contain 100 pages. There are 150,000 manuscripts which will mean some 300,000,000 gigabytes or 300,000 terabytes. The Vatican is one major library. There are 75,000 "major" libraries in Europe alone.

Polygons provide a further sense of discrepancies between what is needed and readily available. Every visible object requires polygons which at the simplest level are defined

by the number of sides of an object. Hence, a cube has six sides or polygons, an icosahedron has twenty polygons etc. Complex objects such as hills and mountains are made up of thousands and thousands of these polygons which are used to approximate the complexities of their true contours. In 1995 the most advanced machine of Silicon Graphics Inc. (*Reality Engine 2*) dealt with 2 million polygons. The latest machine (the *Infinity Engine*) introduced in February 1996 deals with 10 million polygons. Human vision entails an estimated 80 million polygons. Engineers at SGI believe that they can reach this capacity within the next three to five years.

The same holds for bandwidth problems. At present most private homes are limited to 28,800 modems. The Canadian ATM network has been working at 35 Megabits/sec and will move up to about 622 Megabits (OC12) in the next few years. Laboratory demonstrations of OC-192 have already been demonstrated. Gigabit and terabit transmissions are technically possible. At present the bottleneck is in the switches rather than the lines.

The point here is to note that the quantitative hurdles are quite rapidly being overcome. Only a decade ago most of today's achievements were completely impossible and pioneers in the field were still skeptical whether it would ever be possible to achieve these technological challenges.

The real challenges are not quantity but quality. The need for computer equivalents to captions and footnotes has already been mentioned. When a person is being hired, the employer typically requires letters of reference. When a hotel or a restaurant is being considered, the would be client checks the number of stars they have. This is not to say that materials on the Internet should be dominated by rating systems and reduced to a popularity contest, but rather that we need methods for judging the reliability of what is made available on-line. Does this represent merely a personal view? Is it a position shared by a local club, a professional organization, and then is it locally, nationally or internationally? Is the position accepted or rejected by the experts in the field?

History has taught us that all such indicators are limited at best. When Copernicus published his theories in 1543 a majority of experts rejected his position and yet he was right. This was also the case with Leonardo, Harvey, Leibnitz, Einstein and others. There is no easy solution to these difficulties of discerning which claims are worthwhile and which are not. We need to look both at the product and the author. We need methods to trace the intellectual lineage of the individuals involved. Authors such as Copernicus, Leonardo and the others mentioned above were painstaking in studying great minds even if they reached very different conclusions than their contemporaries. Hence, having conquered the challenges of RAM, disk size, and numbers of polygons, the next generation will need to focus on re-contextualizing the parameters of quality.

12. Universal "Libraries"

The rise of networks has introduced new possibilities of sharing knowledge particularly in practical realms. Teams are working on a product family based framework for

Computer Aided Manufacturing (CIM).[47] Leading institutes such as the Centre for Landscape Research (Toronto), the ETH (Zurich) and the Graduate School of Design (Harvard) are beginning to share symbol libraries.

The rapid development of object-oriented programming has meant that various elements of an object can be integrated in new ways. In the past three years there has been a movement, initiated by AutoDesk, in conjunction with other industry leaders, to develop object or industry foundation classes. Here the quest is to go far beyond a simple inventory of building parts: doors, windows etc., to include the characteristics of a door or a window in all situations. Hence, if an architect is planning a fifty storey office building, the knowledge repository will "know" that a building of that height will require doors and windows which have certain characteristics in terms of thickness, usual size, strength etc. If, by contrast, an architect were building a simple one storey cottage, the system would again know the parameters of a door or window in such a case. If this concept is extended to include cultural and historical dimensions then a "door object" will eventually integrate all our past and present knowledge of doors when planning for future applications. An emerging Global Engineering Network (GEN) sponsored by the European Community is aiming at a similar approach to all the principles of engineering.[48]

The concept of object-oriented programming can be extended to the whole of knowledge. At the outset databases served mainly as lists of names or objects. The introduction of multiple fields made it possible to include an increasing number of attributes concerning objects. An object-oriented approach suggests that databases concerning any object will eventually contain all the parameters of that object: i.e. in the case of the term tree, a future database would know that there are conifers and deciduous trees, that they range in size from *a* to *b*, that their average age extends from *x* years to *y* years, that a particular species is found only in Africa, that the leaves of a certain tree have the following medical properties etc., that a given species is known to have first appeared several million years ago and since became extinct at a given period.

In simple terms, databases will no longer just be about lists of persons (who) or things (what), or places (where), which the *Taligent* initiative sought to address, but rather any list of persons (who) will have associated with it all the persons they knew (family, teachers, friends, colleagues, i.e. related who), all the objects with which that person is associated (what), all the places they visited or with which they were in contact (where), the time they lived and all chronological details concerning that person (birth, school, marriage, major events, i.e. when); all the techniques associated with that person (their inventions, their methods of teaching, their approaches, i.e. how) and all the motivations known for what they did (money, fame, honour, i.e. why).

While this goal is theoretically so sensible as to seem inevitable, in practice it is fraught with manifold difficulties. To begin with there are serious problems of making data in various locations compatible: creating authority lists to include translations from multiple languages, and variants of names, objects and places. Then there is the more difficult challenge of reflecting different claims about what ought to be facts. For

instance, the painter Titian produced a number of documented paintings so he must have a date of birth and death. Scholars have several claims about these dates. So nebulous facts will have to have their own sub-objects that provide the parameters of dates within which an event was possible (*ante quem* and *post quem* in technical terms).

Interested parties will not infrequently find it to their advantage to pass off as incontrovertible that which is actually a matter of contention. So there will have to be policies to be attentive in this respect. There will also have to be a campaign to make available electronically all the conflicting points of view and to record duly the level of reliability of each claim. This is much more demanding than most persons suspect and will probably require a movement that provides a modern equivalent of the mediaeval monks to make it happen. It will demand a massive campaign of translation, reconstruction and interpretation.

13. Translations, Reconstructions and Interpretations as New Industries

Computers and electronic media are typically described in terms of their being time saving devices. We can edit faster, we can do charts more quickly, we can make indexes almost automatically etc. Some see this as a euphemistic way of saying that computers invariably eliminate jobs, which is not entirely true. To have computers requires personnel not just to operate them but also to service them, the network connecting them and the various databases on which they draw. Existing materials need to be digitized but also translated, reconstructed and interpreted. These are the new industries of the so-called knowledge economy.

Because they are linear in nature, books almost inevitably present a single story -line. A history text which set out to deal with each episode from all recorded viewpoints would be too long to be practical. So we have French histories which give one account of the Napoleonic wars, German histories which give another and English histories which have their own view of what happened at Waterloo. These histories are usually printed only their original language, so unless an individual takes the trouble to learn French, German and English; acquires the history books in question and studies them in detail, they have no way of discovering these differences.

Computers can present material in both linear and non-linear fashion. They are theoretically not restricted in terms of storage size. This gives them two fundamental advantages over books and makes them particularly suited for presenting multiple interpretations concerning the same person, object, text, place or period. However, this process is not automatic. It requires translation exercises of hitherto unparalleled proportions. For only then can all the facts and insights be correlated.

In terms of reconstructions, one of the paradoxes of the new technologies is that software initially designed to solve a given problem usually has so many "bells and whistles" in the form of special lighting effects and textures, that every solution is effectively a personal interpretation. Fifty students producing a CAD version of the Roman *Forum* or the *Parthenon* would produce fifty different versions. Paradoxically fifty experts

producing a CAD version of the same monuments would produce at least as many versions. The rhetoric of salesmen may well pretend that the revolution associated with computers and multimedia is merely about scanning in existing knowledge to gain content, as if a great digitizing process were all that is really involved. Yet this is but a small part of the actual revolution, which the paradox just mentioned brings into focus.

When Ivan Sutherland first wrote about virtual reality he envisaged it as a tool for visualizing processes otherwise invisible to the eye, models of the possible rather than snapshots of the ontologically established.[49] Virtual reality is only one aspect of multimedia but both are about new tools to visualize not just things as they exist, but also things as they are thought or believed to have been, as they might have been, as they could be or as they could possibly become.

To scan in a photograph of the Roman forum is easy. Scanning in all existing images of the Roman forum is still somewhat easy. The challenge lies in organizing images in terms of schools of interpretation. Italian archaeologists had one set of views concerning this site; French archaeologists had another; the Germans another as did the British, the Americans, the Swedes and so on. Recreating these different visualisations, tracing how they were modified in light of excavations of the actual site, herein lie future industries.

A preview of things to come is provided by Infobyte's reconstruction of the Roman *Colosseum* in virtual reality which allows persons to walk through all its passageways. Such reconstructions have obvious implications for tourism. A tour guide who is on-site can use it to draw various aspects of the construction to the visitors' attention. Persons in other countries could view such monuments in trying to decide whether they wish to travel to that spot. There are also obvious implications for entertainment. Films such as *Ben Hur* and *Spartacus* remind us that Holywood has a long tradition of interest in ancient themes. Steven Spielberg has already expressed an interest in Infobyte's *Colosseum* to create a theme park using Goto Optical's *Virtuarium*, not unlike Universal Studios' (Orlando), *Back to the Future*, but with a classical twist. A next step would be to create virtual Roman circuses. Presented in the context of planetariums and other specialized viewing spaces, these would be like the ultimate video game. These could in turn be extended to include a series of networked contestants as well as the regular spectators. If this sounds like science fiction, IMAX Corp. is already working with Playdium Entertainment Corp. to provide an IMAX Ridefilm attraction at the Sega City Playdium, an interactive entertainment centre in Mississauga. Forty such centres are planned.[50]

As blue rooms and virtual sets enable an ever greater integration of content from different sites the enormous cultural heritage of Europe could well serve as the background content for new films and other visual odysseys of the imagination. It could for instance see a reinstatement of a serious European role in the film industry. The panorama in the late eighteenth century and the movie house in the early twentieth century were two enormously popular and profitable industries. The new technologies could well result in unexpected combinations of these effects, with equally great economic advantages.

Perhaps the greatest potentials lie in the realm of education. Elementary and high school students could use such models in learning about the basics of history, geography and other subjects. University students and researchers could use such models of the *Colosseum* to examine various theories concerning its construction and re-construction. They could also compare these with other examples elsewhere as has already been done by a team at Bordeaux.[51] The reconstructions could also help everyone to recognize the cultural dimensions involved in all interpretations. A French model of Rome may be very different than a German one. A Jewish history of the Holy Land may be quite different than an Arabic history of the same territory. Russian maps of the Mongolian borders may differ considerably from Chinese maps of the same area.

As always there is a reverse side to this wonderful coin which offers new industries in translation and in visualizing reconstructions and interpretations: some countries and certain individuals will continue to see it in their interest to present their particular interpretation of the past and present as if it were the only one. They will seek to use these tools for censorship which closes rather than opens interpretation. Concrete evidence of these dangers is visible in China and Russia[52] today.

It is easy to attack such blatant forms of totalitarian censorship in far away countries and brand them as the enemy. The greater danger probably lurks in more subtle forms in our midst which are less easily recognized for what they are. Intimately connected with interpretation, the theme of this section, is the question of how images and words in electronic form on computers are judged. A simple example will suggest that the problem is more profound than it first appears. If Mr *x* is walking down the street and a total stranger shouts some obscenity at him or calls him a name, Mr. *x* will not be pleased but he will very likely just brush the matter off as something insignificant. If Mr. *x* receives a letter from a stranger calling him names it is again unlikely that he will jump to legal action. Even if these names are printed in a publication such as the *National Enquirer* he is unlikely to take action. The same words published in a major newspaper might prompt him to sue for libel. Yet the same words uttered via a computer screen are presently considered a crime, although this tendency is being challenged.[53] A case was reported where a woman, recognizing a name similar to her own in a fiction story about a murder written by someone who did not know her, accused and successfully prosecuted the author for threatening her life. Is there some curious way in which, even before the notion of avatars is fully evolved, the detachment of the Internet is leading to a heightening of the fixations on propriety associated with political correctness and is imposing a new censorship of silence or is this simply an isolated instance of the trend towards political correctness gone mad?[54]

Most of us would not assume that persons who read murder mystery books or go to a thriller film are necessarily murderers or even mysterious. So why should we assume this of someone who reads of murder on a monitor? In films there is a well established convention to have a trailer reminding us that any resemblance to actual persons and places is purely co-incidental. We clearly need an equivalent in the realm of computers. Indeed we need methods to help us identify the intent behind what is on the screen.

Video clips of different genres might, for example, be framed by different colours: a documentary in one colour; a satire in another, and a purely fictional movie in another. Such an approach might be extended to everything we see on the screen, including texts.

One of the reasons for these problems which we might all too easily be tempted to dismiss as silly and trivial is because the computer screen removes aspects of context which we take for granted in other media. Notwithstanding sayings about not being able to tell a book by its cover, the covers and jackets of books, their size, their typeface, all provide us with copious clues whether this is a scholarly tome, or a cheap novel for bedtime reading. These clues disappear on a typical computer screen. So we need to devise new tools for re-contextualization to distinguish the fictional and flippant from the scholarly. Until we do so we are in danger of judging Shakespeare's murders in the same court as the murder by the latest criminal and in so doing close the very doors of interpretation that computers promise to open to new degrees.

14. Interfaces and Conceptual Navigation

Interfaces are a key element in developing these tools for re-contextualization. Interfaces, according to some, are merely reflections of evolving technology. First, there were only character based commands (DOS), then there icons and images (Windows). Now primitive three-dimensional spaces are evolving (VRML, Active VRML, Moving Worlds, Java). When the technology catches up there will be fully immersive realistic environments (full virtual reality). The evidence suggests, however, that each new advance does not simply replace the earlier technologies.[55] Evolution is usually embracing not replacing, so the advent of two-dimensional images and three-dimensional virtual reality worlds will probably not replace the value of lists which have been useful for the past three thousand years. Perhaps the real challenge lies in (creating methods for) deciding when to use which display strategy. At present these decisions are governed largely by budgets since very few persons have access to million dollar machines required for high level virtual reality. But this will change.

A whole series of questions need attention. Some experts such as Shneiderman, in his *Starburst* method, prefer to give all the data in a given field before focussing in on single items.[56] Alternatively one could begin with classes giving general surveys before focussing on particular details. Ideally one could choose whether one wished to go from the universal to the particular, or from a universe of particulars to a single item. One significant example of a strategy is offered by the brain interface.[57]

Thus far most interfaces have been limited to visual commands in the forms of buttons and others signs. At the University of North Carolina at Chapel Hill, and at the ARTS-LAB of the Scuola Superiore Sant'Anna in Pisa, (the Esprit project SCATIS), there has been considerable work on the use of tactile stimuli in the form of force feedback as a cue to navigation. With respect to voice tracking as a navigational aid, Intel at CEBIT 1992 (Hanover) presented an extension of vrTrader produced by Avatar Partner. This showed financial data in a virtual reality environment through which one navigated using

voice commands and an electronic butler in the form of a stellated-dodecahedron. One of the visionaries in this field is Warren Robinett.[58]

The MIT (Boston) has been among the most articulate on questions of interface which it treats in terms of three categories: spatial data, symbolic data and typography. First, there is spatial data, which includes metaphors of the landscape and geography such as Silicon Graphic's 3-D Fusion Information Landscape Prototype and has already been dealt with earlier.

Second, there is symbolic data which transforms lists of terms into a variety of shapes. The Dutch MediaLab (Schellinkhout), notably Thijs Chanovski, has focussed on the role of visual symbols. For instance, he has been exploring how a cube viewed from different sides can make users intuitively aware of different aspects of a problem. Related to this are the *n-views* and *n-Power* projects linked with the Rogers Communications Centre, which use different intersections of a cube to address different aspects of a problem. Also related to this approach are concepts (environment, culture, seeing, drawing, diagramming, imagining) found in a new product called *Vizability*, designed by Kristina Hooper Woolsey, based on Scott Kim's principles of visualization, which could be seen as points of departure for a method.

Meanwhile, Xerox PARC has developed both a perspective wall visualization and a cone tree visualization, the latter of which bears an uncanny resemblance to the cone tree (*Kegelbaum*) of *LyberWorld*[59] developed by the GMD which has also worked on a relevance circle (*Relevanzkugel*), Information Overviews Visualization (IOVIS) and other techniques for the presentation of learning materials.[60] Closer examination of these techniques will probably confirm that their usefulness varies with the level of knowledge to which they are applied. For instance, cone tree and perspective wall visualizations lend themselves to lists of individual terms as in classification systems, but have less value in the presentation of abstracts or full contents.

Third, there is, typography which can also be used as a tool, highlighting important texts in terms of different fonts and colours. The Visual Language Laboratory at MIT has been exploring a combination of these three approaches, namely spatial data, symbolic data and typography. They envisage perspectival grids of terms, distinguished in terms of different fonts and colours. While this produces dramatic and sometimes spectacular effects, there is again a danger that the bravura of the effects distracts the user form the actual purpose of the exercise, namely to find new materials systematically. Needed is an interface that maintains a coherent look and feel while adjusting constantly to different levels of expertise and many different applications. The System for Universal Media Searching (SUMS) offers a prototype in this direction.

15. Agents

In the United States, Brenda Laurel has emphasized the notion of agents or knowbots.[61] Nicholas Negroponte calls them electronic butlers: the idea being that these will replace the need for direct human searching; that a person can give simple instructions using a

voice activated computer which will then find everything. In this view agents are merely passive slaves to human commands. It is assumed that persons with very different levels of expertise will be able to pose questions using natural language query systems such as CHAT,[62] developed at the Centre for Information Technologies Innovation (CITI). In Europe a more active role for agents is foreseen by the research into tele-virtuality of the *Institut National pour l'Audiovisuel* (INA)[63]. Cameras linked to computers will produce electronic clones of individual users who will then go out to represent us and find what we need. While rhetorically fascinating to the extreme, there are reasons for being sceptical about this approach. Basic search engines such as Yahoo, Lycos, Altavista and Opentext are still painfully inadequate.

It is an old adage that those researchers who know what they will conclude at the outset are usually the least interesting. An essential dimension of research is about the materials one finds in the periphery of one's study, the book beside the one which one set out to find on the shelf, the tidbit which does not concern my main topic but which I file away and twenty years later produces a valuable insight. Hence if we can create agents that can find precisely what we think we want, then a next challenge will be to produce agents to search the peripheries of what we think we want. Learning is largely about discovering that the real questions and answers are often not the ones with which we began.

All too little work has been done in systematically organizing materials even in major fields. A refreshing exception is offered by the eleven G7 pilot projects, namely, global inventory, global interoperability, education, libraries, world cultural heritage, environment, global emergency, health, government, small and medium enterprises and maritime information systems. A common interface and more support are required for such initiatives.[64]

16. Transformations in Publishing, Entertainment and Knowledge

Many of the initial electronic solutions assumed that the computer revolution lay merely in translating earlier media into a digital form such that it could readily be reproduced on a computer screen. We have already shown that more is entailed, namely, linguistic translation, reconstruction and interpretation. In fact much more is entailed. Computers involve polymedial transformations: i.e. it is not just a question of translating various media into digital form but equally one of translating back from digital into other forms, such that an electronic version will in turn generate new versions of printed, voice, and other media. A digital version can be reprinted as a book or played back as if it were an audio tape. Moreover, digitization may entail much more than a simple translation: a) it invites retrospective image updating such that old articles which have poor photographs or rough drawings can also draw on proper colour photography, which could become a new service industry in itself; b) each article or book in the secondary literature can be seen as offering a series of horizontal links between ideas, objects or pictures and these connections can be linked retrospectively with the respective databases; c) electronic versions require much more uniform and detailed descriptions than was required in manuscript or book form, which may become one of the new duties of librarians, or could amount to a further service industry.

All this points to a transformation of publishing. Thus far electronic publishing has tended to mean that one sends in a diskette with a file along with one's typescript. But the end product has remained with the same limitations as before. A major lecture which may have 150 colour slides and five minutes of video is typically printed as a text with a half dozen black and white images. A completely new approach to texts is possible, whereby there is a distributed repository of all basic paintings, objects, places, etc. When an author writes a paper on the *Mona Lisa* or *Notre Dame,* hyperlinks are automatically made to all the source materials, drawings, photographs, video clips relating to that painting or church. In time, such materials can be organized in terms of levels of interest such that authors/readers can choose between a brief image which serves as an *aide-memoire* or a detailed survey of available materials. This process can be applied retrospectively to articles and books of the past such that one transforms the function of authors, the nature of new publications and the value of past publications.

This has fundamental implications for copyright. In the past an author or publisher producing books with many illustrations were burdened with writing separate letters to each individual museum. In the case of scholarly articles and books this usually resulted in a simple agreement to send the institution a copy of the publication. In other cases a small copyright fee was charged that was frequently less than the paperwork on all sides. If images and other multimedia features become a standardized feature of all publications, publishers might pay a set percentage of sales to partners with copyright. These percentages could be scaled: e.g. a set percentage for cases with still images only, another for cases with moving images and a third to include virtual reality links. This approach is fully complementary to the European Commission's recent extension of copyright to databases.[65] Given trends towards consortia as foreseen by the recent Memorandum of Understanding of the European Commission, such generic solutions will be more practical, and save all the paperwork of dealing with each appearance of every image individually.

Computers point to an analogous transformation in entertainment. Video on demand is only an initial step. Instead of paying Blockbuster Video or the local video store for rental of a physical tape, the user will be debited for having downloaded a digital version of the film. Once new technologies allow users to alter the sequences of films, there will a whole range of "new" content. Will these be exchanged freely in on-line amateur clubs, sold individually, or will a new kind of distributor make this their niche market? In the case of famous themes such as *Tarzan* we already have dozens of versions by major companies? Will the new technologies mean that there are thousands of versions of *Tarzan* and if so who will want to see them all? Will there be more home entertainment or will new combinations of movie theatre and theme park bring a revival of public media centres? What implications will all this have for our sense of community?

Ultimately computers are transforming knowledge itself by radically altering the tasks and goals of learning. In the thirteenth century, for instance, it took nearly 100 monks ten years to create an index of the writings of one great man, Saint Thomas Aquinas. Today that same task would take a major computer a few minutes. In the past the ultimate goal

of an individual scholar was to identify everything connected with the artist (*catalogue raisonnée)* or person they were studying. This often constituted a lifetime's work. Within the next generations such lists can also be reduced to a few minutes. So the kinds of questions which scholars have traditionally tackled will become obsolete, or rather they will become so easily solved that scholars can concentrate on other things.[66]

A whole range of new questions will pose themselves. In the past, a classicist often spent a lifetime reading through the major texts of classical literature in order to understand the evolution of concepts such as nature or love. Today, the entire corpus of Greek and Latin literature exists electronically. Initiatives such as the Perseus project[67] are making this available online. Tracing the etymology and all the uses of a word is matter of minutes even if the question of their interpretation still requires some time. A Shakespearean scholar, instead of simply studying a single text, may choose to study the history of different editions and translations, exploring how German treatments of *Hamlet* were very different from French and Danish treatments during the nineteenth century. Instead of looking only at a given concept, scholars may examine the impact of different mentalities to explore how this affected changing definitions, locally and historically.

In future there will be other kinds of questions for those who devote their lives to scholarship.[68] It used to be the case, for instance, that historians limited themselves to studying what the evidence showed happened, as it actually was (*wie es eigentlich geschehen* in Ranke's terms). The latest developments are prompting Italian archaeologists to consider using in virtual reality in order to create various scenarios and test hypotheses concerning urban organization, social structure, economic factors.[69] Visualizations are becoming so realistic that these tools can no longer be dismissed as idle conjectures. Which is not to say that everything that is convincing will necessarily be true. Here again we need new criteria for veracity.[70]

So often in the past a scholar spent a lifetime working on some difficult or obscure problem unaware that someone else was interested in the same thing. In future, those who by nature are loners will use the tools in seeing new patterns, trends, not just the facts but the contexts in which they arise and share the results on-line. Meanwhile, collaborative tools will allow persons inclined to co-operate to compare notes more regularly. Thus, the very tools which may seem to preclude the need for study for some, can provide incentives for a new revival of learning.

17. Conclusions.

Those introducing new technologies have frequently applied them to solve traditional or outdated methods of teaching and research. By way of introduction the pseudo-futuristic scenarios of *Disclosure* were cited. This led to a survey of major trends in computing. Some themes such as the military have not been examined.[71] We have focussed on computers as recording devices; how they are replacing traditional writing and drawing devices; bringing new liberties in editing; revision control; collaborative work and design; space and geography as integrating metaphors; a move from packaged software to on-line applications, from quantity to quality; towards universal libraries; translation,

reconstruction and interpretations as new industries; increasing emphasis on interfaces and conceptual navigation, attention to agents and how computers are transforming publishing, entertainment and knowledge itself.

In the past the great advances of learning came when persons took the trouble to translate the great achievements of others. Alexandria became great because they collected and translated the wisdom of the Egyptians, the Greeks and others. Arabic civilization became great when it took the trouble to translate the Greek and Roman classics. The Renaissance achieved its greatness by bringing this translation campaign to a higher plane through visionaries such as Erasmus who worked with Aldus Manutius to invent pocketbook versions of the classics. Hand in hand with translation has been the growth of methods of reconstruction and interpretation. Each of the historical milestones just mentioned, the Greeks, Arabic civilization and the Renaissance made serious contributions to these fields.

This essay has claimed that the computer revolution marks a new stage in this translation process, and at the same time has major implications for reconstruction and interpretation. Indeed, these contexts are probably where computers will have their most enduring impact: in helping reconstruct past achievements and possibilities from multiple cultural viewpoints, such that interpretation is seen not just in terms of cultural differences, but rather as a tool for cross-cultural tolerance and understanding, literally helping us to see different cultural views.

At the same time, reconstruction is not only a process for dealing with things past. In the case of existing objects, reconstructions create models and simulations of reality. In terms of future objects, this same process helps in designing new things, imagining that which could be. Thus while some continue to see computers mainly in terms of multimedia gadgets, computers are changing our approaches to the past, present and future. They are transforming what we know, how we know and the very nature of knowledge itself.

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CHAPTER 7

SEARCHING, TEACHING, REPAIRING, ADVERTISING AND SELLING

1. Introduction 2. Manual Criteria 3. Semi-Manual Searching 4. Semi-Automatic Searching 5. Agents 6. Teaching and Learning 7. Training, Repair and Re-Engineering 8. Advertising and Sales 9. Static Knowledge and Dynamic Information 10. A New Philosophy of Knowledge 11. Conclusions.

1. Introduction

Browsers have become one of the buzzwords of the Internet. The most elementary versions such as Mosaic and Netscape, required that one type in the precise address where one wished to go. A next stage entailed methods such as Yahoo or Lycos which arranged long lists on a given topic. Search engines such as Opentext effectively searched for all occurences of a term on-line. While this produced a great wealth of hits, it made no distinction between different contexts of a word, with the result that many or sometimes even the majority of the references proved to be of no serious interest. All of the above methods are philosophically equivalent because they assume that searching is merely a question of brawn rather than brain; that a better search engine is bigger, faster and gets more hits.

SUMS begins from a very different premise: quality is more important than quantity. Indeed if there is too much noise in the information one receives then quantity can obscure and even undermine quality. How can we find what we really want and not just that which has the same words as that which we want? This applies not only to the initial web surfing when we first find something, but also to how we organize things such that we can find them back more easily thereafter. Indeed the most basic version of SUMS focusses on organizing what we find.

2. Manual Criteria

The most basic version of SUMS is effectively a bucket for collecting information, but differs from simple databases insomuch as it provides a framework for organization in terms of types of access, levels of knowledge, kinds of media etc. The user gathers material manually and organizes the information in terms of six basic questions: who?, what?, where?, when?, how?, why? Correlations between questions are then established. For example, if the who refers to Leonardo da Vinci, links are made to lists of his art, books, buildings, instruments etc. While the initial input process is tedious, it results in many meaningful connections. Some of these connections are summarized in figure 1.

In the past one would have created a database and used this to correlate various facts concerning Leonardo. The present trends in object-oriented programming mean that these all these parameters can be integrated in a new way. The Leonardo "object" now becomes a series of parameters about the individual with references or pointers to where the

Universal (Person)		
Particular (Leonardo da Vinci):	1. Terms (Charts, lists)	Family tree, dates, classifications
	2. Definitions	Biographical Dictionaries
	3. Explanations	Encyclopaedia articles
	4. Titles	Art Books- Primary Secondary Instruments
	5. Partial Contents	Abstracts
	6. Full Contents.	

Figure 1. A summary of some of the concepts associated with the name of Leonardo da Vinci arranged in terms of levels of knowledge.

materials are kept. Hence, while the complete works of Leonardo may occupy a considerable amount of space even digitally, the Leonardo "object" need only occupy only a tiny fraction of that space. This economy is precisely why it is possible to have a centralized reference base for all persons, objects, places, etc.

Levels of knowledge is but one of ten basic organizing parameters. The others are (kinds of) access, (types of) learning, media, quality, quantity, questions, time, space and tools. Each of these can be used to provide finer granularity in terms of organizing and subsequently searching for materials.

3. Semi-Manual Searching

A next level of complexity uses a search engine such as Opentext to find materials, but rather than initially searching across the entire web for everything possible, it begins by going to a major classification system such as Library of Congress and searching for the term therein. This results in a small number of choices. The person decides which sense of the term is most relevant to their needs and then downloads the materials associated with this term. This provides the user with authors, titles etc. relevant to the term in question, some of which will prove relevant in expanding the search. A further stage would successfully download this material automatically into databases under who?, what?, where?, etc.

4. Semi-Automatic Searching

In the above examples the materials collected relate strictly to the horizons of experience of an individual user. A next stage is to make the process a collaborative one whereby two or more experts can combine efforts in developing a resource. In a further stage this process is generalized. There is now a centralized server on which there exists a standard list of who?, what?, where?, when?, how?, why?. Every time a user finds a term, be it a

person, thing, place, time, instruction or cause, it is checked against the master list. If it is new it is automatically added. Every time new parameters of a term are found this is added to the master list and the information itself is downloaded to the user.

The centralized servers are not concerned with becoming repositories of all the existing content but serve rather, as repositories of references, pointers to and indicators of content. This may include simple thumb-nail images of objects. The full versions of images will remain in their home galleries, museums and libraries. In contrast to present day search engines which focus on finding a given term, this repository would contain the clusters of persons, objects, places, times, instructions and causes associated with any given term. All of these would be associated with a term in the way foreseen by object-oriented programming. However, instead of methods such as Taligent, which focussed only on persons (who?), objects (what?) and places (where?), the SUMS approach extends to three further questions: times (when?), which permits an historical dimension, instructions (how?), which extends to the realms of training and repair (see below section six), and causes (why?), which addresses the reasons underlying events.

This leads to a very different paradigm for searching. The user as a client does not choose a term and then attempt, merely by the use of brute force, to arrive at material directly. Rather the client first goes to a centralized server to learn about the parameters associated with the term in question, employs this knowledge to refine further the parameters of their search and then goes out to search for materials on the Internet.

5. Agents

A fully automated method would entail agents. We foresee agents having different roles than those portrayed in the standard approaches today.[72] Agents require a profile of the user as well as access to centralized databanks of the kind described above. This poses important problems of privacy. If all our preferences and searches are known, our weaknesses and strengths could be exploited. One solution would be to make the general statistics available publicly, and keep the particular links to individuals strictly private in ways analogous to banking procedures today. The banks in general know how much money went out and in of a given banking machine, bank, or city, but do not make public who put in what.

The profile would begin with age, level of education and would also identify details of one's profession. The agent would take this profile and go to a centralized databank containing not the contents but simply the references to basic literature and journals as defined by the standard bodies, associations, societies and committees pertaining to each level of education and each profession. Each corpus of literature thus defined would be culled in turn for standard bibliographies and the corresponding names (who?), subjects (what?), places (where?) etc. Any question posed by a user would therefore go through the filter of these different reference sources.

The cumulative experience of libraries and museums will prove essential for the full development of any systematic approach to agents for four reasons. First, classification systems put isolated terms into context. Hence a user searching for a given term, will receive a vocabulary for other possible terms. Second, systems such as Universal Decimal Classification (UDC) have built into them references to broader and narrower terms, and various kinds of relations such as subsumptive, determinative and ordinal. This means that having searched for a term such as chair, the agent can then be prompted to search for narrower terms, such as lounge chair, or broader terms such as furniture without great effort. The potentials for these modalities have already been built into the SUMS system.

The third reason is more complex. Each classification system is actually a subtle reflection of the culture that it classes. Multiple classifications are therefore needed for international searches because that which a user of the Dewey system calls "sociology" might well come under "culture" or some different heading in other systems. A centralized reference base would therefore have a collection of all the major classification systems of the world. Using combinations of search engines and natural language methods a systematic correlation would be made among the equivalent or most closely related terms across all these methods.

A fourth reason extends this principle into the historical dimension where the problem becomes considerably more complex mainly because the meanings of even the most fundamental categories shift enormously. To take an elementary example: a person who searches for "science" today will find titles on physics, chemistry etc. A person searching under the same word (*scientia* in Latin) in a mediaeval catalogue will find titles relating to "knowledge". To find what we now call science prior to the nineteenth century would require looking under very different terms such as "natural philosophy" (*philosophia naturalis*), "mathematics", "astronomy" or even "geometry".

So a centralized reference base will entail a new kind of etymological dictionary that traces shifts in the parameters of terms. This will require much more than simple study of changing dictionary definitions. A first step will require collating the changing "see also" references over the centuries. A next step requires systematic study of bibliographies and book catalogues. The latest bibliography gives a standard list of names and titles. One then searches through earlier bibliographies and searches for the headings under which these names and titles occur. These findings are arranged chronologically such that one can see how titles which begin in traditional subjects slowly migrate to new subject categories as new fields emerge. Perspective is an interesting example. The earliest bibliographies list perspective treatises under architecture, geometry, surveying, sculpture or even writing. Only gradually does a category of perspective emerge. In addition to bibliographies one needs to extend this same approach to library catalogues and national book catalogues. All of this may sound uncomfortably complex but it needs to be tackled if agents are truly to find serious amounts of information and not just the obvious.

Thus far most work on agents has been done by computer programmers, those trained in artificial intelligence and in knowledge representation. To achieve these goals requires a new kind of centre led by an individual deeply immersed in historical and cultural problems of knowledge, who will work closely with experts in computers, (expert) systems research and knowledge representation. Such a centre should have close connections with a Faculty of Information Science in order to benefit from cumulative experience on classification systems and related themes. The purpose of the centre would not be content but rather to create links for the references of a centralized database which will prove essential for future agents and indeed any serious middleware mediating between the user and sources of content: the great libraries, galleries and museums. In a sense the purpose of the centre will be to extend the approach of industry foundation classes into historical and cultural dimensions.

As the project develops this new approach to objects and foundation classes will be extended to include other seemingly disparate domains, namely, teaching and training; repair and re-engineering and advertising and sales and even philosophy of knowledge.

6. Teaching and Learning

An object-oriented approach to knowledge may start with obvious references to how something is classed, defined, explained, titles to its primary and secondary literature, partial contents in the form of abstracts and even references for the full texts. It will then require systematic references to teaching and training.

Any subject has associated with it a corpus of knowledge. This is typically reflected in standard bibliographies. A single course hardly ever pretends to cover the entire corpus in that field, even though an undergraduate survey course frequently tries to refer to all the major problems in a field, be it psychology, calculus or even western civilization. Note that we are back to the problem of references which is the theme of the centralized reference base. In this case there are references between the corpus, and its subsets in the form of a course, a textbook, and an exam respectively. Some part of the corpus is in a course; some part of a course is in a textbook; some part of a textbook is in or, as they say, on an exam. The problem with traditional versions of courses, textbooks and exams was that the flow of knowledge went one way and there was no possibility of re-contextualizing the subset. As a result while the expert preparing the course, textbook or exam usually had a good idea of how it related to the category above, the student reading a textbook had little way of knowing whether that course represented five, fifty or ninety five percent of the field that it described. Similarly the exam usually gave no internal evidence concerning the proportion of the textbook, course or field that it covered.

Given the new approach of SUMS these relationships become reciprocal, which means that any bit of knowledge in the spectrum of corpus, course, textbook, exam can be recontextualized. How this would actually be done, will depend on whether the approach is manual or automatic. In the most elementary case the approach is manual. The teacher begins by choosing a subject, say, geometry at the grade twelve level. In this case the corpus might well be defined by the curriculum guidelines and half a dozen standard

textbooks. The teacher begins by taking the material in the corpus of curriculum guidelines, practical translations thereof (e.g. the MSSB's guide by Dr. McCudden) and the six standard textbooks, marking these in terms of who?, what?, where?, when?, how? and why?. They then prepare a course with lessons which are a subset thereof. The course and lessons thus have each of their names and terms linked with the basic names (who?), subjects (what?), places (where?), times (when?), instructions (how?) and reasons (why?) in the corpus. The same procedure applies to the test materials. As a result, an individual finding a given name or term in a lesson can find the context of that name or term, using the levels of knowledge to determine the degree of detail into which they wish to enter. Semi-manual, semi-automatic and perhaps even automatic versions of this procedure are possible along the lines outlined above.

This seemingly simple set of connections opens up a whole new range of possibilities in teaching, learning and education generally. It allows a student and/or a teacher to return to the original context of detailed fact somewhere in a course, a lesson, or even in a test (usually after it has been marked). It also allows the user to get some quantitative sense of that context. If a test or exam deals with five problems in calculus, what percentage is that of the problems in calculus in the textbook, in the course and in the field as a whole? Students can therefore reach a more realistic estimate of how much in a given field they really know, which may be quite different from what percentage they obtained on an exam that dealt with a small subset of that field. This information is equally useful for teachers in higher level courses trying to gauge their background knowledge and subsequently to employers who are interested in what their employee can really do as opposed to what mark they received on some exam.

In the past the whole relation of corpus, course, lesson, and test in relation to the individual student was very heirarchical. The ministry of education, faculties and institutes of education, school boards and teachers in a school created a pedagogical great chain of being that somehow connected the universe of knowledge with the individual student. The heirarchy was largely necessary because the system destroyed the context of the knowledge it conveyed at each level. For instance, the teacher knew (or at least that was the assumption), how the course related to the larger corpus of knowledge on which it was based. The student did not. By contrast, the SUMS approach, precisely because it recontextualizes the individual items of knowledge permits a learning based, student- centred approach to knowledge. Ironically, this approach is so often discussed in the rhetoric of faculties of education whose structure prohibits that to which they say they aspire. Thus SUMS opens new possibilities for learning as well as teaching.

7. Training, Repair and Re-Engineering

In the realm of practice, teaching focusses on training, which is typically about instructions (how?, how to make? how to build?, how to do?). A subset of this corpus deals with a more limited question of how to repair or how to overhaul, now fashionably called re-engineering. Since this need to repair often occurs in unexpected contexts there is a trend to call this Just in Time On-line Learning (JITOL). It will be noted that these problems of training, repair and re-engineering are variants of the referencing problem.

Each object, particularly mechanical objects, in addition to their universal concept, need to be linked with their various instantiations in terms of kinds, brands, components, parts and individual examples. Once this becomes part of the reference knowledge concerning an object this is equally applicable for purposes of teaching, training, testing, repairing, and re-engineering.

8. Advertising and Sales

The same principles open new possibilities in advertising and selling products, which is all the more welcome because initial assumptions about the consequences of the Internet for new business have frequently been flawed.[73] Rather than trying to divert the user's attention with an advertisement on a home page while they are in the act of searching for something very different, it is preferable to relate advertising to context. So if a user is searching for campsites under the heading of tourism, then advertising might focus on camping equipment. Ideally information about products, their description, costs, performance ratings, compatibility standards, sales information, market trends of the company could all be available at any time.

At the moment, if I work at a computer all day, rather than hunting on the web to find something I may appreciate a chance to go out to a mall and be sociable. If the Internet option is to be more attractive, it must offer me something the mall alternative does not. If, for instance, there was a guide who helped me decide which products were best suited to my budget, my desires and my needs, this would be very attractive. There might of course be a kiosk version of this at the store in case I decide to go to the store anyway.

If all of these functionalities are combined within a single system, then my criteria for buying can be extended to checking if the product has good on-line instructions concerning use and repair. Hence, the same system that improves the searching potentials of my agent, transforms my approaches to how I learn, how I repair and how I buy.

9. Static Knowledge and Dynamic Information

Traditionally there was a distinction made between books that were enduring (classics) and literature that was only of interest for the moment (ephemera). In the twentieth century this shifted to a distinction between library books and news. In the past decades this has shifted again to a distinction between static knowledge, as found in libraries, and dynamic information, such as stock market news which changes by the minute. In the past these different types of information were treated differently and seen as being relevant to different audiences. Traditional knowledge was typically free, the latest information cost great amounts of money through subscriptions to on-line services.

The object-oriented approach to knowledge organization outlined above promises to create new links between these two information types, treating them as parts of a single spectrum of knowledge. The stimulus for this trend has come largely from the business environment of the office, where traditionally static records are being connected, through Object Linking and Embedding (OLE), with dynamically changing spreadsheets. In

future this principle can be extended to various databases which are changing regularly, such as catalogues of libraries and museums which continue to grow.

This combination of static knowledge with dynamic information will have substantive advantages. Too often those concerned with the latest news have little knowledge of the larger political, cultural and historical context; that the events in Bosnia, for example, relate to Balkan problems that go back for centuries. The combined reference base would allow one to understand these larger contexts. At the same time it would allow a historian to relate past issues to contemporary events and developments.

10. A New Philosophy of Knowledge

Marshall McLuhan once said that the medium was the message. He focussed his attentions on what he perceived to be a shift from print culture to electronic culture, which for him was primarily in terms of television. If we take electronic culture to mean the emerging network based computers which are loosely referred to as the Internet, then it can be argued that the implications of the new media go far deeper than even McLuhan suggested. Involved is a whole new philosophy of knowledge, or rather a transformation in the meanings of both philosophy and knowledge.

Ever since the so called dawn of Western philosophy with Plato and Aristotle, there has been an ongoing debate concerning the relation of universals to particulars. Plato emphasized abstract concepts. Aristotle focussed on concrete particulars. Almost everyone since has either developed these extremes or tried to find some way of moving seamlessly between abstract concepts and concrete particulars. The problem with the latter was largely quantitative. The concept of a chair was simple. A list of all chairs, keeping track of all chairs was impossible for a single person or so it seemed. Given the developments of AM/FM in the sense of Area Management and Facilities Management especially as it becomes integrated with developments in Geographical Information Systems (GIS) and Global Positioning Systems (GPS), the problem of listing all chairs is no longer an insuperable one. Nor is the idea of being able to track patterns in advertising of chairs, sales and repairs thereof. The case of chairs may seem of limited interest, exciting only to furniture sales personnel and accountants responsible for inventory of furniture.

Philosophically, however, even the seemingly dull topic of chairs is fascinating, because it transforms the universal-particular discussion. It is no co-incidence that the best minds in artificial intelligence and knowledge representation have been focussing increasing attention to this set of problems: sometimes in terms of concepts and individuals, which are variously termed instantiations, brands, kinds, components, parts and examples.

If all this is achieved through the centralized reference bases described above it will mean that we can ask whole new sets of questions: not just about where is there a copy of Dürer's book, but where are the known examples of the book, what is the history of their printing, their dissemination, evidence of their influence etc. The scope of things to be known will increase immeasurably. Much of the traditional grunt work of scholarship

will be passed to machines, while persons focus on reconstructing partial evidence, analysing trends in the information concerning particulars. Within the course of the next generations, machines will be able to deal with most problems concerning who?, what?, where?, when?, and even how?, such that persons can concentrate on the supremely human question of why?

11. Conclusions.

A central thrust of the new approach outlined in this paper is that a combination of pipeline and content may produce an information highway but cannot produce a knowledge highway with its interesting roads, streets and paths. And while the rhetoric may rightly be in the direction of distributed knowledge systems, a systematic approach to knowledge requires centralized reference bases to act as starting points for those searches through a distributed network of libraries. Otherwise a person with only 100 names in his personal database will have no way of accessing millions of other names systematically. For while they may be able to go to a major library to collect a thousand or even a million names, they will usually have no way of knowing how compatible the naming standards of that library are with those of another. Centralized reference bases will deal comprehensively with the problem of variant names, that a Leonardo da Vinci under Leonardo is the same as Vinci, Leonardo da or even Da Vinci, Leonardo in another catalogue.

Such a centralized reference base thus offers a pragmatic interim solution to the seemingly insuperable problem of standards. There was a time when computer specialists imagined that a day would come when every major collection used exactly the same database with the same headings and the same protocols. They have since learned that even if great institutions had no nationalistic tendencies, it would still be difficult if not impossible to re-write all the conventions in card catalogues of collections that are centuries old. A centralized reference base will solve this problem. It will also enable agents to become more than electronic caricatures of butlers, transforming them into something useful. Indeed it will make possible many of the high ideals mentioned by proponents of global networks and universal knowledge systems.

A new order is possible with respect to how we approach knowledge, how we access it, how we organize it, and how we analyse the insights that we gain from it. That is the good news. The bad news is that this is not nearly as simple as many have imagined. It is relatively simple to scan in every manuscript in the Vatican. Most persons forget however that these texts are mainly in Latin, with a number in Greek, Arabic, Hebrew, Chinese, and just about every other major language. Most of us do not know that many languages and even those who do would need extensive and intensive training in the reading of old scripts. So after the scanning there will a challenge of translation. Meanwhile we desperately need a centre for the creation of middleware, perhaps a new McLuhan Centre in Culture and Technology, which will prepare the way for making distributed content linked by pipelines sufficiently compatible that the whole will be much greater than the sum of the parts. That was Aristotle's phrase over two millenia

ago. If he were writing today he might speak of SUMS renewing this promise of things greater than the sums of their parts.

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CHAPTER 8

CONTENT ORDERING OR ORDERED CONTENT?
ACTIVE VERSUS PASSIVE KNOWLEDGE

1. Introduction

There are some curious parallels between our approaches to computers and approaches to teaching and learning. In the world of computers there are two contending paradigms for how they should be organized. A first approach, which derives from the original arrangement of a centralized mainframe connected with a series of dumb terminals, extends that idea on a global scale such that there are centralized servers from which individual clients gather the software and contents which they need. A second approach is decentralized, sees each machine as a "personal" computer, an island unto itself, with its own supposedly unique configuration of "standard" software which allows each individual to enter their own unique contents. Between these two extremes is a third model whereby a series of networked machines work together in a local area network, sharing resources for the common good of the group.

In teaching and learning there are also two contending views. One, centralized, assumes that the teacher and the textbook will impose order unto the mind of the individual student. According to this view, the teacher is the server, the student is the client. The teacher is the intelligent hub, the student is the dumb terminal. The teacher is the active master, the student is the passive slave. A second approach is decentralized. It assumes that each individual is a personal learner, the emphasis is on learning not teaching. The teacher is a facilitator. The intelligence is in the individual student and the central aim is in organizing, structuring, constructing one's personal world view which, the rhetoric goes, is more important than any external world view. Between these two extremes there is again a third model whereby it is assumed that the efforts of an individual are more relevant and useful if they are shared with others. In this model collaboration becomes a central concept and networking as a metaphor becomes a buzzword.

Mechanistic metaphors from the world of computing now pervade the worlds of teaching and learning. Teachers interface with students. Students process information. Teachers download ideas and students upload them. Computer experts accept all this as if it were completely natural. We need to remind ourselves, however, that computers were only introduced a century ago: teaching and learning have been around from the beginnings of time. It is important, therefore, to look more closely at the problems underlying these

three approaches and then explore how the latest technologies can help deal with these problems.

2 Outside, Systematic Order

Every society organizes and imposes order unto its collective knowledge. In so-called primitive societies this order was integrally linked with key members of the tribe: the chief, medicine man or shaman. Knowledge was power and also secretive. It was only passed on to chosen individuals designated to carry on the tradition. This model continued to inspire early civilizations. The teacher passed on a corpus of knowledge to chosen students.

The rise of the university with Abelard in the twelfth century promised to change this relationship. The roles of professor and student remained. But now it was the students who chose the professor with whom they wished to study. If a professor had nothing to say they would have no students and not be paid. This seeming remedy introduced its own problems because, as teachers know only too well, the world of learning cannot be reduced to a popularity contest. The most profound and valuable knowledge is not always the easiest. We may believe in giving everyone access to knowledge, but that does not mean that all will learn equally. Everyone may have a chance to learn English, French, German or some other language, but that does not mean that everyone will become a consummate master of those languages. Nor is it all a matter of personal choice or opinion. Student A may think that they speak an excellent French, but when they listen to a lecture at the Sorbonne there will be external criteria for determining how well they speak the language. It may be the fashion to debate which books to include or exclude from the standard corpus of literature but even here there are limits. The English student who insists on ignoring Chaucer, Shakespeare, Milton, Pope, Dickens and Austen, will have the same problems of credibility as a French student who believes they can ignore Rabelais, Montaigne, Corneille, Racine and Hugo. Hence the role of scholars lies in organizing the corpus of knowledge in a given field and giving clear rationales for the boundaries thereof.

In the case of the sciences this corpus or ordered part of knowledge plays an even more central role. The periodic table in chemistry is not just an arbitrary list: it is the basis of many chemical combinations that underly advances in medicine, science and industry. Similarly, library classification systems are vital if we are to have a systematic way of organizing collections of millions of books.

The past centuries have made us very much aware that the systems created even by the greatest experts are fallible and inevitably require some adjustment or even a complete revision. In retrospect, Ptolemy's astronomy needed to be replaced by that of Copernicus. The extraordinary efforts of a Linnaeus in organizing botany required many updates. So we need somehow to communicate the essential value of systematic ordering without trying to limit students to the precise contents of any given system. We need also to find methods of demonstrating the comparative merits and potentials of competing methods of ordering, and classing the world. We need eventually to show this in evolutionary

terms. To use an analogy from fishing, classification systems are the mental-map equivalents of nets. We need to show how changing methods historically have increased the size of the sample caught by a given net.

Hence the role of the teacher can no longer simply be one of passing on to the student a given, static method of classification. It may well be that the details of how a major field such as physics or medicine is organized and classed will change drastically within the next decades and thus a teacher needs to convey this subjunctive dimension to the student. This does not mean, however, that students can simply ignore the standard means of organizing knowledge in a given field. A student may feel that they are brilliant in the field of chemistry. But until they can arrive at an explanation that is more encompassing in its explicative powers than the periodic table, they will be advised to continue learning that method. To make a fundamentally new contribution one has to master the best existing classifications in a field, not only show their limitations but provide a more encompassing alternative.

For this reason the process of organizing a corpus of knowledge continues to apply for all disciplines. The systems may change and evolve but the need for systems remains. A combination of past and present experts serves to define the limits of a field, which are codified in standard bibliographies of a field. Curriculum committees attempt high level summaries of a field which are a subset thereof. Courses are subsets of a given curricular corpus. Textbooks are subsets of courses. Tests and exams are subsets of the texts. Evaluations and reviews are commentaries on how the results of a test relate to a course and text.(fig. 1).

a) Corpus of knowledge in a field, defined by experts past and present, which is codified in standard bibliographies.
b) Curricula (high level description of boundaries and therefore subsets of a)
c) Courses (subsets of b)
d) Textbooks (subsets of c)
e) Exams and tests (subsets of d)
f) Evaluations (commentaries on e with respect to c and d)
g) Reviews (commentaries on e and f with respect to c and d).

Fig. 1. Relation between a corpus of knowledge, curriculum, textbook, course, exam, evaluation and review.

3. Personal Ordering

It is the fashion among educators to insist that we have moved from teaching to learning, which they epitomize in phrases such as: "From the sage on the stage, to the guide on the side." Ironically, they typically do so while claiming centre-stage in lectures or at the microphone in public meetings. The more radical proponents of this approach would go further to insist that textbooks can also be dropped from the agenda, the assumption being that students are now so independent that such structured materials are not really

necessary. If they were in *Star Wars* their motto would be: "May the structure be with you".

At the same time the efforts concerning constructivist knowledge reflect important problems. For example, in botany very few persons will ever create a system as inclusive as a Linnaeus. Yet most of us do study some botany and make some attempts to organize plants. Every attempt at organization is a learning process. A child who tries to count how many kinds of plants are in their parents' garden is learning something. Indeed such efforts could prove to be vital training for future professional classing of plants in terms of genus, species, variants etc.

While all these exercises may be learning experiences, few learning experiences change the frontiers of learning. Almost invariably, a child's discovery of the differences between conifers and deciduous plants, however exciting to that child, entails a discovery that was made long ago by a pioneer in a field. The challenge for a teacher is to help the child make that re-discovery as if it were being made for the first time: to permit the child to have the full sense of wonder attending to that discovery and at the same time not leave them with a false sense that they are, by virtue of that one experience, now superior to the original discoverer. It is relatively easy to repeat one of Galileo's or Newton's experiments, but that does not mean that everyone who does so is instantly a Galileo or a Newton.

What is needed, therefore, is a context which encourages individual children and students to organize their findings and knowledge on a subject within a framework while at the same time making them aware of the fact that frameworks also have a history. For instance a child may be learning about colour. They create their own list of colours which is also a catalogue or classification system of colours. They may decide that there five, six or eight colours. They are then taught that others have had this idea that lists of five-eight colours have been made since Antiquity. More advanced children discover that their basic computer monitor has 256 colours while others will learn that there are potentially millions of colours. Only when they have confronted the problems of ordering the complexity of reality, will they be in a position to recognize the need for and value of existing attempts at ordered content.

4. Collaborative Efforts

One obvious way to help children and students see beyond the boundaries of their own experiences is to confront them with the ideas of other children and students. Child A may only see four colours, but that may be because they grew up in a dark place and never had a chance to see the variety of colours in the outside world: the glory of an alpine field of flowers all in vernal bloom. If such a child met Heidi, they would need to revise their list of colours and probably most of their other classification schemes as well.

This comparative dimension is one of the main arguments for having children attend school. At home we are all too easily convinced that we are the only ones in the world to

be in a given situation. When we go to school we are likely to discover that other individuals have experienced some of the things we thought or feared were unique to us. When we go to university this sample is increased and most persons, who were accustomed to feeling they were the most intelligent individual in their school, need to adjust their perceptions as they discover that they are surrounded by many other bright young persons.

The new networked environment of computers seems to undermine the need for contact in schools. Actually it cannot replace the reality of human contact. It does, however, broaden the number of persons with whom to draw comparisons: it increases the sample which we use to create our world view. This is especially true in the case of persons with more specialized interests. If I live in a small town I may not reasonably be able to find others with my interests in genetic algorithms, butterflies or the like. If I am connected through a network there will almost always be others with the same specialized interest. Thus collaborative workspaces increase the horizons of topics for which I am likely to find partners for discussion, sharing ideas, learning together. At the same time collaboration is complementary to the traditional corpus of knowledge: it embraces, not replaces other modes.

It is instructive to note the extent to which models from the world of industry and business are impinging on these new approaches to learning. Collaborative has become a new buzzword. So there is much discussion of collaborative work, collaborative design and collaborative learning. A number of academics have attempted to provide a philosophical foundation to this approach under the headings of constructionism (Papert) and constructivist knowledge (e.g. Jonassen, Ravitz). They cite the work of Jean Piaget as proof that individuals change their world view as they evolve from small children to adults. They frequently cite the work of Kuhn to argue that there are paradigm shifts in knowledge and claim that these paradigm shifts occur as a result of consensus building among the great scientists. That these great scientists are also struggling to discover truth is often downplayed. So too are the great differences between a) scientists who reach consensus using all the criteria, methods, and discipline of scientific experimentation and verification; b) office workers who reach consensus for pragmatic reasons and c) young students who may well reach consensus in terms of popularity and fashion rather than by the strictest rules of scientific rigour.

5. New Approaches to Teaching and Learning

From the above it becomes clear that the revolution introduced by networked computers should not be limited to any one of the three seemingly competing models, namely, systematizing external ordering; empowering personal ordering or in creating collaborative environments for ordering. The revolution lies, rather, in creating a framework where these three approaches are integrated.

One effective way of looking at these changes is in terms of the seven basic components outlined in figure one: a corpus of knowledge, curriculum, course, textbook, exam, evaluation and review. Traditionally these were hierarchically arranged such that persons

lower down the system were never able to see, let alone understand, how their subset fit into a bigger whole. Hence a teacher typically had a textbook but often had little idea of how it fit into a curriculum and almost no idea how this in turn fit into the corpus of knowledge in that field. Students were in an even more difficult position. Any penetrating question which touched upon the frontiers of that field would be dismissed on the grounds that it was not in the textbook. Why they were studying a given subject was seldom if ever explained. Nor was it ever easy to understand how the subsets of the whole called exams were determined. And while teachers made fun of students perennially asking: "Is it on the exam?", they usually overlooked the cause prompting such questions. Nor was there any systematic way for students to retrace their steps in terms of evaluation and review to see precisely where they went astray. The hierarchical organization of facts entailed a de-contextualization of knowledge.

The networked computer revolution offers a re-contextualization of these seven basic elements such that students and teachers alike can see how each subset fits into a larger whole. This does not mean that every student will automatically become a researcher at the frontiers of a field. It does mean, however, that any young person, or teacher for that matter, who think they know it all will have a tool for assessing realistically where their particular bit of knowledge fits into a larger picture.

Hence one can acknowledge trends towards collaborative learning, without abandoning the value of traditional knowledge. In practical terms collaborative work is about on-line comparing of notes (the Lotus product by that name is not accidental) concerning possible strategies. In the past this function was fulfilled by letters and telephones. Collaborative design is an on-line sharing of alternative design proposals.

Collaborative learning is an attempt to create courses dynamically on-line, rather than relying on any given static text. All these exercises can be useful and even valuable. It is important to recognize, however that many, possibly even most notes produced in collaborative work will probably retain some sociological interest but not make profound contributions to the collective sum of human knowledge. Similarly in the case of collaborative design. Many will prove to be rough drafts. If the person attains the level of a Leonardo da Vinci or Michelangelo then even rough drafts are of interest, but in most cases drafts are just that: stages in the development of something that is presentable and memorable. This is equally true in the case of collaborative learning. The process of comparing viewpoints can be extremely useful. But unless this occurs in the context of a higher standard each little group will be tempted to define the world in light of their own limitations and the resulting discussions will be correspondingly narrow in terms of their enduring value.

It is very instructive in this context to note the extent to which computer software and hardware have focussed on quantity rather than quality. There are all sorts of programs to measure things, to calculate, to produce spreadsheets of trends. There are very few programs or even buttons within programs that show us stars to indicate the quality of a work. There is a simple reason why this has been so. Computer hardware and software are designed by engineers who think in binary terms: it either works or it does not work;

it is either good or bad. Multiple viewpoints of the same materials have traditionally been omitted from the system. We need a system which allows for individual viewpoints on any topic and at the same time provides a context whereby those viewpoints can be weighed in terms of standard views and the criteria accompanying them. For instance, anyone can write something about Leonardo da Vinci. But if the person has never read the man's texts they are likely to be less serious than someone who has taken the trouble to spend two years doing so before daring to have an opinion about what Leonardo actually wrote or meant. So we need more than footnotes of sources. We need contextualizing functions for clues as to how serious is the author. Has the work been vetted by friends, professional colleagues, locally, internationally? Has it appeared privately, through an organization, through a major publisher? Were there reviews? Were these in standard journals or merely in local magazines and papers? Were there different editions? Were there translations into different languages? Quality must become as important a criterion as quantity.

6. Limitations

There is an important strand of modern educational theory that focusses on giving children confidence in their learning abilities. A danger in this approach lies in giving them false confidence that they know when they are still ignorant. The networked solution offers a solution to this problem. Any student can see where the test they are taking fits into a course, text, curriculum and a larger corpus of knowledge. Hence a particularly bright person who has mastered a given course will not have illusions of knowing it all, when they recognize precisely how that course fits into a larger framework.

The networked approach also means that the training part of learning can be codified and mechanized such that persons will, in future, be able to pursue a considerable amount, or perhaps even the whole of training as self-learning, without the need of instructors. Some will no doubt look at this for potential savings in terms of instructors. Here, two things need to be remembered. First, the process of encoding an oral and textbook teaching tradition into electronic form is not nearly as obvious as it may seem and will require if anything more instructors. The economically minded might therefore be tempted to delay the move to electronic versions on financial grounds. But they need to recognize that a shift to computers is a necessity rather than a luxury. In a world where many traditional techniques, crafts, jobs are being replaced by automation, unless the tasks are recorded, the skills therein will go lost. This applies especially in the case of high level tasks in the scientific professions such as engineering, architecture, surveying, and cartography, where new devices are replacing human skills. If we do not codify this knowledge before those who are retiring have died, the advent of electronic methods will have brought a great loss rather than an increase in knowledge.
A second point that needs to be remembered is that training is but a small fraction of learning. Learning is an attitude of constant curiosity, an ever continuing process of discovery. The role of a great teacher has never been to help with memorizing. Their role, rather, has always been one of quiet example, being supportive while forever reminding the student who thought they knew it all that there was more, sometimes

revealing a little more, at times confronting the student with the truth that there is a lot more. We can design machines that help pace students, but this human dimension of teaching cannot be mechanized. Taping the lectures of great scholars may show the results of their efforts but this cannot reveal their methods. Students need to see the personal methods of masters, their patient discipline, not just their moments of public show and glory.

Rhetoric may pretend that computers will destroy hierarchies, but this is not true. There will always be experts who know more than the uneducated. The expert and the uneducated person may be equal as human beings, equally worthy of respect for their innate human dignity. But they are not equal in terms of specific fields of knowledge. Faced with a decision at a nuclear power plant, it would be folly to say that a nuclear physicist and a person with no degrees were equally qualified. In such contexts the hierarchy of education will continue to prevail.

What computers can do, however, is to remove some of the negative aspects of hierarchies. In the past the process of moving down the ladder from expert, to curriculum, text, course and finally test was an opaque one insomuch as the person taking the course seldom knew what percentage of the field it actually covered. There was no way of knowing how representative was the test or even the text. The networked computer framework enables this process to become transparent. An enterprising student who has mastered textbook A, can widen their field to discover that there exists textbook B, C, D, E, and F. They can explore how all of these reflect portions of the curriculum and can verify precisely which parts of the curriculum. They can go further to see how the curriculum is itself an abstraction of a larger corpus defined by the field on which it is based. If they so wish they can even quantify this process. Hence a student who has achieved 100% on a given test may determine that the test represents 15% of the contents of the textbook, 8% of the course, 2% of the curriculum and perhaps .05 % of the entire field. This provides both a more realistic and a more sober view of what 100% on a given test might mean in the grander scheme of things. It also introduces a new framework for discussion of standards. For once the links between local schoolroom and the great seats of scholarship have been established clearly, those who lay claim to knowing more than they do can very effectively be brought back to earth. So computers will not replace hierarchy, but they will establish criteria for its legitimation and in the process create a new framework for establishing and maintaining standards.

7. Conclusions.

There are three current models for computers: 1) centralized servers feeding passive dumb terminals; 2) decentralized stand-alone personal computers active in their own right and 3) interactive networked computers in a collaborative environment. It was noted that there are three analogous models of teaching that go back many centuries. Hence, while it may be the fashion to describe learning in terms of computer jargon, the underlying approaches existed long before computers.

This begged the question how the advent of computers will affect these three competing views. Computers should not bring into focus any single side of this triad. Hence, we challenged claims that computers will produce electronic butlers which replace teachers; those who claim that knowledge will soon be a passive exercise. We suggested instead that computers offer a new synthesis of all three methods, whereby the roles of teachers as leaders, students as individuals and combinations thereof working collaboratively are confirmed.

In the past knowledge was organized hierarchically into at least seven levels where each lower level was a subset of the former: a corpus of knowledge, curriculum, course, textbook, exam, evaluation, and review (cf. fig. 1). By creating new sets of links among these seven levels, computers will transform this hierarchy, making it more transparent and creating a new framework for standards. The computer revolution is not about replacing teaching with learning. It gives us new approaches to both teaching and learning, whereby better teachers are greater learners. There must be ordered content if students are to do meaningful ordering of content. A central role of teachers lies in helping students understand the significance of their ordering in relation to the greater order that is the established corpus of knowledge. To achieve this, teachers will always need to remind students that learning is more than a passive exercise of absorbing facts. Learning must be active if learning is to remain a true activity.

27 February, 1996.

CHAPTER 9

IMAGES AND WORDS: FRACTALS AND FUZZY LOGIC

1. Introduction 2. Images and Fractals 3. Words and Fuzzy Logic 4. Adjustable Perspective and Image Classification 5. Grammar and Cultural Words 6. Universal Concepts and the Classification of Particular Words 7. Conclusions.

1. Introduction

Each of us has at some point been misunderstood. Three simple variables are involved: a) what we mean, b) the words we use for this and c) the objects, events or experiences in the physical or spiritual world to which they correspond (fig 1). In our minds there was a one-to-one correspondence between a, b and c. In the mind of the person who misunderstood us there was no such correspondence.

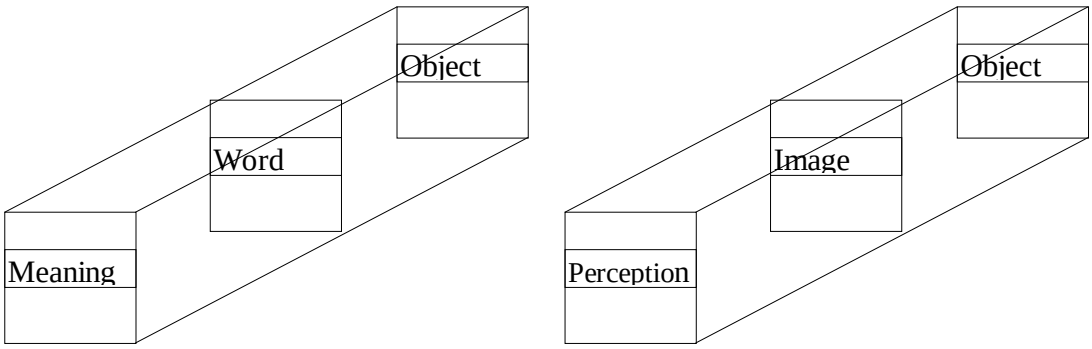


Fig. 1. Schema assuming a one-to-one relation between meaning, word and object or between perception, image and object.

The correspondence that we assumed should exist between our meaning, our words and our objects, was not unlike the correspondence that Renaissance artists and scientists assumed between our perception, our (visual) images and the objects they represent, and built on a much older tradition which compared painting and *poetry (ut pictura poesis*). What was there, what we drew and what we saw were assumed to correspond.

These approaches to both words and images[74] were both guided by an underlying faith that under we could make these equations and that we would normally be understood. The faith relied on basic tools to certify that the process was correct, namely, logic in the case of words, and perspective in the case of images. Or so it seemed. In the course of the twentieth century, most of the assumptions underlying this optimism have been called into doubt. The extreme consequence of this approach would make non-correspondence and misunderstanding almost a matter of course rather than an accidental case. This paper explores these developments, suggests that the interim solutions are unsatisfactory and proposes a fresh approach.

2. Images and Fractals

In the case of images, we have become conscious that there is more to perspective than the basic inverse size/distance law, which states that the distance affects only the size of objects, such that if we double the distance an object is half as small, if we treble the distance, an object is one third as small, and so on. If an object has irregular contours, as we change the distance or the scale of an object, not only its size but also its shape changes. Mandelbrot cited as an example the coast of England. A small image of England, say five centimeters (at a scale of 1,000,000: 1), will have relatively few indentations along its coast line. A fifty centimeter image would have more. A five meter image would have many more and so on. The closer we approach the scale of 1:1, the more indentations there will be on the coastline. Hence scale affects not only the size, but also the shape and thus the relative length of the coastline.

Mandelbrot's example brought into focus a problem of which we have implicitly been aware for several centuries ever since the invention of the telescope and microscope. The familiar shape of an object in one scale becomes transformed as we move to a radically different scale. The surface of a table which appears completely flat and smooth to the naked eye, reveals itself as rolling plateaus at another scale and veritably mountainous at another scale.

Such examples led Mandelbrot to identify a larger problem. Organic forms in nature are predominantly irregular in shape. Our chief tool for dealing with nature is Euclidean geometry, which is regular in shape. The challenge, he argued, was to find a new geometry which could deal properly with nature's irregular forms. His proposed answer lay in fractals, which led him to entitle his book *The Fractal Geometry of Nature*.

Unfortunately, Mandelbrot's answer did not solve the problem to which he had drawn attention. Fractals may have wonderful aesthetic aspects, but this fascination is intimately connected with their iterative nature whereby a pattern or image at a given scale recurs when one focusses into another scale. This is not what happens in nature. A surface which seems flat to the naked eye, under a microscope becomes hilly, then mountainous before dissolving into a series of forms and eventually into molecules and atoms. The simple iteration of fractal patterns does not capture the transformations of shape as we go through the different scales of nature. In short, if there is a non-correspondence between object, image, and concept, fractals cannot resolve the problem.

3. Words and Fuzzy Logic

There are unexpected parallels in terms of words and fuzzy logic. Until the twentieth century it was largely assumed that, like the connections between images, objects and percepts, there could be easy equations between objects words and meanings, the assumption being that logic provided the key to such links. However, philosophers from the time of Peirce onwards have been increasingly insistent that these links are by no means as obvious as we thought. The phrase "tall man" may seem obvious, but it will mean something very different to a pigmy and a Patagonian, let alone a child and an adult.

Just as fractals were intended to solve problems of correspondence in the case of images, fuzzy logic was introduced to solve problems of correspondence with words. This proposed solution has drawn great criticism from the champions of traditional logic on the grounds that one cannot reduce a fact to percentages. It makes no sense, they claim, to refer to a man as being 80% a man. One either is or one is not, they claim, and base their arguments on the law of non-contradiction. Hence the twentieth century has rightly drawn attention to major problems of mis-understanding in the realms of images and words, but the proposed solutions to these problems in terms of fractals and fuzzy logic do not resolve the issue.

4. Adjustable Perspective and Image Classification

In the case of visual images the principles of perspective work perfectly well as long as we do not radically change the scale. Images traced with ordinary sight are valid. Images traced with the use of an intervening microscope are equally valid. So what is needed is an adjusting perspective that takes into account different scales. Within each range of scales there will be no significant change in shape, the traditional inverse size distance laws will hold, and there will be a genuine correspondence between object, image and percept.

We need, of course, to be aware that there is no necessary one-to-one correspondence between an image and object. Some images are symbolic; some strive to express universal concepts and thus cannot reflect all the distinguishing characteristics of a particular object. So we need a classification of images into those intended to represent objects and methods of recording a digital equivalent of watermarks in order to assure that an image has not been adjusted or transformed.

5. Grammar and Cultural Words

A number of the debates between the champions of traditional logic and the exponents of fuzzy logic are resolved if we simply use grammar to make some basic distinctions. Supporters of traditional logic assume that one is discussing nouns. They are right to insist that a noun, once defined, either is or is not something. A man cannot be 72% or 83% a man, except loosely speaking. By contrast, proponents of fuzzy logic, typically refer to nouns with adjectives and/or adverbs, and they apply their fuzziness to the adjectival and adverbial part of their claim. They are not speaking about a person being 73% a man, but rather about his being 73% a "tall" man or 73% a "very tall" man. So the distinctions made between crisp and fuzzy terms lend themselves naturally to different grammatical functions. Nouns are crisp: adjectives, adverbs and indefinite pronouns are fuzzy.

Crisp	Fuzzy
noun (man)	adjective (tall)
	adverb (very)

pronoun (a, an)

Fig. 2. Crisp and fuzzy as a function of grammatical functions.

It is instructive to note that those grammatical functions which are fuzzy are also much more subject to cultural differences than are those associated with crisp ones. For example, the basic characteristics of the noun "man" are fairly constant around the world even though the term may vary somewhat from culture to culture in terms of the degree to which it evokes macho characteristics. By contrast, adjectives and adverbs vary enormously from culture to culture. In Nordic countries (such as Denmark, Frisia and Scotland) "not bad" is often a great complement and is effectively the equivalent of "excellent". Qualitative quantifiers such as "some", "quite a few", "a fair number", "many", "a lot" all depend on the speaker. Thanks in Scotland and a thousand thanks in Italy may mean the same thing.

What is required, therefore, is a basic vocabulary of elementary adjectives and adjectives, partly in combination with key nouns, for which individual users can adjust the parameters of personal meaning. The term "tall man" may be in the range of 6'- 7' 8" for a Texan and in the range of 4'5"-5' for a pigmy.

6. Universal Concepts and the Classification of Individual Words

A second domain broached by the exponents of fuzzy logic entails classification in terms of relations between terms. A generic term such as bird is chosen and the question is asked to what extent examples such as sparrow, eagle, chicken, turkey or dodo are considered typical (or prototypes to use the jargon of fuzzy language). From a subjective standpoint this may be both challenging and interesting. From a practical viewpoint, however, this is an example of trying to re-invent the wheel since librarians and scholars have already spent millions of hours creating classification systems and taxonomies of knowledge which organize knowledge in terms of genus and species.

Closely related are the efforts made by proponents of fuzzy logic to determine whether a term is basic (e.g. chair), whether it has superordinate or broader terms (e.g. furniture) and subordinate or narrower terms (e.g. lounge chair). This again is something that librarians have tackled. What is needed, therefore, is a cross-referencing between classes, definitions, explanations, titles, abstracts and contents as in the SUMS approach. Hence whenever one links an object with a word one can choose to go to a broader concept as a means of contextualizing the term and discovering related vocabulary (cf. fig. 3).

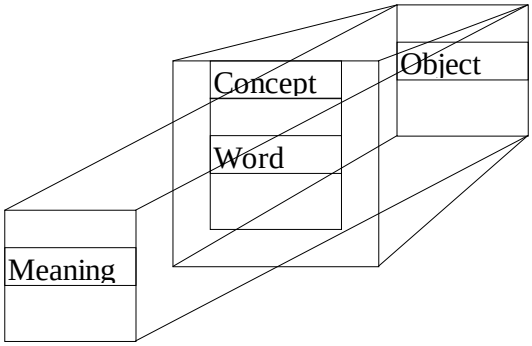


Fig. 3. Visual schema of how a correspondence between object, word and meaning can lead to broader concept. This in turn can generate related vocabulary.

To take a simple example, let us say that the initial word is hawk. If the user asks for narrower terms they are given examples such as chicken hawk and sparrow hawk. If they ask for broader terms they are taken into birds of prey and find eagles, buzzards etc. In principle this is the kind of activity that is usually associated with expert systems. What is different in this case is that the results are not generated by complex examples of artificial intelligence or neural networks but rather on the basis of existing classification systems.

As a next step one would wish to add a temporal dimension to these classifications. We know that the major classification systems be they of libraries (Congress, Dewey etc.) or specialized topics (botany, periodic table in chemistry, etc.) have their own histories. Plants as organized by Aristotle were very differently arranged than by Linnaeus or by botanists today. The terms linked with the word "flower" have expanded enormously over the centuries.

Given developments in object-oriented programming one would wish to develop objects with these characteristics which change over time and in different cultures. Hence the term "flower" would have characteristics which adapted automatically depending on the time and place. The largest and smallest examples of an object would automatically be included to define the parameters thereof. Hence if we chose pumpkin we would be given not only the size of a typical pumpkin (e.g. 8 inches in diameter weighing five pounds) but also the smallest and largest known pumpkins.

7. Conclusions

Clear communication requires correspondence. In the case of images this entails correspondence between object, representation and percept. In the case of words this entails correspondence between object, word and meaning. The proponents of fractals and fuzzy logic have made us aware of conditions under which this correspondence does not obtain. However, as we have shown, their solutions are not satisfactory. Instead we need adjustable perspective and cultural filters in order to restore to images and words the kind of correspondence necessary for understanding to be the norm.

In a world where object-oriented programming is becoming ever more significant, we need a richer approach to objects that defines in addition to their substance (who, what?), and their place (where?), their temporal co-ordinates (when?), their construction (how?) and their underlying purpose, cause or reasons (why?). Moreover, these must be co-ordinated such that we can trace the ways in which answers to these questions may shift as we change the co-ordinates of time and space. Paper has different meanings in thirteenth century Beijing than it does in seventeenth century Paris or twentieth century New York. New breakthroughs in knowledge require much more than simply making everything available electronically. They require a whole new approach to classification of and access to knowledge as we have known it in the past. Within the SUMS framework these functions will be covered through the Access and the Quality meters (see Appendix).

24 October 1995

CHAPTER 10

A BRIEFEST HISTORY OF QUESTIONS

How do we learn? We ask questions. The basic questions: who, what, where, when, how, why have been around since recorded civilization. Yet the relative emphasis given to these questions and the resulting answers have changed enormously in the course of the past two thousand years.

Plato, for example, as a student of Socrates, was famous for asking questions. Perhaps because he was a philosopher he focussed on why questions. He dabbled in what questions (philosophy, law), in how questions (rhetoric, politics) and made passing references to matters involving when, where and who questions. It is noteworthy, however, that he wrote no biography, geography or history in the way that we know it today. Plato's why questions led him to focus on abstract concepts and to leave out much of physical reality and almost all personal reality.

Plato's most famous student, Aristotle, was more wide ranging in his questions. He too wrote minimal biography (who), little history (when) and some geography (where). Aristotle focussed on three questions who, what and why (fig. 1). It is striking how most of these concepts are static.

Why	Cause	Quality
How	Quality, State, Action, Passion, Relation	Quality
What	Substance, Accident, Quantity	Quality
Where	Place, Position	"Space"
When	Time	"Time"
Who	------	

Fig.1 A summary of Aristotle's questions, in relation to basic concepts.

Question	Traditional Description	Modern Description	SUMS
Why-universe	Metaphysics	Determinative	Quality
-nature	Physics	" "	"
-ideas	Philosophy	" "	" "
-language	Logic	" ", Logical	" "
What, Why	Philosophy	Subsumptive	" "
What, How	Arithmetic		Quantity
What, How	Geometry		" "
What, How	Music		" "
What, How	Astronomy		" "
How	Rhetoric	Determinative	
Where	Geography		Space
When	History		Time
Who	Biography		Questions

Fig. 2 A summary of Aristotle's questions, their corresponding disciplines and relations.

It can reasonably be argued that his systematic approach to these three questions established the disciplines of metaphysics, physics, philosophy, and logic (fig. 2). In most of these Quality dominates over Quantity. Even in those cases where Quantity is in play, it is almost strictly in terms of proportion rather than in terms of measurement. This is particularly true of his treatment of space and time.

For the next fifteen hundred, some would say nearly two thousand years, Aristotle's model exercised an amazing hold on the western world. With the rise of Christianity why questions continued to be in the foreground. A quiet change also took place. The crystallization of scientific subjects under the rubric of the quadrivium led to a gradual emphasis on Quantity (fig. 3).

	Quadrivium		
Why, How	Arithmetic	Discrete Quantity	Quantity
Why, How	Geometry	Continuous Quantity	Space
What, How	Music	Discrete Quantity to Sound	Quantity
What, How	Astronomy	Continuous Quantity to Sight	Quantity
	Trivium		
What	Grammar	Structure	Quality
Why	Dialectic	Logic	Quality
How	Rhetoric	Effect	Quality
Why, What	Law		Quality
Why, What, How	Medicine		Quality
Why, What	Theology		Quality
Where	Geography		
When	History		
Who	Biography		

Fig. 3 A summary of mediaeval questions, their corresponding disciplines and relations.

There were also other subtle changes. While the universities focussed on the trivium and quadrivium at the undergraduate level, the higher faculties concentrated on law, medicine, and theology. The undergraduate subjects focussed on theory rather than practice: the higher faculties included both theory and practice. In terms of our story this was important because it meant that the higher faculties were increasingly concerned with combinations of questions: not just what is an organ, or why is an organ but also how does it function, where is it exactly, when does it function and who knows about it? With the advent of the Renaissance, there was a flourishing of who, where and when questions which saw the emergence of biography, history and geography as major fields of study.

A simple glance at the basic questions and concepts of John Stuart Mill (fig. 4) shows that Quality remains as a concept but Quantity plays a greater role. More significantly, How, which had been mainly a static concept in Aristotle, is now concerned with dynamic principles.

Why	Cause	Quantity, Quality
How	Agents, Operations, Processes,	Quantity
What	Whole, Thing, Kind, Parts, Materials, Properties	Quality
Where	Place, Position	Space
When	Time	Time
Who	------	

Fig. 4 A summary of John Stuart Mills' questions, in relation to basic concepts.

If we turn to university subjects of the twentieth century it is striking how the questions have shifted (fig. 5). How now dominates, or rather how to. Questions of why are considered largely impractical, unprofitable and therefore bad.

	Arts and Science
What, How	Science, Engineering
What, How	Astronomy
What, How	Music
What, How	Mathematics
What, Why	Philosophy
When, How	History
What, How	Languages and Literature (English, French, German, Italian)
What, When	Art
How, Why	Psychology
How, Why	Sociology
What, How	Law
What, How	Medicine
Why, What	Theology
How	Business
How	Education
How	Information Studies

Fig. 5 A summary view of questions in major faculties and disciplines in universities of the twentieth century.

Such a cursory survey of academic disciplines at universities gives only one small measure of today's situation. In fact all six questions are being pursued with an unprecedented intensity. The advent of (relational) databases has led to an enormous upsurge in alphabetical and chronological lists. The pioneering work of Ranganathan on faceted classification has led to the rise of hierarchical lists whereby concepts such as broader and narrower topic are being studied more systematically.

There have also been several attemptsto understand the nature of these changes. Marshall McLuhan studied this shift mainly in terms of the trivium. He was intrigued how certain periods focus on logic (dialectic) others on structure (grammar) and others on effects (rhetoric). He found an answer in the shifting use of media, shifts from oral to literate culture at the time of the Greeks, to book culture through the advent of printing with Gutenberg in the fifteenth century and the shift to electronic culture, radio and television

in the twentieth century. This led to his now famous phrase: the media is the message. In terms of our story the history goes from questions of why (Greeks), to what (Renaissance) to how (twentieth century). In this context the extraordinary development of propaganda, advertising, and marketing as dominating features in our society are reflections of something much deeper than a passing fad. In the 1920's, Cassirer wrote of a shift from substance to function, from quiddity to relations, from why and what to how. Jacques Perrault, one of the leading individuals of the library world, has focussed on this problem and has suggested a scheme of five basic relations (fig. 6):

Perrault	SUMS
ORDINAL	
Conditional	Quality
State	
Necessary	
Contingent	
Arbitrary	
Attitude	
Favourable	
Indifferent	
Unfavourable	
Energy	
Potent	
Latent	
Impotent	
Comparative	Quantity
Degree	
Superior	
Equivalent	
Inferior	
Size	
Larger	
Equal in Size	
Smaller	
Duration	Time
Longer	
Equally Durable	
Shorter, Less Durable	
Identical	
Similar, Analogous	
Dissimilar	
Positional	Space
Figurative	
Outside	
Parallel	
Inside	
Near	

	Between	
	Far	
Spatial		Space
	Lateral	
	Right	
	Middle	
	Left	
	Axial	
	Front	
	Center	
	Back	
	Vertical	
	Above, Upon	
	Level	
	Below, Under	
Temporal		Time
	Prior	
	Simultaneous	
	Posterior	
Toward		Space
At		
Away		
DETERMINATIVE		
productive		Quality
limitative, frame of reference, orientation		
destructive		
INTERACTIVE		Quality
concord		
difference		
contrariety		
SUBSUMPTIVE		Quality
possession, belongingness		
type/kind		
whole/part		
LOGICAL[75]		Quality
reciprocal		
converse		
negative		

Fig. 6. Basic categories of relations according to Perrault (1994) and corresponding categories in SUMS.

It will be noted that Perrault's categories focus on the contents of the traditional trivium. A minor difficulty with his terms is that they are too complex for everyday use, and some simpler alternatives are therefore suggested (fig. 7).

Classical	Perrault	SUMS

	Conditional	Conditions
Rhetoric	Determinative	Causes, Effects
	Interactive	Interactions
Dialectic, Logic	Logical	Logic
Grammar	Subsumptive	Definitions, Subsumptions, Structures

Fig. 7 Classical disciplines, Perrault's terms and their equivalents in SUMS.

Precisely because of his focus on the trivium rather than the quadrivium, there is a further problem with Perrault's approach in that his concept of ordinal relations mixes qualitative and quantitative features. In SUMS the conditional aspect of ordinal is listed under quality while the comparative and positional aspects are listed under quantity.

While it has become fashionable to speak of the noun, quantity, and the adjective, quantitative, as if they were single features, this overlooks a) the distinctions made by Aristotle between continuous and discrete quantity and b) Kant's work claiming an independent role for the categories of space and time. In light of the above, SUMS uses three terms for quantitative and regroups the traditional categories as follows

Classical	Type	SUMS	
Arithmetic	Discrete Quantity	Quantity	Numerical
Music	Discrete Quantity	Quantity	Musical
Geometry	Continuous Quantity	Space	
Astronomy	Continuous Quantity	Space	
Chronology	Discrete Quantity	Time	
History		Time	

Fig. 8 Classical disciplines, their characteristics and equivalents in SUMS.

One of Marshall McLuhan's interests in the history of these disciplines lay in linking disciplines and media with different senses. He inherited this concern from his elder contemporaries such as Havelock and it was pursued by his students such as Ong. McLuhan was particularly concerned with the shift from aural culture with the rise of literacy to visual culture with the advent of printing.

There is a related problem that deserves much further study, namely, the history of links between particular questions and the senses. In terms of why questions, for example, the Greeks, focussed on verbal criteria for their sense of truth, especially in philosophy and in the subjects which later became the trivium. Apparent exceptions were mathematical disciplines such as geometry, astronomy and chronology. Geometry entailed (visual) diagrams. Astronomy and chronology entailed observation. Yet the proofs were in terms of calculations which were not visual. This helps account for the ambiguous role of figures in ancient geometrical texts. These results are summarized in the list below (fig. 9):

Questions	Classical	Sense	SUMS
Why	Philosophy	Aural Verbal	Quality Conditional
" ", How	Rhetoric	" "	Quality Causes, Effects

" "	" "	" "	Quality Interactions
" "	Dialectic	" "	Quality Logic
What	Grammar	" "	Definitions...Structures
What, How	Arithmetic		Quantity Numerical
What, How	Music	Aural Musical	Quantity Musical
Why, How	Geometry	"Visual"	Space
What, How	Astronomy	"Visual "	Space
When	Chronology	"Visual "	Time
When	History	Aural Verbal	Time

Fig. 9 Questions, classical disciplines, the senses and equivalents in SUMS.

All of this may at first seem an unnecessary exercise in shuffling words, but given the distinctions made above (figs. 7 and 8), we are now able to distinguish between those who answered why questions in verbal terms (quality), in terms of mathematical proofs and calculations (quantity) and in visual terms (space). Moreover, if we return to the notion of the six basic questions, it is clear that they all apply to some aspects of each of the four basic concepts, quality, quantity, space and time. To put it simply, for a Greek a concept such as space could be answered with a single question, why? At best every answer was based on a single question (fig. 10).

Subjects	Question
Zeus, God, blue sky, love	Why?
Bake cake, repair car, make shed	How?
Plane depart, train arrive, guest leave	When?
Country, province, city, building, room	Where?
Object, trinket, idea	What?
Person, woman, man	Who?

Fig. 10 Traditional approach of a different subjects having a single question and thus a single answer.

Today we think we have a full answer only in cases where we have answers to the who, what, where, when, how and why of space. An answer is now a product of many questions (fig. 11). An answer thus somehow becomes more than than the sum of its individual parts.

McLuhan's phrase about the medium is the message takes on a new meaning here. While the number of questions that one can ask about persons may be endless, the number of questions that one can hope to hope to answer is very much dependent on the medium at hand. In the Middle Ages, when it took a hundred monks some ten years to make a single index of the works of Saint Thomas Aquinas, the number of lists one could make in a lifetime was very limited. Once indexes exist in print form, the amount of time needed to search for someone, or something is amazingly reduced. Once lists can be generated automatically by computers, the possibilities are immensely increased. That is the threshold on which we are standing today.

Pumpkin	Who?	Who first discovered it? Who classified it?

What?	What is is its size, maximal, minimal?
	What are its parts, seeds?
Where?	Where was it first found? Where did it migrate?
	Where is it found? Where is it eaten?
When?	When was it discovered? When did it first get cultivated?
How?	How does it grow?
Why?	Why is it used for Hallow'een

Fig. 11 SUMS approach where a single subject has multiple questions and multiple answers.

Entailed is a mass of material far greater than any individual can deal with without systematic aids. For this reason the five basic concepts require five further ingredients to produce a useful system. First, one requires a survey of different access methods. Second one needs to calibrate these with and to different approaches to learning: goals, types of learning and kinds of learner. Third, one needs to distinguish different levels of knowledge in order to identify the depth of information that wishes to reach. Fourth, one needs to decide on the kind of media which are being used. Finally, one needs to have a clear survey of the software tools available. Hence SUMS has ten basic entry points which are listed alphabetically: Access, Learning, Levels, Media, Quality, Quantity, Questions, Space, Time, Tools.

Search engines today often ignore these distinctions. They assume that one only needs to answer a single question, rather than multiple combinations of questions systematically. The rhetoric today is on education, yet the emphasis is on training. The irony here is that we are using machines to teach us things that are sufficiently mechanical that they will eventually be tasks for machines. We are not yet using computers and the new technologies to help us with learning, with the uniquely human dimensions of our gifts. Needed is an integrating instrument which does four things. First, it provides us with a tool for classing information and creating our own trees of knowledge in terms of personal classification structures. Second it gives us a strategy and methodology for searching and finding material. Third, it provides a structure for organizing what we have found. Third, this structure should provide a framework for self learning. These are the challenges which SUMS and SUMMA are designed to meet.

IMPLICATIONS

SUMS effectively transforms all analysis of existing material, learning about known material and searching for new material into a coherent set of decision trees. One of the brilliant features thereof is that the whole process can be translated into the equivalent of a dialogue between machine and user. This is much more than a clever turn of phrase. Telephone companies and their travel service customers have discovered that information concerning bus or train times can be automated through a series of simple choices: if Toronto to Montreal press one, if Toronto to Ottawa press 2 etc., SUMS takes

this principle much further by asking the user to press a number between 1 and 10 in a series of lists. All of us are familiar with the game 20 questions. SUMS transforms the underlying intent of this game into a serious tool for learning systematically. The input device can be anything from a simple touch tone telephone, a personal digital assistant, to a computer activated by a mouse, joystick, touch screen, by voice or any other means capable of distinguishing choices. The display screen could be as elementary as the minimal screen which Worldspace is developing for their $20 devices designed to capture satellite messages, to a computer monitor, a television screen, a wall size panel, or even a complete surrounding as in an IMAX theatre, a CAVE or a Virtuarium.

SUMS is much more than just another software. Rather than competing with the isolated functionalities of individual pieces of software, it provides a framework for integrating them within a coherent framework. SUMS therefore has fundamental implications for how electronic products are advertised and sold, for our concepts of knowledge and for how we learn.

ADVERTISING

In addition to defining the software available for users with a given hardware specification, the system will also have built-in features for those wishing to change the parameters of their present equipment. The user will define how much they are willing to pay, what the direction of their development will be, be it new graphics tools, non-linear editing capabilities, computational power for major number crunching, data mining tools, or whatever. These alternatives will be correlated with learning curves for the new goals. For example, if they wish to use the latest version of an Alias graphics package they would need three weeks of home training at a cost of x, or two weeks of personal training with an advisor at x + y. The necessity of having teachers intervene directly will vary with the subject.

All of this will completely transform the role of advertising and the computer business. Rather than selling a product in isolation, vendors will present items as part of some larger package. This trend is already evident in Office Software which combines word processing, spreadsheets, fax and e-mail in a single package. In future there will be much more developed and more specialized versions of this trend. There will be the equivalent of Lawyer's Office, which combines the above tools with subscriptions to the legal documents appropriate to that province or state and to the specialty of the firm: civil, corporate, torts etc. There will be will be the equivalent of Doctor's Office which does the same for medical doctors at all levels of specialization. Indeed each profession will have its equivalent. These packages will be available on-line. The system will know from one's education that one is a lawyer or a doctor and offer the appropriate package accordingly.

Today most persons still make clear distinctions between hardware and software, even though a number of functionalities have both a hardware and a software solution. Increasingly these distinctions will become meaningless. A user will not be concerned with whether they buy a given piece from some brand name or clone. Rather they will

need to decide on the relative computing power to which they wish access. Are they working as a general user, as a designer of new architecture or machines or as a researcher? This will define the kinds of packages they will need. So vendors will sell integrated solutions rather than isolated pieces.

For this to occur may require a restructuring of many of the traditional categories of business. In the past there have computer hardware and software companies for the basic devices; content producing companies ranging from museums and libraries, and publishers to radio and television companies; then companies which dealt with the pipelining and transmission of content telephone, cable, satellite and wireless companies and finally electrical companies which powered the systems. All of these now require new connections and co-operation.

Corporations are focussing on object oriented approaches to create industry foundation classes. A next step will be to expand the horizons of this approach to include historical objects and cultural objects, to create a new kind of dynamic object which adjusts as one moves spatially and temporally.

KNOWLEDGE AND LEARNING

The extraordinary links here outlined will transform what it means to know. The past centuries have seen ever greater and in a sense ever more futile attempts to conquer some small part of knowledge and claim it as one's own. Knowledge is not just about details in one area. It is about relations. It is about interpretations.

Knowledge was traditionally something static. One took one's degree and then one knew. One could stop learning. Now there is no end. Learning is a lifelong experience. Each level of education will have basic knowledge and learning packages. There will be a junior package which gives access to all the courseware, i.e. courses available for children in the first three years of school, complete with the links to the Internet appropriate for that level. An exceptional 8 year old who is particularly gifted will need proof of having finished the requirements of that level before proceeding to a higher grade. Such packages will exist for all levels: high school students, university students, teachers, trainers and researchers. Corporations already have their lifelong training institutions. There will also need be trainers for the trainers.

There will need to be a new international dimension for these developments. Authority files for names (who), subjects (what), places (where), time schemes (when), methods (how) and explanations (why) will need to be constructed. For all this to work will require the greatest translation campaign in history. For it is only by having access to what is present that we can hope to combine it in new ways. And only thus can we have an international framework for terms in a distributed system.

The functions of SUMS are not new. The originality lies in a structure that presents itself only as necessary. Its complexity adjusts to the complexity of the user. Indeed the user makes their categories until they are advanced enough to recognize why the larger

systems of libraries and museums make sense. We have focussed on how the structure can be used to organize existing material and search for new material. But combinations of the choices are also possible such that the same structure presents a framework for self learning. The user might, for example, choose Space, then choose Map Projections, then choose Mercator, then go to Learning, define the depth to which they wished to learn and obtain what they wished. Some persons call this approach contextualization. In terms of navigation, it can be likened to the surveyor's term of triangulation, looking at the same thing from different viewpoints to gain a clear estimate of its co-ordinates.

In the past century it has become increasingly popular to see education and learning as issues and problems which can then be dealt with. As a result education and learning are seen as problem solving. As a result the student is reduced to a passive instrument, responding to someone else's definitions, someone else's agenda. These are undoubtedly important lessons to be learned. Life is frequently like that. We are a plumber, the plumbing does not work and we have to fix the plumbing. But there is also a great deal more to learning than solving other persons problems. We need a framework that allows us to become problem-definers as well as problem-solvers; active more than passive, searchers rather than the owners of agents. We need to transform our understanding of interactive as something passive to interactive as a quest. We need a set of tools to class, organize, search and to learn. We need to discover new questions for these are the true dimensions of learning and this is also an activity for which SUMS offers a structure. Perhaps this will prove to be its true purpose. All this will transform the present hype of an information highway, into the beginnings of a knowledge and a wisdom highway.

Appendix 1. Choices

Kim H. Veltman

PATENT for a

SYSTEM FOR UNIVERSAL MULTI-MEDIA ACCESS (SUMMA)

for Classing, Searching, Organizing and Learning

June-July 1996

CONTENTS Pages

INTRODUCTION

The following constitutes a new approach to search strategies for the Internet. The originality lies in a new combination of items which, in isolation, are very familiar. The underlying philosophy is to keep the tools for navigation as simple and homogeneous as possible notwithstanding changes in levels of education and enormous changes in complexity of facts. The key display modules are outlined in the first section on basic formats of pages.

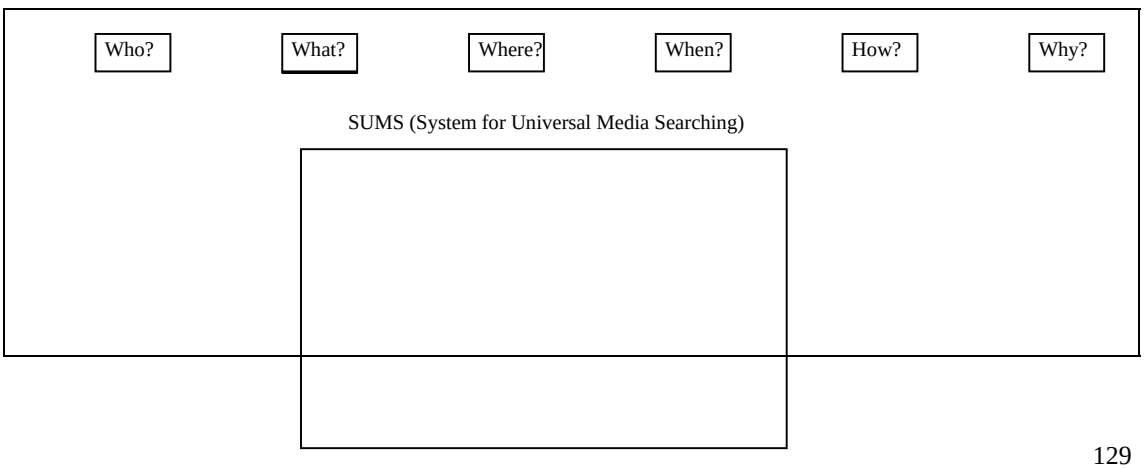
The power of SUMS comes through combinations of ten basic choices: Access, Learning, Levels, Media, Quality, Quantity, Questions, Space, Time, Tools. Each of these breaks down into further lists of ten or less choices. There are hundreds of these lists. Combined in various ways these generate many thousands of choices. Each of the ten choices is discussed in turn. The system includes a series of numbered premises. The final section gives examples to illustrate strategies for Classing, Searching in terms of basic, intermediate and advanced navigation, Ordering and Learning.

INTERFACES AND TEMPLATES

1. Current software typically uses buttons for functions. Everyday programs such as *Microsoft Word* or *Netscape* have two, three or even four rows of buttons. Such programs often attempt to show as many buttons as possible. By contrast, SUMS entails a small number of buttons. These include:

Button	Function
Who	Who?
What	What?
Where	Where?
When	When?
How	How?
Why	Why?
Navigator	Choices
⇒	Forward
⇐	Backward
◊	One level back (or exit if at entry)
S	Back to main entry interface of SUMS

These buttons are placed at the top and the bottom of each screen in a set manner as follows as in figure 1. The SUMS logo only appears on the opening page.



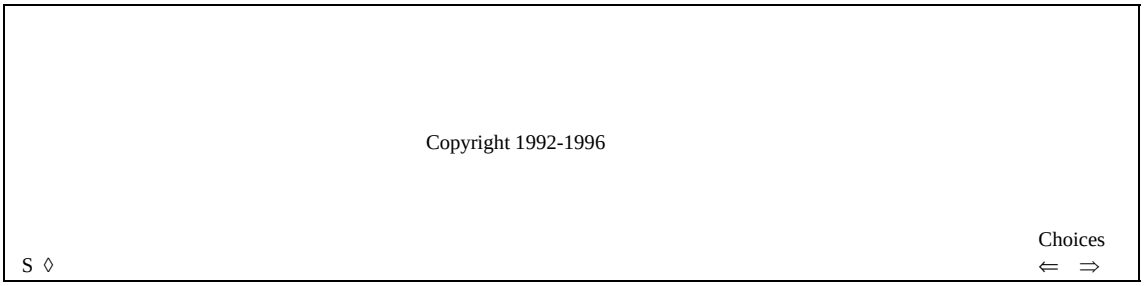


Figure 1. Basic buttons in SUMS interface.

2. At the centre of the opening screen is a world map. In its present configuration there are hot buttons for each of the continents, which then break down into countries, provinces, cities, buildings etc. It is foreseen that this will be co-ordinated with GIS, AM/FM and GPS. On subsequent pages this map is relegated to a miniature map in the bottom left hand corner which serves to re-invoke the map function (figs. 2ff.).

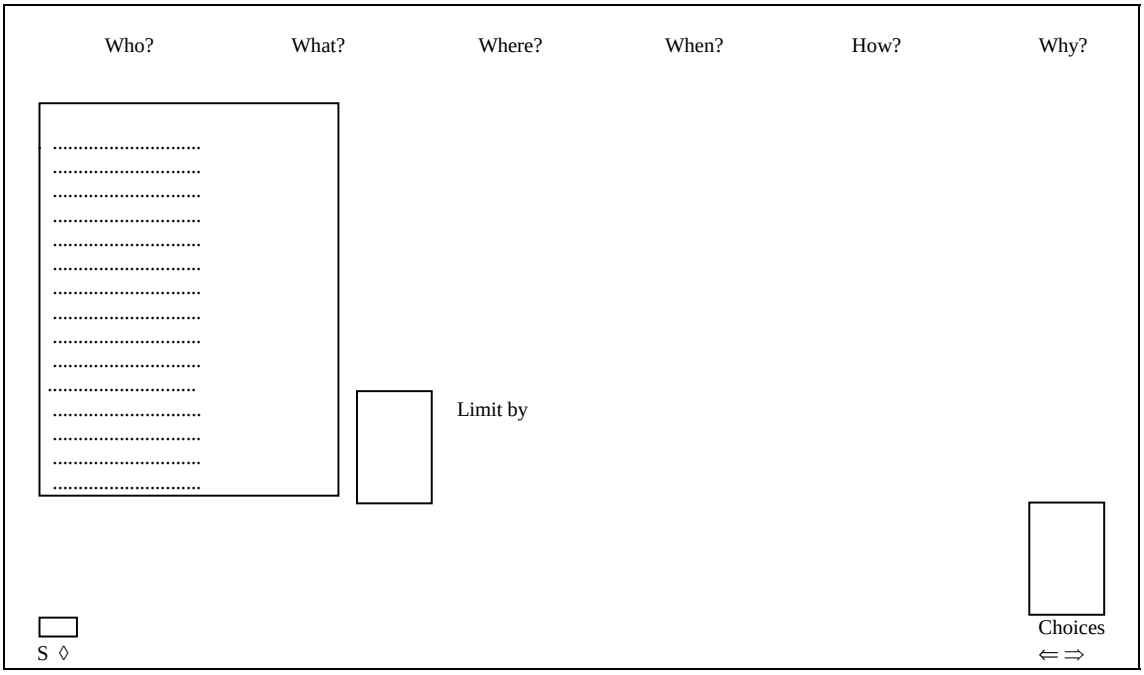
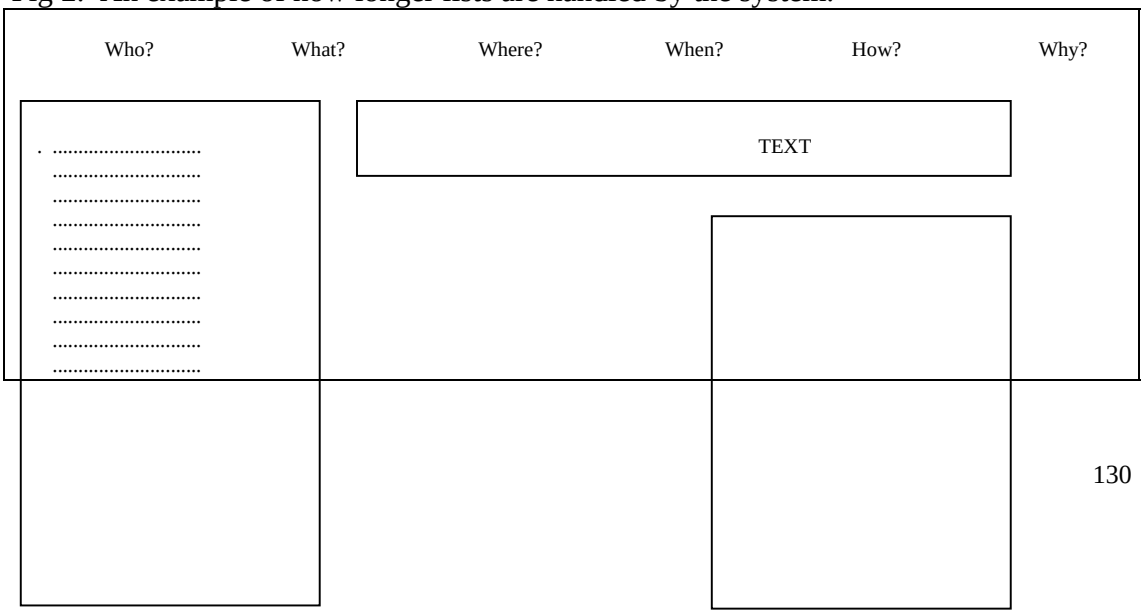


Fig 2. An example of how longer lists are handled by the system.



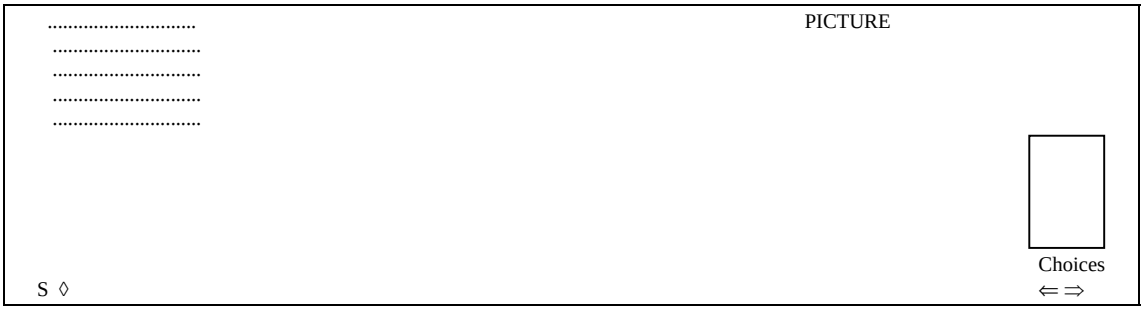


Fig 3. An example of how longer lists are handled by the system in conjunction with text and pictures. The text space can include a brief biography, definition, title, etc.

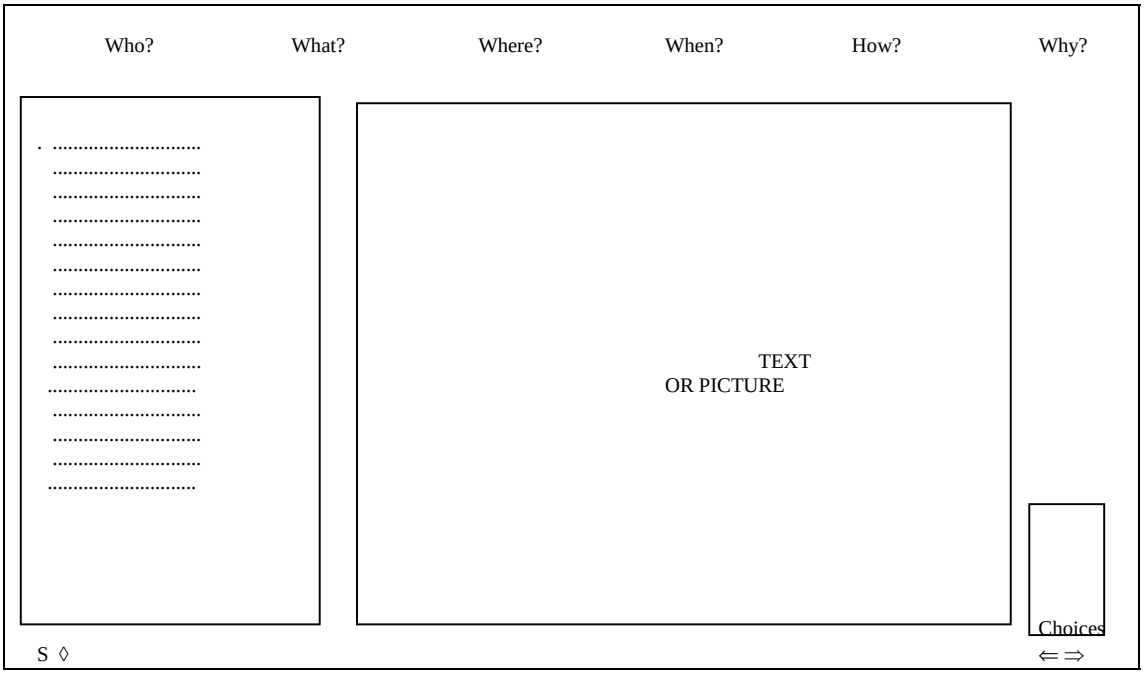
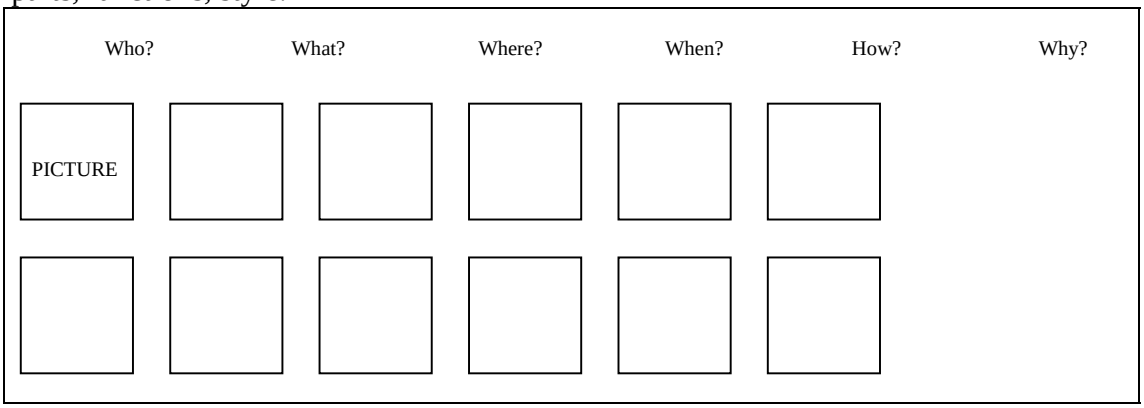


Fig 4. In cases where appropriate, the text space is expanded as shown. The text space can include a biography, definition, title, etc. In the case of a picture it can also deal with parts, functions, style.



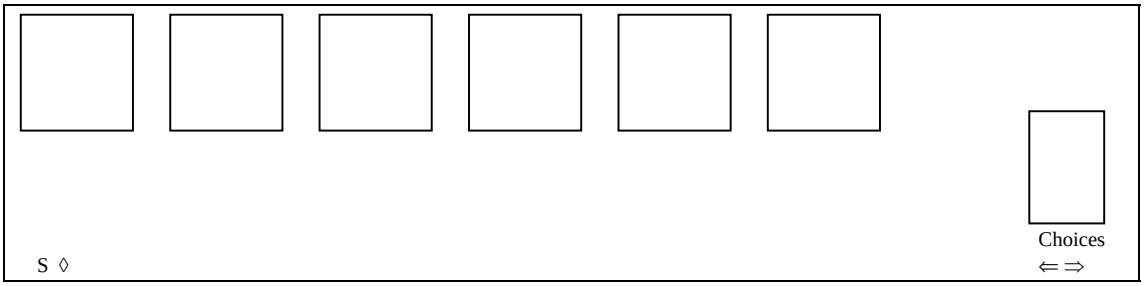


Fig 5. An example of how 15 thumbnail pictures are displayed in External Analyses Comparisons. There will be variants with 3, 4, 6, 12 and 20.

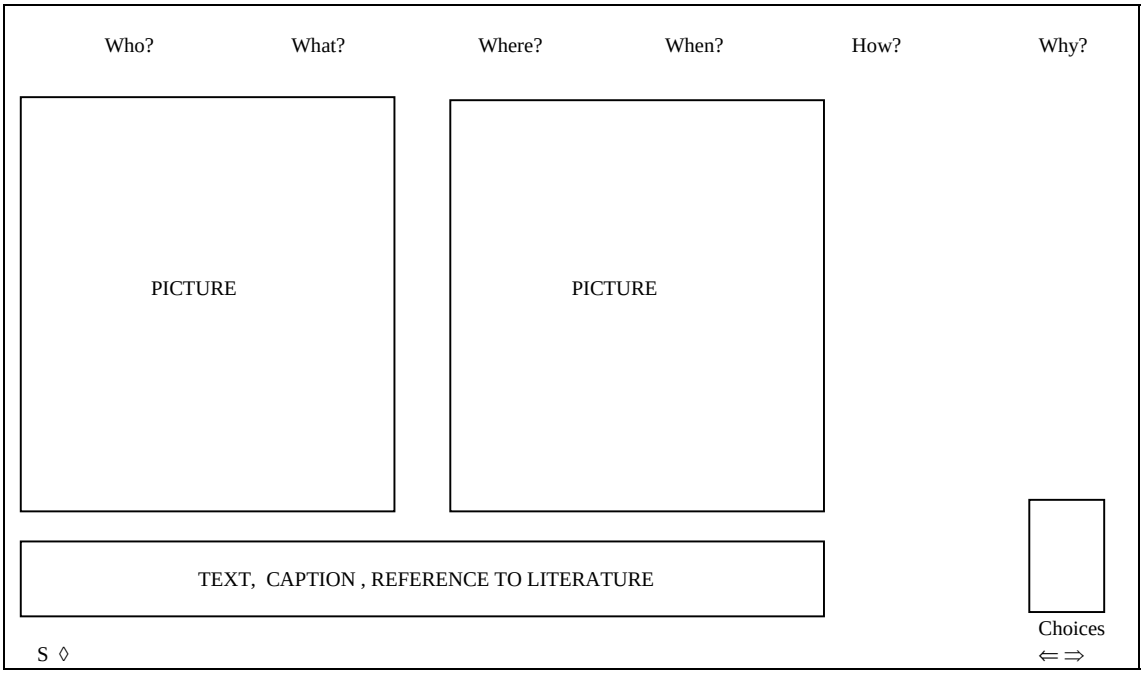
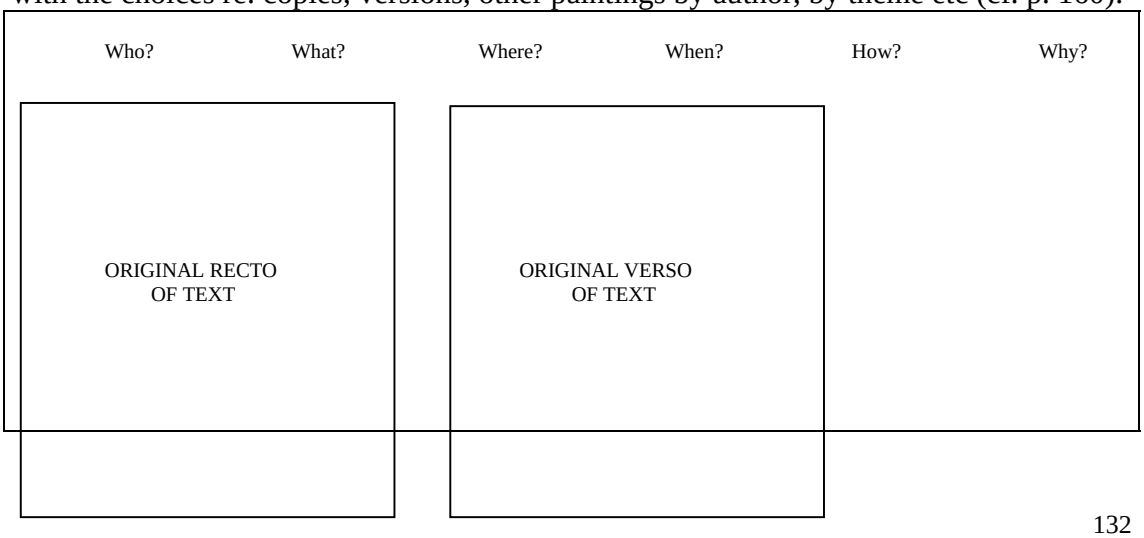


Fig 6. An example of how complete pictures are displayed in External Analyses Comparisons. Clicking on an individual picture takes one back to the description thereof, with the choices re: copies, versions, other paintings by author, by theme etc (cf. p. 160).



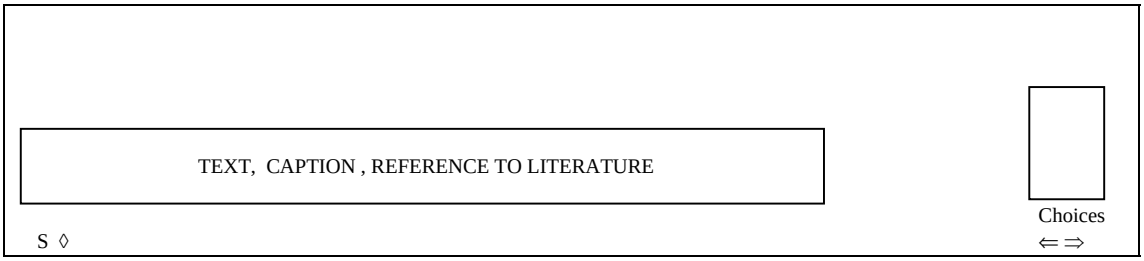


Fig 7. The same principle applied to two pages of an original manuscript.

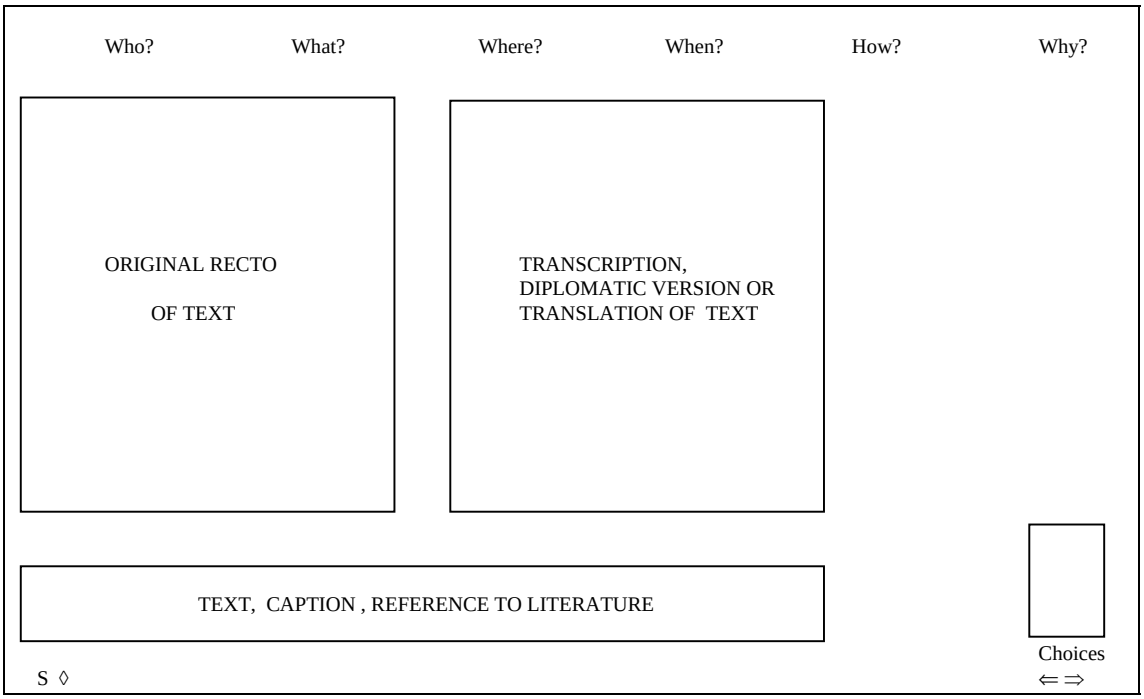
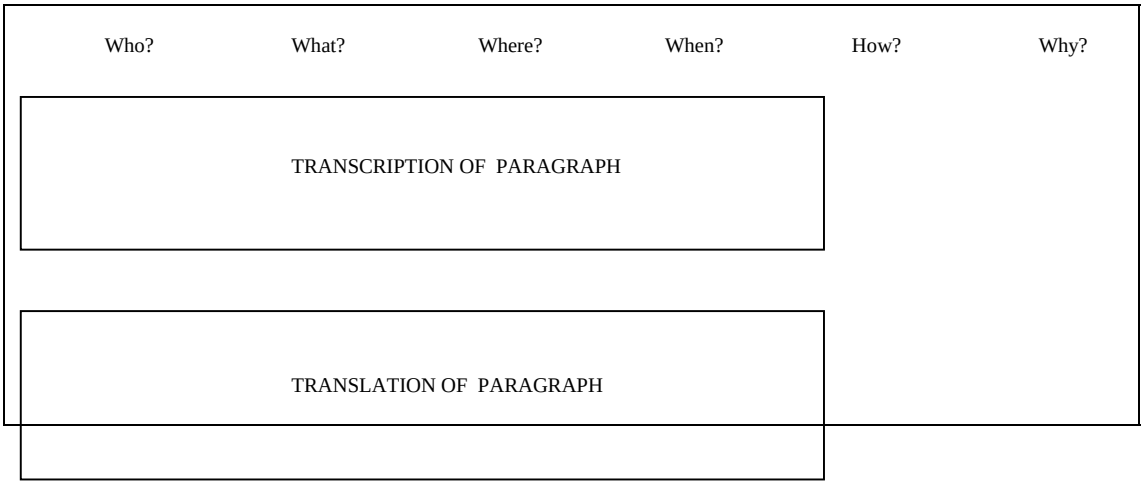


Fig. 8. A variation on this template the the case of transcriptions and translations.



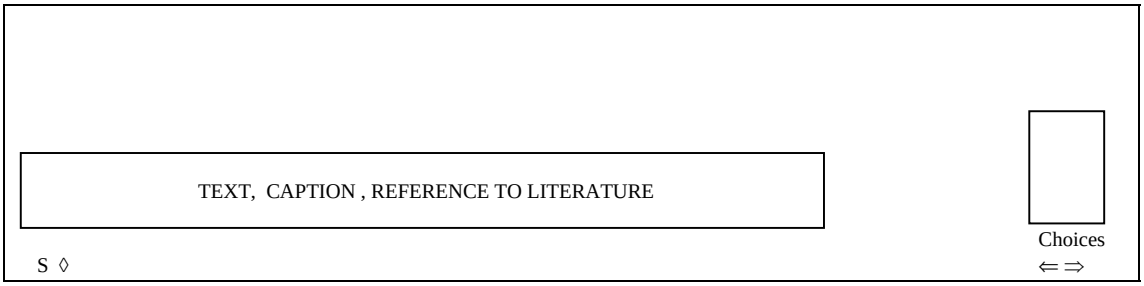


Fig. 9. A variation on this template in the case of transcriptions and translations.

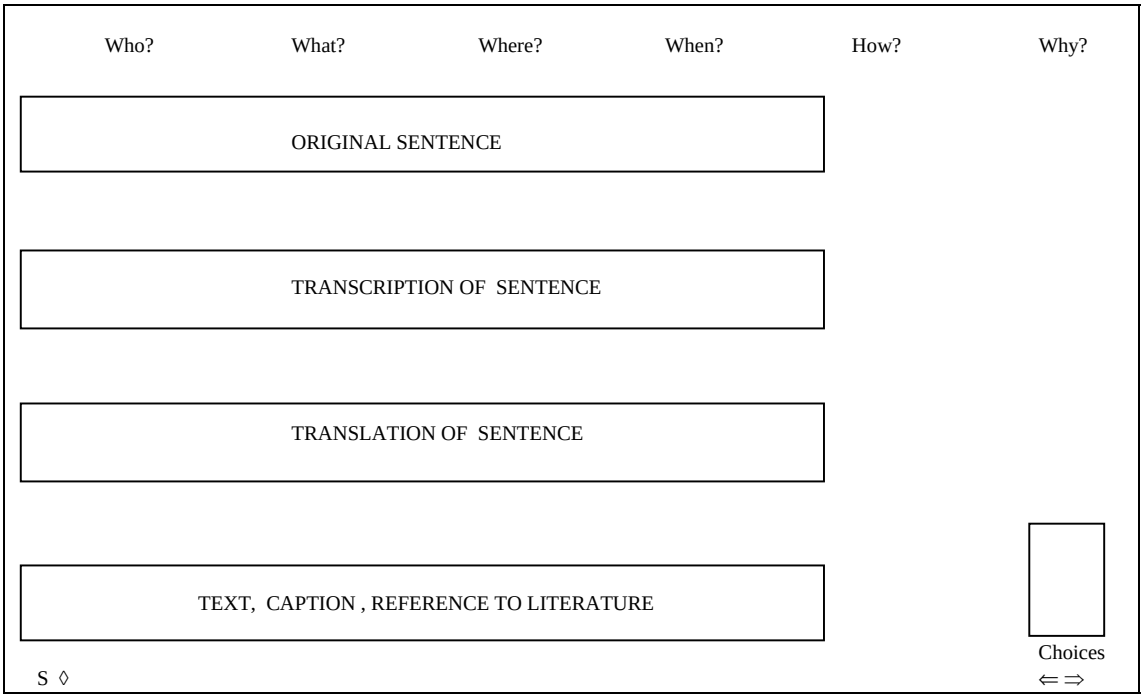
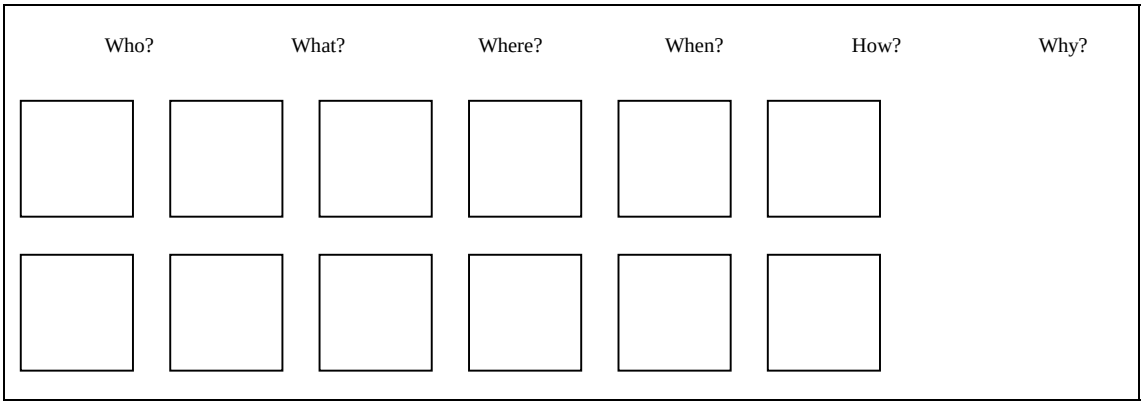


Fig. 10. A variation on this template in the case of original sentence, transcriptions and translations.



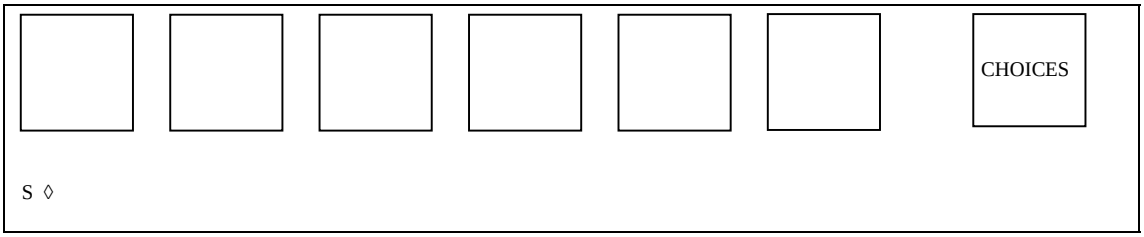


Fig. 11. An example of a history tree of choices to show how one has arrived at a certain place. Each of these can be connected numerically, in cascading fashion or displayed in tree fashion according to the tastes of the viewer.

When a student is consulting a book or manuscript, clicking on the caption will give one the source thereof. If the student wants further informationthey can go to Internal Analysis, Books, and find references to other literature on this work. If the list is small this will come up as a choices list in the following fomat:

LITERATURE
1590 Lomazzo
1651 Chambray
1750 Muratori

Clicking on any of these gives one the option of having the full title, partial contents, full contents etc.

There will be other templates for entering material. These will be adapted for different levels of education. Some persons will prefer to have their own interface. While allowed in cases of personal study it will be discouraged in public situations. One of the secrets of a universal method is that the basic look and feel should be the same whether one enters a school, library, museum or any other institution.

CHOICES

3. SUMS assumes that the eye should not be distracted any more than is essential. Basic choices should be in small lists of ten or less. The initial list of ten choices includes:

1. Access
2. Learning
3. Levels
4. Media
5. Quality
6. Quantity
7. Questions
8. Space

9. Time
10. Tools.

Each of these breaks down into other lists. (A survey of initial lists will be published separately). These lists do not normally cascade as in some programs, but if context is required a history function allows one to see the sequence in which they were used (fig. 11). Hence, SUMS deliberately hides choices until they are needed. The lists are expandable and will need to be adapted as specialized content is added. Part of the license agreement will be that users with specialized content will recommend appropriate lists which will then become part of the SUMS corpus of choices.

4. These small lists permit the choices to be moved to a personal digital assistant which can then function in the manner of the channels on a remote apparatus. In future this will apply equally to a computer monitor or a television screen.

5.SUMS is about the methodology of navigation and presentation of material in a timely manner. The methodology applies equally whether one is operating it at a distance with a remote apparatus, using a mouse, a touch screen, or a voice activated approach.

6. Navigation in the system takes place in keeping with ten levels of education which determine different levels of complexity. The lower levels of education use the simple lists of choices, which are presented systematically to guide the user. These lists function in co-ordination with the basic questions. How all this works is best illustrated by means of an example (see below p. 215*).

1. ACCESS

In the complete system, Access involves ten choices listed below. The lists are usually in alphabetical order. Some items are more futuristic than others. Basic and Intermediate Navigation involve subsets of these lists.

ACCESS
1. Agents
2. Filters
3. Languages
4. Level of Education
5. Machine Configuration
6. Personal Profiles

7. Relations
8. Special Needs
9. Structures
10. Viewers

ACCESS 1. AGENTS

Each of these choices in turn breaks down into other lists. Agents, for instance, represent a futuristic feature and fall into two classes:

AGENTS
1.Assistant
2. Representatives (Avatars)

One's assistant, also called an electronic butler, will search for materials on one's behalf, and present it in the manner that one wishes. Persons will tend to have only one of these and define their basic characteristics in keeping with their personality:

AGENTS ASSISTANT
1. Age
2. Gender
3. Persona

For example a man may choose to have the equivalent of an attractive secretary as his assistant. The persona of this assistant will include not only the colour of hair and eyes, but also the type of voice, whether it be soothing or authoritative, etc. Under normal circumstances this assistant will tend to be constant or changed infrequently.

A second type of agent will act as a representative of the person. In some cases this will be a simple clone of the individual in question. In some cases persons will simply use their Assistant acting in the manner of an executive secretary. In many cases, however, or so we are told, persons will choose to go in some kind of disguise such that the Internet will be a new forum for the tradition of masked balls and carnival festivals where persons mask their true identities. Some futurists believe that we shall have collections of avatars in the manner that we now have wardrobes of clothes ready for use at any occasion. Standard types might well evolve such that these become further lists of choices.

ACCESS 2. FILTERS

Filters represent a second dimension of Access with both present and futuristic features:

FILTERS
1. Distance between Words
2.. Fuzzy Logic
3. Match Percentage

4. Natural Language
5. Neural Networks

Most search engines today focus on finding a specific word. Words change their meaning depending on context. The words “linear” and “perspective” have a meaning in isolation that is different from their juxtaposition in the phrase “linear perspective.” Sometimes this same idea is expressed in a way that separates the words as in the phrase: “He used a perspective of the kind known as linear.” Filters help search for such contexts through the Distance between Words.

Sometimes one is not quite certain of the precise term and one wants to search for its contexts. One way of so doing is by going to classification schemes (see below LEVELS 1. Terms 3. Classifications). Another is by using Fuzzy Logic which has four basic categories:

FUZZY LOGIC
1. Decision
2. Definition
3. Generation
4. Relation

A third type of filter involves Match Percentage. This is particularly relevant when the user has a vague idea of the spelling or does not quite remember precisely how a term is spelled. Natural Language and Neural Networks represent other filters for accessing information. Neural Networks frequently rely on fuzzy logic. Because these are all rapidly evolving fields, the boundaries between them are very likely to shift. Even so the basic concept of filters is certain to remain important.

ACCESS 3. LANGUAGES

One of the most basic features of access is language, and in a sense it could almost be seen as another type of filter. Whether or not one accepts the radical formulations of Whorff, there is no doubt that language has an effect on what we say. French is often more precise than English. At the same time the ambiguities of English tend to make it richer in meaning. The list below offers a typical selection of European languages. This list can of course be customized in keeping with the needs of the user. In cases where more than ten languages are needed simultaneously the choices will be transformed into a list in the left hand margin.

LANGUAGES
1. Dutch
2. English
3. French
4. German
5. Italian
6. Latin

7. Portuguese
8. Russian
9. Spanish
10. Other

ACCESS 4. LEVELS OF EDUCATION

Access is not just about being able to access materials but also about decisions whether one wants materials to be accessible. These decisions entail levels of education:

LEVELS OF EDUCATION
1. Pre-School
2. Junior
3. Intermediate
4. Senior
5. General
6. Craftsman
7. Professional
8. B.A.
9. Postgraduate
10. Research

This dimension of Access is concerned mainly with varying entry points to knowledge. For instance, the question When? leads to periods of History. For a Pre-School child this list might be limited to two items:

PERIODS PRE-SCHOOL
1. Ancient
2. Modern

In the case of a high school student that same list will be longer:

PERIODS SENIOR
1. Ancient
2. Baroque
3. Byzantine
4. Egyptian
5. Greek
6. Mediaeval
7. Modern
8. Prehistoric
9. Renaissance
10. Roman

At the Research level this list might entail some 65 periods as in the Marburg Archive. While the Access level is concerned mainly with the points of entry at different levels, the corresponding content is the focus of 2. LEARNING (see below pp. 144 ff.).

ACCESS 5. MACHINE CONFIGURATION

The characteristics of the machine one is using have subtle but important effects on access. For instance, a machine with a low resolution monitor is simply unable to render many of the key details of a drawing or painting. Among the choices here will be the following:

MACHINE CONFIGURATION
1. Background
2. Printer: Dots per Inch
3. Screen Resolution
4. Screen Size

As interoperability becomes more a reality than a buzzword and as object-oriented programming advances, most of these features will become automated and no longer require the user's personal intervention. For instance, if the computer's client arrives at a server for the Uffizi (Florence) and is at the research level, it will adjust the monitor to a high resolution to benifit maximally from the images at that source.

ACCESS 6. PERSONAL PROFILES

Although the term personal computer (PC) is almost universally used, most computers do not yet take into account the complexities of individuals. The following list offers seven provisional choices:

PERSONAL PROFILES
1. Age
2. Gender
3. Music
4. Places
5. Preferences
6. Times
7. Scope

Age provides some context for suggesting contents. For example, one does not offer x rated films to children under 18. Persons will be at liberty whether they wish to give their exact age or whether they prefer to enter an age range such as under 5, between 6-12, 13-17, over 80 etc. Gender is another indicator which may or may not be relevant. The kind of music one wishes to have in the background consitutes an important aspect of a

personal profile. Some persons may of course choose not to have any music. The following list shows a possible set of choices which can be adjusted for different individuals.

MUSIC
1. Classical
2. Country
3. Folk
4. Jazz
5. New Age
6. Punk
7. Religious
8. Rock and Roll
9. Other

In terms of Personal Preferences such as those listed below, Internet software such as Netscape has already introduced most of these. In this case, SUMS simply places these options in a much larger framework.

PREFERENCES
1. Applications and Directories
2. Cache and Network
3. Fonts and Colours
4. Helper Applications
5. Images and Security
6. Mail and News
7. Moods
8. Proxies
9. Styles

In many cases the choices one makes in terms of Music and Preferences are a matter of context. The music one wants in the workplace is different than when one is surfing in one's leisure time. One may also want quite different music in the early morning than in the evening. The Places and Times options are for this purpose.

One of the most important dimensions of access is determined by one's purpose, goal or scope of one's search which is effectively why it is being carried out and includes choices such as:

SCOPE WHY
1. Everyday, Emergency
2. Business
3. Culture
4. Education
5. Environment
6. Government

7. Health
8. Legal
9. Leisure
10. Religion

In the first example (given below p. 220*) the purpose or scope is Everyday. Having determined why? the questions how? when? where? what? who? help to focus the parameters of the search. There will be slight variations in the sequence of these questions as the scope changes. For instance, if the scope is Emergency, then the most pressing question is where?

EMERGENCY WHERE
1. Local
2. Regional
3. National
4. International

If the first of these possibilities obtains, then the list becomes:

EMERGENCY LOCAL
1. Ambulance
2. Assault
3. Fire
4. Operator
5. Police

If the scope is international then one is directed to the sites being established through G7 pilot project 7 on Global Emergency. It will be noted that in this case where tells us much more than the geographical location. It tells us something of the scope of the problem. Only something of the magnitude of a major war, a massive earthquake, a very large typhoon or hurricane can be considered as an international emergency.

If we take this global approach we find that the eleven pilot projects of the G7 fall easily within the scope of these ten major goals, (fig. 12):

SCOPE WHY	G7 Pilot Project
1. Everyday, Emergency	7. Global Emergency
2. Busiiness	1. Global Inventory (of Projects)
	2. Global Interoperablity
	10. Global Marketplace for SME's
	11. Maritime Information Systems
3. Culture	5. Multimedia Access to World Cultural Heritage
	4. Bibliotheca Universalis
4. Education	3. Cross Cultural Education and Training, 4,5
5. Environment	6. Environment
6. Government	9. Government On-line

7. Health	10. Global Healthcare
8. Legal	
9. Leisure	4,5 (as above)
10. Religion	

Figure 12. The basic purposes in USMS and the corresponding themes of the eleven pilot projects of the G7.

The three areas not covered directly by the G7 pilot projects represent domains where there are already major initiatives underway from other quarters. For example, the legal profession is creating its own network of electronic legal documents. The tourism and entertainment industries are both focussing on different aspects of Leisure and the major religions are covering their field. That which is happening at the global level has corresponding initiatives at the national, regional and local levels. In other words the content needed for the framework outlined here is being produced. It only needs to be accessed efficiently.

ACCESS 7. RELATIONS

7. Relations offer a key to meta-search capabilities.

In searching for information finding the material on a given term is often only a small part of the task. If one is a beginner in a field one does not know the vocabulary and one needs to find the context of the term. In the case of advanced research, classification systems provide a valuable aid (see below LEVELS 1. Terms 3. Classifications). Initially, relations between terms are a very helpful means of increasing the scope of one's search. These lead to two choices, the first of which breaks down into ten further choices:

RELATIONS
1. Related Terms
2. Relators

RELATED TERMS
1. Alternatives
2. Associations
3. Complementaries
4. Duals
5. Identicals
6. Opposites
7. Indicators
8. Broader
9. Narrower
10. Contextualize

Of these the first again breaks down into four categories three of which are familiar from subject catalogues in the library world. The fourth concept is also listed below under LEVELS 1. Terms 8. Thesauri

ALTERNATIVES
1. Related Topic (RT)
2. See Also (SA)
3. Thesaurus
4. Used for (UF)

The subsequent five choices, Associations, Complementaries, Duals, Identicals, Opposites and Indicators relate to the work of Judge[76]. The next two choices Broader and Narrower again derive from Subject Catalogues of the library world, namely, Broader Topic (BT), Narrower Topic (NT). The final choice in this series, Contextualize, derives from Judge. Williamson[77] has listed twelve choices in terms of Associations which have been standardized in the list below:

ASSOCIATIONS
1. Action and Patient
2. Action and Product
3. Action and Properties
4. Action or Thing and Counter-Agent
5. Concept and Properties
6. Concept and Opposite
7. Concepts Linked Causally
8. Concepts Related to Origins
9. Field of Study and Objects Studied
10. Occupation and Person in Occupation
11. Process and Agent or Instrument of Process
12. Whole-Part

A second set of Related Terms uses as its starting point a famous article by Perreault[78]:

RELATORS
1. Alternation
2. Conjunction
3. Reciprocal
4. Converse
5. Negative
6. Subsumptive
7. Determinative
8. Ordinal

The first five of these are self-explanatory. Subsumptive leads to further choices which are discussed below under QUALITY 3. DEFINITIONS, STRUCTURES, SUBSUMPTIONS. Similarly, other choices concerning Determinative are discussed below under QUALITY 2 CAUSES ACTION. In the case of Perrault's concept Ordinal,

for reasons discussed in chapter 10 above, we have divided this between Quality, Quantity, Space and Time.

8. In themselves the categories under subsumptive, determinative, and ordinal look as if they were just another series of lists. In Perrault's scheme all of these are linked with categories in Universal Decimal Classification. Hence all of these choices become direct ways into bibliographies on those topics. In this Access section Perrault's own method of organization is maintained. Elsewhere, the same terms are re-arranged under the headings of quality, quantity, space and time. There are multiple approaches to the same material.
Those wishing to have simpler versions of these lists can construct their own subsets such as the following:

Determinative
1. Type
2. Kind
3. Genus
4. Species
5. Whole
6. Part

Alternatively the list might look as follows:

1. Type
2. Kind
3. Principle
4. Manifestation
5. Genus
6. Species
7. Whole
8. Part

At the same time professional botanists will require more specialized lists:

1. Phylum
2. Class
3. Order
4. Family
5. Genus
6. Species
7. Subspecies
8. Variety

ACCESS 8. SPECIAL NEEDS

The area of special needs introduces a whole world of access problems. This area will include initial choices such as the following:

SPECIAL NEEDS
1. Blind
2. Deaf
3. Disabled

Each of these has considerable consequences for interface design. For instance, a blind user will require either a voice-activated, or braille version of the choices. These dimensions of the software require development.

ACCESS 9. STRUCTURES

Access is not just about classing and finding material initially but also how one finds back material one found at some stage during one's work. So Access will lead to a series of choices about structuring tools as foreseen by Judge:

STRUCTURES
1. Classic
2. Musical
3. Symmetrical
4. Tensegrity
5. Personal
6. Free Form

]

ACCESS 10. VIEWERS

9. In addition to classing, finding and structuring materials, problems of display are also an aspect of access. Thus far most discussions of these Viewers assume that some particular option is likely to dominate all others. SUMS departs from the premise that each of these methods has its uses, each probably has contexts where it is more effective than others,and therefore all of them should be available. In those instances where one method seems particularly suited, the system will suggest that option.

VIEWERS
2D
1. Lists
2. Spreadsheets
3. Starburst
3D
4. Blue Room
5. Cone Tree

6. Landscape
7. Perspective Wall

The reader will note that these different Viewers are specialized and extreme cases of interface changes presented by the use of different Media (see below 4. MEDIA).

2. LEARNING

Learning is closely connected with formal education but is a more fundamental concept because it includes informal learning as well. It includes five basic elements:

LEARNING
1. Contexts
2. Goals
3. Methods
4. Kinds of Learner
5. Types of learning

LEARNING 1. CONTEXTS

10. When a student writes an exam they may obtain a mark of 95%. Yet this may represent only 40% of the the text, 10% of the course, 2% of the curriculum and .002% of the corpus of knowledge in any field. One of the challenges of learning is to contextualize the achievements of students (and teachers) allowing them to understand these links in such a way that they are not discouraged. in concrete terms this requires a systematic linking of facts and modules in each level of the system as listed below:

LEARNING CONTEXT
1. Corpus
2. Curriculum
3. Courses
4. Texts
5. Tests
6. Evaluations
7. Reviews

LEARNING 2. GOALS

Goals list all the benchmarks, curriculum documents and equivalents in other provinces and other countries:

GOALS
1. Benchmarks
2. Curriculum
3. Equivalents

Curriculum entails the standard items one wishes to achieve in a given course. It includes information about standards, outcomes, leaning tasks, assessment samples, planners and resources.

CURRICULUM
1.Common Document
2. Standards
3. Outcomes
4. Learning Tasks
5. Assessment Samples
6. Planner
7. Resources

Curriculum outcomes can in turn be divided into essential and specific:

CURRICULUM OUTCOMES
1. Essential
2. Specific

LEARNING 3. METHODS

Learning methods include all the formal methods of learning:

LEARNING METHODS
1. Course
2. Collaborate
3. Demo
4. Simulate
5. Train
6. Test
7. Evaluate
8. Review
9. Tracking
10. Reports

Different kinds of courses are identified:

COURSES
1. Curriculum Course
2. Just In Time Learning
3. Lifelong Learning
4. Professional Development
5. Skills

At the university level a course will have a series of choices:

COURSE
1. Administration
2. Description
3. Lectures
4. Readings
5. Further Readings
6. Internet
7. Other Media (Films)

Courses are but one way of learning. A second method is collaborative learning, which leads to a series of further options.Very much needed are methods that will help us assess which kind of learning is more effective using collaboration and which kind of learning is better pursued on an individual basis.

LEARNING COLLABORATIVE
1. Encounter
2. Meeting
3. Comments
4. Thoughts
5. Reflections
6. References

Simulation and Training are other methods of learning applicable in some cases. Once the student has learned then they are tested in various ways:

TEST
1. Essay
2. Multiple Choice
3. Problem Solving

PROBLEM SOLVING
1. Correct Conceptions
2. Parallel Concptions
3. Misconceptions
4. Incorrect Solutions
5. Irrelevant Responses
6. Not Understand the Question

As part of the greater move towards accountability, these learning methods include four stages for checking progress: evaluation, review, tracking and reports. Evaluation breaks down into at least three choices:

EVALUATE
1. People
2. Process

3. Product

Of these the first breaks down into at least another five categories:

EVALUATE PEOPLE
1. Directors
2.. Supervisors
3. Principals
4. Teachers
5. Students

Access to this information will be limited to the appropriate level in each case. The same approach applies to reviews:

REVIEW
1. Teacher
2. Peer Review
3. Student

It also applies to reports.

REPORTS
1. Interim Reports
2. Report Cards

These interim and final reports will apply to the whole spectrum of the system:

REPORTS TO
1. Directors
2.. Supervisors
3. Principals
4. Teachers
5. Students
6. Parents

These reports will be in the form of grades:

GRADE
1. Percent
2. Number
3. Letter
4. Word
5. Equivalents

LEARNING 3. TYPES OF LEARNING

At the level of theory a great deal of effort has been dedicated to identifying kinds of learning. Four basic kinds are generally agreed upon:

KINDS OF LEARNING
1. Cognitive
2. Affective
3. Perceptual
4. Psychomotor

Precisely what these mean and how these subdivide is a matter of debate. For example, the Ontario guidelines divide cognitive in one way, while theorists such as Bouchard do so differently:

COGNITIVE (Ontario)
1. Focus
2. Organize
3. Locate
4. Record
5. Assess/Evaluate
6. Synthesize and Conclude
7. Apply
8. Communicate

COGNITIVE (Bouchard)
1. Knowledge
2. Comprehension
3. Application
4. Analysis
5. Synthesis
6. Evaluation

SUMS is not concerned with taking sides or pretending to know which of these alternatives is best. If the province of Ontario uses one alternative and wishes to use that exclusively then the SUMS framework allows this. In time, an international version of SUMS will present users with a list of various versions such that scholars, educators and students can explore the ways in which they relate and the extent to which they are equivalent. This same principle applies to the other three kinds of learning:

AFFECTIVE
1. Receiving, Responding
2. Valueing
3. Organization
4. Characterization

PERCEPTUAL

1. Sensation
2. Figure Perceptual
3. Symbol Perception
4. Perception of Meaning
5. Perceptual Performance

PSYCHOMOTOR
1. Perception
2. Imitation
3. Manipulation
4. Precision
5. Articulation
6. Naturalization

At a future date these features of kinds of learning will be related directly back to the curriculum, courses, texts, exams etc. such that there is a greater contextualization of knowledge. It will then be possible for a teacher or student to start from some learning skill such as focus or perceptual performance, determine what things in the curriculum and the course are directed to those goals and see precisely which courses, texts, tests exist for those skills. Alternatively, a student or teacher could begin with some item in their course of study and trace back what skills this item or set of exercises is meant to develop, i.e. the reasons why it is being learned.

LEARNING 4. KINDS OF LEARNER

At present most schools give students some basic psychological tests the results of which are usually only consulted if the student become a so-called problem child, in which case the school psychologist uses the results in trying to help the child. There are various kinds of learner.

.

TYPES OF LEARNER
1. Basic
2. Myer-Briggs (Jung)
3. Sternberg

Each of these breaks down into further categories:

BASIC
1. Abstract
2. Sequential
3. Concrete
4. Random

In addition to the basic tests there are the others such as those of Jung which are the basis of the Myer-Briggs tests:

MYER-BRIGGS
1. Extraversion E
2. Sensing S
3. Thinking T
4. Judgment J

5. Introversion I
6. Intuition N
7. Feeling F
8. Perception P

These two sets of four combine to produce 16 categories which are not listed here. Other systems include the seven kinds of intelligence identified by Sternberg.

STERNBERG CATEGORIES
1. Anthropological
2. Biological
3. Computational
4. Epistemological
5. Geographic
6. Sociological
7. Systems

These too will become part of the system. In future there will be links between these categories and the different goals and contents of curricula such that these psychological types serve as filters of access to information. These filters can function in different ways. A person with, say a geographic intelligence, will be presented geographical materials as best suited to them. They will also be given a particular approach to materials entailing other kinds of intelligence. The precise details of this content are not the concern of SUMS, which focusses on a systematic framework for gaining access to the results.

11. Much of scholarship is about making links. Each new medium allows some of those links to be made more easily. At the same time each new medium poses the challenge of creating many new links which were previously impossible. Hence the advent of computers means there will be whole generations working to create systematic connections. SUMS offers a comprehensive framework for dealing with the results.

Some will object that all this is much too complex for the everyday needs of schools and that a much simpler approach would do fine. Here it bears remembering that there is a basic and intermediate level in addition to the complexities of advanced navigation just outlined. A simpler approach is given in the examples below on p. 222*.

LEVELS

A user who chooses Levels (of knowledge), in SUMS is given ten choices:

LEVELS
1. Terms
2. Definitions
3. Explanations
4. Titles (Headlines)
5. Partial Contents (Abstracts)
6. Full Contents
7. Internal Analyses
8. External Analyses
9. Restorations
10. Reconstructions

In this presentation these choices are outlined in passing as they have been described in some detail elsewhere (see chapter 3 above).

LEVELS 1. TERMS

Terms deals with all treatments of words and images as separate entities, before they are combined as definitions in dictionaries, as explanations in encyclopaedias and as essays in articles and books. The basic categories here listed have been influenced by the work of Judge:

TERMS
1. Action Plans
2. Charts
3. Classifications
4. Declaration Principles
5. Functional Units
6. Mind Mapping
7. Structural Transformations
8. Thesauri
9. Visual Forms

These choices adapt to the questions and contexts at hand. For instance, if one is dealing with Who then these charts become family trees (see below under Questions Who), where this is outlined in more detail.

LEVELS 2. DEFINITIONS

This includes all dictionaries. While some of these will be local, most of them will be remote. In the case of major works such as the Oxford English Dictionary users will pay a subscription to add this to their choices.

DEFINITIONS
1. Standard
2. Oxford English

3. Websters
4. Etymological
5. Other Contemporary
6. Other Historical
7. Other Languages

LEVELS 3. EXPLANATIONS

Explanations are all descriptions beyond those found in dictionaries. They are of three kinds:

EXPLANATIONS
1. Basic
2. Charts
3. Encyclopaedias

The third of these includes all encyclopaedias with arrangements such as those outlined above for dictionaries.

EXPLANATIONS ENCYCLOPAEDIAS
1. Britannica
2. Comptons
3. Other Contemporary
4. Other Historical
5. Other Languages

LEVELS 4. TITLES

Titles will usually include a simple list such as the following:

TITLES
1. Art
2. Books
3. Instruments

This list will vary in accordance with the individual. If, for instance, the person is also an architect, and an engineer of bridges then the list of titles will include these. The keywords associated with the publications of an individual help in generating these characteristics automatically:

TITLES
1. Architecture
2. Art
3. Books

4. Bridges
5. Instruments

As in a library catalogue, once a user has chosen a Title they can decide on the level of detail:

TITLES
1. Full Record
2. Regular Title
3. Short Title

12. In many library catalogues this functionality already exists but with different interfaces. One of the underlying principles in SUMS is that the interface for finding a title should have the same look and feels as when one is searching for something else.

Treatment of the choices associated with BOOKS also varies depending on different circumstances. An educational example at the high school level is cited below (p. 22*). At lower levels of education the number of titles is so small that no further distinctions need to be made. At more advanced levels users will be asked to choose between

BOOKS
1. Primary
2. Secondary

At the research level there will also be choices between different kinds of books:

BOOKS A
1. Bibliographies
2. Book Catalogues
3. Databanks
4. Library Catalogues

Bibliographies gives one a chronological list of the bibliographies on a field or a person with a numerical table of how many works are listed in each. Book catalogues provides one with a list of national book catalogues such as the following:

BOOK CATALOGUES

1. England	Books in Print
2. France	Lorenz, Biblio
3. Germany	Kayser
4. Italy	Pagliaini
5. Netherlands	Brinkmans

Databanks gives one access to standard electronic repositories:

DATABANKS
1. ESTC
2. OCLC
3. RLIN

Library Catalogues begins with a where function to determine whether one wishes local, regional, national or international collections. When one has chosen one of the above one has further choices:

BOOKS B
1. Bibliographies
3. Chronological
4. Key Words
5. Languages
6. Places
7. Subjects
8. Terms of Titles
9. Titles

Any of these choices will then lead to further alternatives:

BOOKS C
1. Names
2. Authors
3. Editors
4. Publishers
5. Printed For
6. Sellers

The number of book catalogues, databanks and libraries will to a large extent be determined by the scope of the research. A biologist in Athabasca studying only local sightings of a particular bird or animal, will presumably not need to consult sources everywhere around the world.

The level of study will also define the detail with which one chooses to distinguish between materials. For instance, a student in elementary school will be quite content to ask at random for materials. A researcher may wish to decide whether they are interested in both Books and/or Articles, then whether they wish only Journals, or include Magazines, Newspapers, Bulletins and other Ephemera.

If the user chooses Art the list might look as follows:

ART
1. Drawings
2. Engravings
2. Paintings

In more complex cases this list might include the following:

ART
1. Drawings
2. Engravings
3. Fresco
4. Paintings
5. Sculpture

If they choose Paintings they are given a list of all the paintings by a given artist or concerning a given theme. If they wish more information about the painting itself they do so by proceeding to internal analysis. If they wish to learn more about related works they go to external analyses, comparisons and delve deeper in this way.

LEVELS 5. PARTIAL CONTENTS

This leads to abstracts, indexes, reviews and other summaries of the material:

PARTIAL CONTENTS
1. Abstracts
2. Summaries
3. Reviews
4. Key Words
5. Tables of Contents
6. Indexes

LEVELS 6. FULL CONTENTS

This entails the complete digital contents of an article or book.

FULL CONTENTS
1. Volume
2. Chapter
3. Page
4. Diagrams
5. Photographs
6. Tables

LEVELS 7. INTERNAL ANALYSES

The reader is referred a detailed description of this level which has been given elsewhere (see chapter 4 above).

INTERNAL ANALYSES
1. Identifications

2. Interpretations
3. Analyses

Each of these breaks down into other choices:

IDENTIFICATIONS
1. Art
2. Books
3. Objects
4. Persons

The first of these choices provides basic information about the work of art:

IDENTIFICATIONS ART
1. Function
2. Motif
3. Part
4. Study

A person wishing to study the work in more detail chooses option four:

ART STUDY
1. Administration
2. Alternate Names
3. Conservation
4. Details
5. History
6. Image History
7. Loans

Each of these breaks down in turn. For the purposes of these examples, mainly categories from the Canadian Heritage Information Network (CHIN) are used:

ART STUDY
ADMINISTRATION
Accession No.
Borden No.
Height
Width
Length
Outside Diameter
Depth
Unit_Linear
Unit
Value
Price

ART STUDY
DETAILS
Catalogue No.
Culture
School/Style
Object Type
Object Name
Material
Medium
Support
Technique
Produced in
Used in

ART STUDY
HISTORY
Acquisition
Owners
Owners Date
Previous No.
Previous Transfer

ART STUDY
IMAGE HISTORY
Pedigree
Original
Photo
Bitmap
Owner

ART STUDY
LOANS
Conditions
Corporate Body
Corporate Names
Credit Line
Currency
Date
Date in
Date out
Deposit
Documentation
Document Group
Event
Event Name
Exhibition

Grant Aid
Loan Out
No. of Items
Return Date
Return Required
Subsequent Transfer
Temporary Location

In the case of book these characteristics differ somewhat:

IDENTIFICATIONS BOOKS
1. Captions
2. Frames
3. Literature
4. Numbers
5. Transcriptions
6. Translations
7. Text
8. Voice

Manuscripts will have added features such as mirror scripts. Other variations obtain in the case of objects and persons.

With respect ot interpretations, persons can choose between:

INTERPRETATIONS
1. Literal
2. Allegorical
3. Moral
4. Anagogical
5. Metaphorical
6. Visual
7. Other

Many persons will be content with some subset of the above. A full list will include the following:

1. Equivalence	statue equals god	
2. Substitution	statue represents god	
3. Euhemerism	painting represents man as if god	
4. Symbolism	"	" *a* but means *b*
5. Literal	"	" *a* and means *a*
6. Allegorical	"	"*Old Testament* and means *New Testament*
7. Moral	"	"Christ's actions in relation to man
8. Anagogical	"	"Christ's actions in relation to eternity
9. Guisal	"	"*a* in the guise *a1*

10. Playful Guisal " "*a* in the playful guise of *a1*

Analyses takes one back to the three basic categories of the trivium:

ANALYSES
1. Effects (Rhetoric)
2. Logic (Dialectic)
3. Structure (Rhetoric)

LEVELS 8. EXTERNAL ANALYSES

This includes all comparisons, contrasts between an object and other objects.

EXTERNAL ANALYSES
1. Persons
2. Objects
3. Places
4. Events
5. Instructions
6. Reasons

Objects leads to further choices:

OBJECTS
1. Comparisons
2. Development
3. Concrete-Abstract
4. Practice-Theory
5. Universal-Particular

Comparisons leads in turn to further choices:

COMPARISONS
1. Copies
2. Versions
3. Related Drawings
4. Related Paintings
5. Other Paintings by Author
6. Other Paintings by Theme
7. Other Media
8. Detailed Comparisons

One reason for this arrangement is because one sometimes wishes to consider the same painting from different points of view. One might, for instance, look at a fresco by

Ghirlandaio in terms of the portraits, then in terms of the background and subsequently make comparisons in terms of its themes etc.

LEVELS 9. RESTORATIONS

The first six levels of knowledge are largely objective. While it is true that there are various definitions of a term, no one would question that the Oxford English Dictionary is an authoritative source for general definitions in English.

Levels six to ten, by contrast, entail increasing amounts of subjective interpretation. Restorations are treated separately because they involve the a priori interpretations of the person who restored the book, painting or building in question. The initial heading leads to four choices each of which leads to further subheadings.

RESTORATIONS
1. History
2. Present
3. Learning and Teaching
4. Conservation

HISTORY
1. Dates
2. Restorers
3.Techniques

PRESENT
1. Climate
2. Environment
3. Management

LEARNING
1. Dissemination
2. Education
3. Research

RESEARCH MEDIA
1. Written Descriptions
2. Drawings
3. Photographs
4. X-Rays
5. Ultra-Violet Rays
6. CAD
7. Virtual Reality

As the functionalities of basic choice 2. LEARNING evolve these aspects relating to education might well be subsumed into that framework:

CONSERVATION
1. Materials
2. Methods
3. Processes

CONSERVATION METHODS
1. Authentication
2. Care of Art in Travel
3. Conservation
4. Deterioration
5. Examination
6. Fundamental research
7. Technique

CONSERVATION EXAMINATION
1. Frontal View
2. Side View

Conservation materials and processes will generate longer lists than the standard less than ten choices.

LEVELS 10. RECONSTRUCTIONS

In the case of restorations this level of interpretation is much stronger and hence the choices entail not just the generally accepted critical version, different views and different versions, but also the question of criteria:

RECONSTRUCTIONS
1. Critical version
2. Ground-Plan
3. Elevation
4. Perspective
5. Models
6. CAD, Animations
7. Games
8. Virtual Reality
9. Historical
10. Criteria

Reconstructions can also have choices in terms of a Limit by:

1. Within Objects

2. Between Objects
3. Sites

Criteria, in turn, help identify the veridity of the claims, and are another way of approaching the criteria for Truth Source listed below under Quality:

RECONSTRUCTION CRITERIA
1. Personal
2. Oral Tradition
3. Documents
4. Physical Evidence
5. Combinations

MEDIA

Media again present the user with a list of choices, most of which are so obvious as to require no explanation:

MEDIA
1. Animation
2. Film
3. Pictures
4. Photographs
5. Public Media
6. Sculpture
7. Sound
8. Text
9. Video
10. Virtual Reality

Such a list typically appears when a user has arrived at a particular image, be it a painting or a photograph. If materials in other media are available these are highlighted accordingly. In some cases such as pictures, photographs or public media, further choices appear:

PICTURES
1. Diagrams
2. Drawings
3. Paintings
4. Other

PHOTOGRAPHS
1. Black/White

2. Colour
3. Stereoscopic
4. Auto-stereoscopic

PUBLIC MEDIA
1. Internet
2. Magazines
3. Newspapers
4. Radio
5. Television

The first of these again breaks down into further lists:

INTERNET
1. File Transfer Protocol (FTP)
2. Gopher
3. Listserve
4. Newsgroups
5. Telnet
6. World Wide Web (WWW)

Each of these will give the user further choices in terms of basic operations which are also accessible through Tools Verbal Edit:

INTERNET OPERATIONS
1. Copy
2. Delete
3. Open
4. Paste
5. Print
6. Reload
7. Save
8. Save As
9. Search
10. Stop

In the case of virtual reality there are more choices:

VIRTUAL REALITY
1. Monitor
2. Monitor and Stereoscopic Glasses
3. Head Mounted Display
4. BOOM
5. IMAX
6. Virtuarium

IMAX
1. Regular
2. OmniMax
3. Flying Carpet
4. IMAX Solido

Since most of these are machine specific these are choices which can be automated such that the system automatically determines whether it is operating on a monitor, a display screen or some theatre setting.

In the case of a professional the above choices will not be sufficiently differentiated. The usual principles apply. When the list is longer than ten it moves from the choices box to a longer list in the left hand corner such as the following:

MEDIA
Album
Animation
Assemblage
Collage
Diagram
Drawing
Film
Illumination
Installation
Manuscript
Mosaic
Painting
Photograph
Portfolio
Poster
Print
Sculpture
Sketchbook
Sound
Television
Text
Video
Virtual Reality

Similarly an expert on Painting or Sculpture would have lists such as the following:

PAINTING OBJECTS
Altar
Diptych
Icon
Miniature

Mural
Oil Sketch
Scroll
Triptych
Wall Painting
Watercolour

PAINTING MATERIALS
Acrylic
Encaustic
Gouache
Ink
Tempera

SCULPTURE OBJECTS
Altarpiece
Bust
Diptych
Figurine
High Relief
Low Relief
Maquette
Photosculpture
Plaque
Ronde-Bosse
Statue
Statuette
Triptych

SCULPTURE MATERIALS
Bronze
Cement
Ivory
Jade
Marble
Steel
Wood

13. The important insight here is that SUMS makes no pretense that any list is comprehensive. If a user finds something which they wish to add they are free to do so. If they wish to add many things they may do that also. The one proviso is that the terms they choose be consonant with standard subject lists such that subsequent connections with library and other catalogues are possible. The power of the system lies in the systematic approach, in the forms for presentation, not in the individual contents of what is being presented. It ultimately makes no difference whether the list comes up on a

million dollar UNIX machine or one of the new $500 computers. For these reasons SUMS is truly an open system.

QUALITY

Computers are usually designed by engineers who are suspicious of anything which they cannot quantify. Not surprisingly computer software has many features which deal with quantity. SUMS deals with both Quantity (see below) and Quality, which is taken both in Aristotle's sense as a non-essential attribute and in the sense of something with a certain standard. The idea here is not that the computer determine quality but rather that it provides the user with a series of categories to help them in the process of distinguishing and establishing quality. To this end the user is initially offered a series of five basic choices :

QUALITY
1. Conditions
2. Causes
3. Definitions, Subsumptions
4. Interactions
5. Logic

These distinctions owe much to the distinctions of Perrault but use simplified terms to make the underlying concepts more accessible (fig. 13):

QUESTION	PERRAULT	SUMMA
How	Conditional	Conditions
Why, What	Determinative	Causes
How	Interactive	Interactions
What	Logical	Logic
What	Subsumptive	Definitions, Subsumptions

Fig. 13. Basic questions, Perrault's terms and their equivaents in SUMMA.

QUALITY 1. CONDITIONS

CONDITIONS
1. Conditional
2. Probabilities
3. Possibilities
4. Modifiers
5. Attitude[79]
6. Energy
7. State

The first of these leads to four choices:

CONDITIONAL
1. Aesthetic

2. Basic
3. Logical
4. Pragmatic

Each of these breaks down into further choices some of which are clearly more relevant to certain fields than to others. For instance, artists will be more interested in Aesthetic Conditions:

AESTHETIC CONDITIONAL
1. Beauty
2. Elegance
3. Grace
4. Manners
5. Taste

A second set of choices applies more universally:

BASIC CONDITIONAL
1. Excellence
2. Importance
3. Innocence
4. Kindness
5. Purity
6. Sincerity
7. Truth
8. Value
9. Virtues

EXCELLENCE
1. Best
2. Grades
3. Stars
4. Words

BEST OF
1. Week
2. Month
3. Year
4. Classics
5. Alternative
6. All

STARS HOTEL
1. *
2. **

3. ***
4. ****
5. *****

Stars will adjust themselves to the context. For instance, if hotels are being considered the system will automatically adjust to hotel stars. If films are being considered then the four stars of films will be used:

STARS	FILM
1.*	(Poor)
2. **	(Fair)
3. ***	(Good)
4. ****	(Excellent)

In the case of tourism the three stars of Michelin will apply:

STARS	MICHELIN
1. *	(Interesting)
2. **	(Worth a Detour)
3. ***	(Worth the Trip)

Alternatively one can choose Words which simply offer verbal equivalents to stars:

WORDS
1. Ordinary
2. Moderate
3. Good
4. Excellent
5. Superb

Why go to all the trouble of making a series of choices out of stars? Why not add them automatically? There are two simple reasons. A first is philosophical. SUMS begins from the premise that the information is complex in itself and therefore any value judgements should not be added a priori. The initial display should be kept as simple as possible, with levels of complexity being added as desired. Secondly, there are times when one wants to see the material in a neutral state, without being influenced by the assessments of others.

A similar principle applies to innocence:

INNOCENCE
1. Age Groups
2. Ratings

RATINGS	
Not Rated	NR
General Audience	G

Parental Guidance	PG
Parental Guidance over 13	PG-13
National Classification over 17	NC-17
Restricted over 18	R

While this basic approach also applies to truth, the problem becomes more complex because in this case there is no single criterion for determining truth. A series of choices is therefore offered:

TRUTH
1. Community
2. Geography
3. Kind of Knowledge
4. Level
5. Source

The first of these choices identifies the community who is making the claim to truth. Is it merely an individual person, a group, a profession or an organization?

TRUTH COMMUNITY
1. Person
2. Group
3. Profession
4. Organization

Closely related to this is the geographical span of the claim. Is the group or organization merely local, is it national or international? If one medical doctor makes a claim about cancer it has a certain weight. If the claim is made by the International Cancer Organization or by the World Health Organization, this claim has a very different weight. It is of course possible that the isolated, individual claim is a right one whereas the official position of an international body is the wrong one, yet if the claim reaches this level it, nonetheless, tells us something about the seriousness with which it is taken.

TRUTH GEOGRAPHY
1. Local
2. Regional
3. Provincial
4. National
5. International

KIND OF KNOWLEDGE
1. Knowledge Verified
2. Memory Refreshed

3. More Confidence
4. New Aspects

NEW ASPECTS
1. Dimension
2. Information
3. Knowledge
4. Wisdom

Further indications concerning truth are given through reference to truth level and truth source.

TRUTH SOURCE
1. Personal
2. Oral Tradition
3. Documents
4. Physical Evidence
5. Combinations

TRUTH SOURCE PERSONAL
1. Anecdotal
2. Belief
3. Claim

TRUTH SOURCE DOCUMENTS
4. Guideline
5. Good Practice
6. Hypothesis
7. Standard
8. Fact
9. Law

In addition to aesthetic and basic conditional there is:

LOGICAL CONDITIONAL
1. A conditions B
2. A conditions B, B conditions A
3. B is conditioned by A

Following the distinctions of Perrault we distinguish between this conditional aspect of logic and basic logical operations which are classed under Quality 5. Logic along with the logical functions of language generally, namely, Dialectic.

If the Scope is Business then Pragmatic Conditional will dominate and these choices will come up automatically:

PRAGMATIC CONDITIONAL

1. Cost
2. Need
3. Performance
4. Use

The second and third conditions, Probabilities and Possibilities, may have further subsets which are then qualified by the fourth condition:

MODIFIERS
1. Extremely
2. Very
3. Mostly
4. Quite
5. Approximately
6. Somewhat
7. Slightly
8. Hardly

The fifth condition is attitude which leads to further distinctions introduced by Perrault:

ATTITUDE
1. Favourable
2. Indifferent
3. Unfavourable

ATTITUDE FAVOURABLE
1. Availability
2. Contents
3. Expertise
4. Helpfulness
5. Location
6. Speed

A sixth condition is energy:

ENERGY
1. Potent, Capable
2. Latent, Virtual
3. Impotent, Incapable

A seventh condition is state. As in the case of attitude and energy, these distinctions reflect the work of Perrault:

STATE
1. Necessary
2. Arbitrary

3. Contingent

QUALITY 2. CAUSES

CAUSES, EFFECTS
1. Action (Active)
2. Affection
3. Limitative
4. Destructive
5. Effects (Passive)

These initial choices again break down into a series of choices most of which are self-explanatory:

ACTION (ACTIVE)
1. Actions
2. Motions
3. Active

The first of these breaks down into a list of ten typical actions which can be modified and/or expanded into a much larger list if required:

ACTIONS
1. Dancing
2. Drinking
3. Eating
4. Fighting
5. Loving
6. Playing
7. Praying
8. Reading
9. Singing
10. Sleeping

MOTIONS
1. Carrying
2. Kneeling
3. Leaning
4. Lifting
5. Lying Down
6. Pulling
7. Running
8. Sitting
9. Standing

10. Throwing

ACTIVE
1. Productive
2. Causing
3. Originating, Source
4. Influencing, Environmental Pressure, Catalytic

AFFECTION
EMOTIONS
1. Anger
2. Ecstasy
3. Fear
4. Joy
5. Sorrow
6. Suffering

LIMITATIVE
1. Restrictive
2. Orienting, Establishing Goals or Applications
3. Frame of Reference, Point of View

DESTRUCTIVE
1. Injuring
2. Suppressing, eliminating
3. Curing

EFFECTS
1. Images (Advertising, Propaganda)
2. Words (Rhetoric)
3. Passive

This in turn breaks down to various forms of Advertising, Rhetoric and Passive, the latter as defined by Perrault:

PASSIVE
1. Produced
2. Limited
3. Destroyed

PRODUCED
1. Effected,Product
2. Derived, By-Product
3. Influenced, Catalyzed

LIMITED
1. Restricted
2. Applied, Oriented
3. Frame of Reference, Point of View

DESTROYED
1. Injured
2. Suppressed, Eliminated
3. Cured

QUALITY 3. DEFINITIONS, STRUCTURES, SUBSUMPTIONS

A third kind of quantity deals with definitions and structures, the area that Aristotle associated with quiddity. Just as the second kind of quality is linked with rhetoric, this third kind of quality is linked with grammar, and the fifth kind of quality (logic) is linked with dialectic, the third section of the trivium.

DEFINITIONS, STRUCTURES
1. Language (Grammar)
2. Verbal Categories
3. Visual Images

LANGUAGE
1. Parts of Speech
2. Parts of Sentence

PARTS OF SPEECH
1. Adjective
2. Adverb
3. Noun
4. Pronoun
5. Verb

ADJECTIVES
1. Beautiful
2. Cold
3. Hot
4. Sour
5. Sweet
6. Ugly

ADVERBS
1. Friendly
2. Likely
3. Feasible
4. Possible
5. Probable

PARTS OF SENTENCE
1. Object
2. Predicate
3. Subject

That which we term verbal categories take us to the heart of Aristotle's attempts at definition in terms of quiddity:

VERBAL CATEGORIES [80]
1. Type/Kind
2. Whole/Part
3. Subject/Property

TYPE/KIND
1. Principle
2. Manifestation
3. Genus
4. Species
5. Individuum

WHOLE/PART
1. Organism
2. Organ
3. Composite
4. Constituent
5. Matrix
6. Particles

SUBJECT/PROPERTY
1. Subject
2. Property
3. Substance
4. Accident
5. Possessor
6. Possession
7. Accompanance

Of these Accompanance breaks down into:

ACCOMPANANCE
1. Presence, With
2. Passive Presence
3. Absence, Without

QUALITY 4. INTERACTIONS

In Perrault's scheme the determinative (which we term Quality 2. Causes, Effects) includes active, interactive and passive. Since the terms associated with interactive are less clearly causes and/or effects (closer to the state of a Greek middle verb), we have chosen to make this a separate branch of quality:

INTERACTIONS
1. Concordant
2. Differing
3. Contrary

CONCORDANT
1. Association, Community
2. Imitation, Simulation
3. Cooperation

DIFFERING
1. Borrowing, Parasitism
2. Barrier, Exclusion
3. Distinction, Withdrawal

CONTRARY
1. Attack, Aggression
2. Competition, Antipathy
3. Resistance, Defence

QUALITY 5. LOGIC

Historically logic is one of the most complex terms. Following Perrault we have distinguished between the conditional aspects of logic (Quality 1) and logical operations which are included here as is the logical component of language, dialectic (Quality 5). As noted elsewhere[81] in mediaeval times logic often included determinative and subsumptive aspects.

LOGICAL
1. Operations
2. Words (Dialectic)

LOGICAL OPERATIONS
1. Reciprocal
2. Converse
3. Negative

At a first glance, many of the aspects or attributes of quality may seem superficial. This is especially true of qualities such as adjectives, adverbs and modifiers. These decision

trees have four, separate but equally important uses. First, they serve in describing any image or text that is on the screen. The system will store the adjectives and adverbs connected with an object. Hence if one asks for adjectives, SUMMA will go directly to the appropriate word in a list and thus suggest its context. It thus helps in the classing of new information.

Secondly, these qualities help to define the parameters of complex searches. For example, if one is searching for an image of an amazon one could add the term "beautiful", plus the modifier "extremely" in making one's search more precise. These lists thus serve to narrow down the object for which or the person for whom one is searching. These lists are again customizable. Some users will require only a few terms to define their parameters. Others will want near comprehensive lists. The combinations of Quality 1. Conditions 2-4 (i.e. Probabilities, Possibilities and Modifiers) with Quality 3. Definitions 2. 1-2 (i.e. Adjectives and Adverbs) provide the ingredients for a general method for approaching fuzzy statements in a search environment.

Thirdly, these qualities help in the organization of knowledge once it has been found, which is closely connected to the classing process outlined as the first reason. Fourthly the qualities serve as a tool for learning, each new level of depth serving to prompt the user with increasing precision concerning the particulars of the object being studied. Upon reflection it becomes clear that this orienting and guiding function applies not only to Quality but to all the meters.

QUANTITY

Just as Quality provides a framework for all qualitative statements, Quantity provides a framework for all quantitative ones. These further parameters for defining a search are for the most part self-explanatory:

QUANTITY
1. Comparative
2. Monetary
3. Musical
4. Numerical
5. Tolerance

QUANTITY 1. COMPARATIVE

COMPARATIVE
1. Identical
2. Similar
3. Dissimilar
4. Degree
5. Qualitative
6. Percent
7. Proportion

The first three of these are self explanatory. The fourth, Degree, subdivides into:

DEGREE
1. Superior, More
2. Equivalent, Equal
3. Inferior, Less

The fifth, functions in ways analogous to the Modifiers in Quality 1, and leads to the following choices:

QUALITATIVE QUANTITY
1. All
2. Most
3. Many
4. Some
5. Several
6. Few
7. Less
8. None

The sixth and seventh aspects of comparative quantity, percent and proportion, require no explanation.

QUANTITY 2. MONETARY

QUANTITY MONETARY
1. Currency
2. Cost
3. Price
4. Qualitative

MONETARY QUALITATIVE
1. Exorbitant
2. Expensive
3. Moderate
4. Reasonable
5. Inexpensive
6. Cheap

QUANTITY 3. MUSICAL

This requires elaboration.

QUANTITY 4. NUMERICAL

NUMBERS
1. Cardinal
2. Imaginary
3. Ordinal
4. Real

REAL NUMBERS
1.
2.
3.
4.
5.
6.etc.

QUANTITY 5. TOLERANCE

Tolerance here is in the technical sense of the acceptable limits of error within which a given instrument or device can be produced:

TOLERANCE
1. Centimeters
2. Millimeters

QUESTIONS

There are questions across the initial screen. These determine the primary focus of a search whether it is biographical (who?), focusses on a subject (what?), a place (where?) etc. The questions in the choices list provide greater detail and for this reason adjust to the topic. For example, a user may have chosen Who on the initial screen to ask for Leonardo da Vinci. They can then be presented with Questions as choices:

QUESTIONS
1. Who
2. What
3. Where
4. When
5. How
6. Why

Who in this case will give them a list such as the following:

WHO PERSONS
1. Family
2. Family Tree
3. Friends
4. Colleagues

5. Contacts

This list could also include other items such as Business Colleagues, Club Members, and Fellow Artists.

If they choose Family this will again break down into further choices. In such cases, where there are logical sequences as well as alphabetical ones, there will eventually be a choice between the two modes which may become part of a user's preferences. In short, some may prefer alphabetical listings over logical ones, or conversely:

Hierarchical Option FAMILY
1. Grandmothers
2. Grandfathers
3. Mother
4. Father
5. Sisters
6. Brothers
7. Aunts /Uncles
8. Nieces/Nephews
9. Cousins

Logical Option FAMILY
1. Aunts /Uncles
2. Brothers
3. Cousins
4. Father
5. Grandfathers
6. Grandmothers
7. Mother
8. Sisters
9. Nieces/Nephews

In detailed research these categories can be broken down further. Hence father might lead to the following choices:

FATHER
1. Biological
2. Adopted
3. Stepfather
4. Godfather

If the scope of the search is business then the list of who will be different[82] and include:

WHO BUSINESS
1. Employees
2. Executives

3. Departments
4. Regional Branches
5. Inner Corporate Structure
6. Inter Corporate Structure
7. Related Partners
8. Staff

This same principle applies to other questions. For example, When? refers to Events which can then break down into a series of further choices. In the case of an individual this list might be as follows:

WHEN EVENTS PERSONAL
1. Birth
2. Baptism
3. High School Graduation
4. Marriage
5. Retirement
6. Death

WHEN EVENTS NATIONAL
1. Accord
2. Battle
3. Declaration
4. Peace
5. Treaty
6. War

Similarly HOW? might initially break down into:

HOW? INSTRUCTIONS
1. Activities
2. Processes
3. Steps

HOW ACTIVITIES
1. Assemble
2. Cook
3. Construct
4. Do
5. Make
6. Repair

This might in turn lead to a limit by list:

Limit by:
1. Hobby

2. Trade
3. Profession

SPACE

This category deals with every major aspect of space. In our treatment quantity is treated as arithmetic (discrete quantity in Aristotle's terms), whereas space is treated as geometry (continuous quantity in Aristotle's terms), while both entail quantity, only the latter is visual and physically measurable.

As in the case of quality and quantity, the concepts of space and time have four functions in SUMMA: 1) They serve to class, define and describe the parameters of objects one has on one's screen; 2) They help to narrow down the spatio-temporal co-ordinates of the objects for which one wishes to search; 3) They help to organize materials one has found and 4) They help in learning about space and time. Once these parameters are clear the lists of choices require practicaly no explanation:

SPACE
1. Size
2. Area (2D)
3. Volume (3D)
4. Position
5. Direction
6. Co-Ordinates
7. Orientation
8. Projection Methods
9. Scales
10. Kinds of Maps

SPACE 1. SIZE

SIZE
1. Length
2. Height
3. Width
4. Depth
5. Comparative

Measurements come in various forms. With the help of object-oriented approaches to knowledge, the machine will be able to know whether a metric or some other system is required and adjust the results displayed accordingly.

COMPARATIVE SIZE
1. Larger
2. Equal
3. Smaller

SPACE 2. AREA

AREA
1. Square
2. Rectangle
3. Circle
4. Cylinder
5. Regular Solid
6. Irregular Solid
7. Other

POLYGON
1. Triangle
2. Square
3. Pentagonal
4. Hexagonal
5. Heptagonal
6. Octagonal

In the examples above only two-dimensional area is covered. More advanced applications will include areas of three-dimensional objects and beyond.

SPACE 3. VOLUME

VOLUME
1. Cube
2. Rectangular Prism
3. Sphere
4. Cylinder
5. Regular Solid
6. Irregular Solid
7. Other

REGULAR SOLID
1. Tetragon (Pyramid)
2. Hexagon (Cube)
3. Octagon
4. Dodecahedron
5. Icosahedron

SPACE 4. POSITION

POSITION
1. At
2. Away
3. Between
4. Far
5. Inside, Imminent
6. Near
7. Outside, Transcendent
8. Parallel
9. Toward

SPACE 5. DIRECTION

DIRECTION
1. Front
2. Back
3. Left
4. Right
5. Above
6. Below
7. Orientation

SPACE 6. CO-ORDINATES

CO-ORDINATES
1. Lateral
2. Axial
3. Vertical
4. Plan (X Axis)
5. Elevation (Y Axis)
6. Depth (Z Axis)

LATERAL
1. Right (Y/Z)
2. Middle
3. Left

AXIAL
1. Front (X/Z)
2. Centre
3. Back

VERTICAL
1. Above (X/Y)

2. Level
3. Below

SPACE 7. ORIENTATION

ORIENTATION
1. North
2. South
3. East
4. West
5. Longitude
6. Latitude

If one chooses longitude one is asked to type in degrees and given other choices:

LATITUDE MAPS
1. Grid Resolution
2. Elevation Exaggeration
3. Output Units
4. Size of Map
5. Texture Mapped

If these seem rather obscure choices, the reader is referred to http://evlweb.eecs.uic.edu/pape/vrml/etopo/ where this functionality is already in place.

SPACE 8. PROJECTION METHODS

MAP PROJECTIONS
1. Clark
2. Gemma Frisius
3. Gnomonic
4. James
5. LaHire
6. Lambert
7. Mercator
8. Ptolemy
9. Other

SPACE 9. SCALES

SCALES
1. Qualitative
2. Quantitative

The purpose of the qualitative list is to provide handy contextualization in the reverse path. Hence if a person has chosen an object and wishes a quick reminder where that

object fits in a room, building, city etc, then they can do so in a single jump. Given the advances in GIS and GPS it is reasonable to foresee that most if not all of such links can be automated in the near future.

SCALES QUALITATIVE
1. World
2. Continent
3. Country
4. Province
5. City
6. Building
7. Ground-Plan
8. Room
9. Wall
10. Object

Quantitative scales will allow one to do this contextualization using precise, numerical scales, including all the possibilities between the ten points highlighted in the list above:

SCALES QUANTITATIVE
1. Micro
2. Macro

SCALES QUANTITATIVE MICRO
1:1
10:1
100:1
1,000:1
10,000:1
100,000:1
1,000,000:1
Set Increment

SCALES QUANTITATIVE MACRO
1:10
1:1,000
1:5,000
1:50,000
1:100,000
1:500,000
1:1,000,000
Set Increment

As explained earlier the amount of detail in any list will vary with the educational level and needs of individual users. The following list is intended for a general user:

KINDS OF MAPS

1. Climate
2. Cultivation
3. Energy
4. Food
5. Geology
6. Medicine
7. Politics
8. Population
9. Religion
10. Terrain

Experts will wish to make more distinctions to include:

KINDS OF MAPS

1. Economic
2. Environmental
3. Historical
4. Physical
5. Political
6. Social/Cultural

ECONOMIC MAPS

Agriculture
Communications
Economic Geography
Employment
Energy
Forestry
Fisheries
Income
Manufacturing
Medicine
Mining
Transport
Urban Canada

ENVIRONMENTAL

1. Ecology
2. Environment
3. Phytogeography

HISTORICAL

1. Defence
2. Exploration

PHYSICAL
1. Climatology
2. Geology
3. Geomorphology
4. Geophysics
5. Hydrology

POLITICAL
1. Administrative and Geo-Statistical
2. International Affairs
3. Political Geography

SOCIAL CULTURAL
1. Culture
2. Ethnography
3. Migrations
4. Population
5. Religion
6. Vital Statistics

A complete beginner will probably be happy with Maps as a heading with no distinctions at all. As the system evolves, SUMMA will provide users with lists in keeping with their level of education and expertise. If the user finds this list either too simple or too complex for their wishes they will have an option to peruse other lists more suitable for their needs.

The various lists can be thought of as nets both for defining the objects at hand and as strategies for that which is being sought. The detail of the list is like the fineness of the net. If I am only interested in general lines of approach, big ideas, then I can be content with a few very general descriptors. For instance, if I want to reduce geography to five words I can do so with: Africa, Asia, Europe, North America and South America, but then I will only have continents and have no precise names of major cities, let alone that there are seven occurrences of Toronto in the United States alone. We all know that there is a world of difference between searching for continents in general or towns in particular. Knowing what steps to take is often profoundly difficult. SUMMA creates an intuitive framework for those decisions.

TIME

As with Space, SUMMA creates a framework for dealing with the classing, description, searching and learning of temporal events and features.

TIME
1. Calendars
2. Clocks
3. Duration
4. Frequency
5. Geological Periods
6. Historical Periods
7. Sequences
8. Tense
9. Time Scales

TIME 1.CALENDARS

As in numerous cases cited earlier this list will vary depending on the users' needs and interests:

CALENDARS
1. Arabic
2. Chinese
3. Gregorian
4. Hebraic
5. Hind u
6. Japanese

One of the subtle possibilities introduced through this comparative approach to time is to link this with different interpretations of the same events and places. For example, Jerusalem is a holy place in the Jewish, Christian and Arabic cultures. Yet the relative role it plays varies enormously. The challenge is not simply to present one cultural view, but rather to use the different chronologies and histories as ways of telling the story both from the side of the loser and the winner, reminding us that the fall of Constantinople was simultaneously the rise of the Ottoman Empire.

TIME 2. CLOCKS

CLOCKS
1. Analog
2. Digital

TIME 3. DURATION

DURATION
1. Longer, More Durable
2. Equally Durable
3. Shorter, Less Durable

TIME 4. FREQUENCY

FREQUENCY
1. Qualitative
2. Temporal

As in the case of Modifiers in Quality, Qualitative Frequency serves to focus in on temporal dimensions in “fuzzy terms” in cases when there was no stopwatch and temporal concerns were not very clear.

FREQUENCY QUALITATIVE
1. Always
2. Almost Always
3. Often
4. Occasionally
5. Seldom
6. Never

FREQUENCY TEMPORAL
1. Every Second
2. Every Minute
3. Hourly
4. Daily
5. Weekly
6. Monthly
7. Yearly
8. Never

TIME 5. GEOLOGICAL PERIODS

The complexity of one’s list of geological periods will again vary enormously with one’s education and interests. The list below is but one of a number of possible lists:

GEOLOGICAL PERIODS

Quaternary	
Recent	
Pleistocene	1 million years
Tertiary	
Pliocene	13
Miocene	26
Oligocene	38
Eocene	58
Paleocene	63
Cretaceous	135
Jurassic	181
Triassic	230
Permian	280

Pennsylvanian	310
Mississippian	345
Devonian	345
Silurian	405
Ordovician	500
Precambrian	600

TIME 6. HISTORICAL PERIODS

As noted earlier under Learning, lists of Periods will vary enormously from very simple through increasingly complex:

PERIODS
1. Ancient
2. Modern

PERIODS
1. Prehistoric
2. Egyptian
3. Greek
4. Roman
5. Byzantine
6. Mediaeval
7. Renaissance
8. Baroque
9. Romantic
10. Modern

TIME 7. SEQUENCES

SEQUENCES
1. Prior, Before
2. Simultaneous, During
3. Posterior, After

TIME 8. TENSE

TENSE
1. Past
2. Present
3. Future

In those languages where it is appropriate, there will be additional tenses such as the Past Definite, Pluperfect, Subjunctive etc.

TIME 9. TIME SCALES

TIME SCALES
1. Seconds
2. Minutes
3. Hours
4. Days
5. Months
6. Years
7. Macro
8. Micro

MACRO SCALES
1. Decades
2. Centuries
3. Millennia
4. Millions
5. Billions
6. Set Increment

MICRO SCALES
1. Seconds
2. Milliseconds
3. Nanoseconds
4. Picoseconds
5. Set Increment

TOOLS

Tools will eventually become all software available to perform electronic operations. Users will begin with a simple list of kinds:

TOOLS
1. Games
2. Mathematical
3. Media
4. Verbal
5. Visual

Each of these will be subdivided:

TOOLS 1. GAMES

Games have already been mentioned in the context of Reconstructions under Levels. There they were used specifically to illustrate aspects of given reconstructions, hence they were games as applications. Here they are games as such which can be used for any playful purpose:

GAMES
1. Card
2. Chess
3. Combat
4. Crossword
5. Racing
6. War

As object oriented approaches advance, it will be possible for the machine to recognize its own characteristics and use this as a filter in offering choices to the user. If a person has a Macintosh machine they will usually have little interest in a game that requires a PC or a special SEGA device.

TOOLS 2. MATHEMATICAL

This principle applies equally to software for mathematics or words. The system will determine which software is appropriate for the hardware at hand. It will then prompt the user concerning licensing possibilities: whether this is wanted on a short term basis for a very specific project, or is to be licensed as part of an individual's standard toolkit for their profession: e.g. a CAD package for an architect, and then on what basis, renewable monthly, yearly, or perhaps even as a lifelong license.

In the past, there were individual machines for isolated tasks: calculators for calculation, conversion charts for conversion, rulers for measuring. All of these isolated functions will become integrated. Individual vendors may be responsible for this piece or that piece but in terms of the user all this will be seamless.

TOOLS MATHEMATICAL
1. Calculation
2. Conversion
3. Currency
4. Form Libraries
5. Geometrical
6. Measurement
7. Spreadsheets
8. Structures

TOOLS FORM LIBRARIES
1. Disciplines
2. Geometry
3. Ornament

4. Pattern
5. Symmetry

TOOLS GEOMETRICAL
1. Operations

TOOLS GEOMETRICAL
OPERATIONS
1. Augment
2. Dissect
3. Distort
4. Fistulate
5. Fold
6. Reciprocate
7. Rotate
8. Symmetrically Integrate
9. Translate
10. Truncate

TOOLS STRUCTURES
1. Data in Images
2. Resonance
3. Symmetry
4. Tensegrity

TOOLS 3. VERBAL

TOOLS VERBAL
1. Class
2 Create
3. Edit
4. Input
5. Organize
6. Output
7. Search
8. Translate

TOOLS VERBAL
CLASS
1. Add
2. Edit

TOOLS VERBAL
EDIT
1. Copy
2. Delete

3. Open
4. Paste
5. Print
6. Reload
7. Save
8. Save As
9. Search
10. Stop

It is foreseen that basic versions of most images on the Internet will be free of charge especially if this be for educational purposes. Users wishing to have their own copies will pay for the privilege just as we now do when we buy postcards or posters. If a relatively low level print is required this will be available on one's local printer. More dramatic needs will be available in service centres which will be like today's museum shops with the difference that they will have high quality printers and ATM access to a global network of museums, galleries and libraries such that visitors can literally have posters on demand. Given advances in stereolithography, even sculpture on demand will soon be fully feasible. The interested user will determine:

PRINT FORMAT
1. Postcard
2. 5.5 x 8.5
3. 8.5 x 11
4. 8.5 x 14
5. 11 x 17
6. Poster

Having decided on a format, the system will request payment via one of the standard credit cards. In the near future, especially in personal machines at home it is likely that the machine will "know" in advance precisely which card one uses and thus perform the debit operation automatically:

TOOLS OUTPUT
PAYMENT
1. American Express
2. Eurocheque
3. Mastercard
4. Visa

In the interim a user will be asked to type in their PERSONAL ID Number.

TOOLS 4. VISUAL

TOOLS VISUAL SEARCH
1. Alta Vista

2. Excite
3. Infoseek
4. Lycos
5. Magellan
6. Open Text
7. SUMS
8. Yahoo
9. Other

Such lists will again adjust themselves to the user's needs and interests.

Appendix 2. EXAMPLES

CLASSING

There are famous sayings about databases such as garbage in garbage out and one gets what one puts in. SUMMA uses these principles as a point of departure for basic strategies a) to class one's own knowledge in order to create personal search engines and b) to class materials in order to make it searchable. These boil down to some simple rules. If one searches indiscriminately one finds things indiscriminately. The best way to find things precisely is to decide precisely what one is wanting to find.

Classing knowledge to create personal search engines

This can be done at a number of different levels which include the following lists (fig. 14), each of which will be considered briefly in turn:

1) personal classification
2) personal lists based on one's database fields
3) standard subjects
4) a standard classification system
5) multiple classification systems

Fig. 14. Five kinds of access strategies to knowledge

Personal Classification

We all class material although we do not always do so consciously. The lists we make reveal as much about our preparation as they do about the precision with which we are seeking knowledge about a given topic. Student *A* is asked to make a list of all the categories under who. This individual begins with persons, thens decide that they wish to have professions as examples of which they identify explorers, firemen, pilots. Student *B*'s list includes artists, chemists, doctors, engineers, mathematicians, physicists and scientists. Student *C*'s list might be identical to *B*'s list initially, but then add a series of distinctions under physicists, namely atomic physicists, particle physicists and muon experts. What this boils down to is asking persons to write a list of the terms which are important to them. This gives a personal dictionary of the terms in which they are interested.

Student A WHO
Professions
Explorers
Firemen
Pilots

Student B WHO
Professions
Artists

Doctors
Engineers
Mathematicians
Scientists
Chemists
Physicists

Student C

WHO
Professions
Artists
Doctors
Engineers
Mathematicians
Scientists
Chemists
Physicists
Atomic Phyicists
Particle Physicists
Muon Experts

Fig. 15 Hierarchical lists of students *A*, *B* and *C*.

If these lists are viewed hierarchically (fig. 15) they provide us with useful clues about the students. Given the absence of female professions it is likely that the lists were composed by males. The simplicity of the first list suggests a boy aged 6-12. The second list suggests a high school student, whereas the third list suggests a university student studying science. Ultimately the details are less important than the general principle whereby the number of levels of distinctions reveal the complexity of their author's mind. The more levels, the greater the precision with which one can search. A complete beginner sees no need for any distinctions, has no levels and is content simply to have a list of all persons under who. The expert has many levels. Thus each personal classification system effectively provides a cognitive map of what they consider important.

In the example above the question who was used. The same principle applies to all of the basic questions, namely, what, where, when, how, and why. For instance, a beginner will have an undifferentiated list of subjects/objects. A specialist will have many levels of distinctions. If these lists are to be compatible with other sources then it is important that they use terms accepted by the standard subject lists.

Classing (or tagging) information to make it searchable

One of the obvious applications of such a personal vocabulary of terms which concern one entails the ordering of materials found when surfing the Internet. One comes across an item. One determines whether it is a who, what, where, when, how, or why question, checks the categories one has listed under the important question and classes or tags the

new-found material with the appropriate category. If the material requires a new category then one adds this in the appropriate place.

WHO
Artist/Maker
Culture
  Tribe
Ethnic Tradition
Manufacturer

WHAT
Institution
        Department
Object
        Object Name
        Object Type
Material
Medium
Number
        Accession Number
        Borden Number
        Catalogue Number
Quantity
School/Style
Support
Subject/Image
SPACE
        Height
        Width
        Length
        Outside Diameter
        Depth
        Unit_Linear
        Unit
        Title

WHERE
Manufacturer Country
        Manufacturer Province
Origin Country
        Origin Province/Territory
Use Country
        Use Province/Territory

WHEN
Begin Date 1
End Date 2

HOW
Technique

Fig. 16. List of core fields in the CHIN Human History Database arranged hierachically in terms of basic questions. Italicized terms indicate that a broader topic has been added

to cover two narrower topics. A capitalized italicized term indicates one of the basic choices in SUMS.

WHO

Collector

Collector

WHAT

Chemical Classification
Institution
Department
Discipline
Number
Acquisition Number
Accession Number
Catalogue Number
Phylum/Division
Class
Order
Family
Genus
Species
Subpecies
Variety
Specimen Nature
Quantity Specimen
Sex
Spec lithography
Lithostratigraphic

WHERE

Origin-Continent
Origin-Country
Origin-Province/Terr.
Origin-Geo Prov
Origin -Ocean /Basin
Locality number
Lot
Mine
Spec Group/Region

WHEN

Age/Stage
Geological
Period

Fig. 17. List of core fields in the CHIN Natural Sciences Database arranged hierachically in terms of basic questions.

WHO
Author
Authority
Honorific
Name
    Full_Name
    Other_Name
Ownership
Person
    Person_Name
Recorder

WHAT
Activity
Administration
    Admin_Category
    Admin Status
Audit
Brief Summary
Caption
Catalogue_ Number
Category
    Full_Category
    Simple_Category
Class
    Classified_Category
    Classified_ Name
Concept
Conditions
Conservation
Content
    Content_Analysis
    Content_Outline
Context
Copyright
Corporate Body
Deposit
Description
    Desc
    Descript
    Brief_Description
Disposal
Documentation
    Documentation_Group
Event_Name
Exhibition
Collection
    Field Collection
    Named Collection
Identification
Inscription
Institution
Item_Checklist

Journal
Link
Name
    Service_Name
    Simple_Name
Nature
Note
    Notes
Number
    Assigned Number
    Collection_Number
    Previous_Number
Number_of_Items
Object
Part
    Part_Code
    Part:Aspect:Desc
    Part: Summary
Phone
Photography
Preproduction
Production
Publisher
QUALITY
Aspect
Type
QUANTITY
Monetary
    Credit_Line
    Currency
    Grant_Aid
    Price
    Valuation
    Value
Recording
Record
    Record Number
    Record type
Reference
Reference Number
Related Record
Removal
Research
Result
Service
SPACE
Size
    Dimen
    Part:Dimen:Reading
Volume
Stratigraphy
Summary
System
Technical_Data
Title

Titled
Transcript
Translit

WHEN
Acquisition
Context
Context_Date
Context_Period
Date
Date_In
Date_Out
Dates
Event
Loan_Out
Period
Transfer
Previous_Transfer
Subsequent_Transfer
Return_Date
Return_Required

WHERE
Address
Coordinates
Habitat
Location
Locality_Number
Locality_Type
Permanent_Location
Temporary_Location
Place
Place_Name
Position
Relative_Position
Site_Name
Vice_County

HOW
Association
Method
Process
Recording Process
Role
Status

WHY
Purpose

Fig. 18. List of core fields in the MDA arranged hierachically in terms of basic questions.

There is much talk about student based learned and knowledge construction in the classroom. SUMMA provides a practical context for so doing. If the techniques of version control are added to the process, then we effectively have a new method for tracking the evolution of a person's cognitive map from childhood onwards. In a world where life long learning is becoming more than a buzzword, this method will provide a useful tool in identifying those whose categories keep growing and those who have mentally retired at an early age. Learners have expanding vocabularies. Non-learners do not and never need a dictionary.

Databases as Mental Maps

We invariably apply this vocabulary every time we make a database. A database is effectively a list of the terms which we consider important.

This applies equally in the case of institutional databases. If we wish for clues as to what we might search for in these databases we begin by examining the fields used therein. These are arranged in terms of the six basic questions and then organized hierarchically. To use concrete examples we might begin with core fields in the CHIN (Canadian Heritage Information Network) human history database (fig 16), the CHIN natural science database (fig 17), and the MDA (Museum Documentation Association) core fields, list them in terms of who, what, where, when, how and why and arrange these hierarchically (fig 18).

These hierarchical lists effectively provide sets of universal terms which can then be queried in terms of individuals. Hence our tools for classing the world and gathering information about it, become tools in helping us to develop search strategies.

SEARCHING

The following examples using news, education, business, and tourism will give some ideas of the principles for searching using SUMMA.

1. NEWS

BASIC NAVIGATION

In the case of Access the essential idea is simple. In traditional libraries, users rely on an author catalogue (who?) and a subject catalogue (what?). In SUMMA the user has six questions: who, what, where, when, how, why? These are presented in reverse order to help the user limit their search in a systematic fashion.: i.e. one begins with the scope of the search (why?), determines the means, or media involved (how?), defines the time frame appropriate (when?), specifies whether the search is local, regional, national or international (where?) and then asks the subject (what?) and if necessary which specific persons (who?). As the user makes their choices the results are listed under the corresponding question as an *aide-memoire*.

To take a concrete example, when a user first enters SUMMA they define basic parameters relating to Access, namely the Language(s) they will use, choose one of ten Levels of Education and then define their Personal Profiles which include:

PERSONAL PROFILES
1. Age
2. Gender
3. Preferences
4. Music
5. Places
6. Times
7. Scope

Of these, entry of Age and Gender are optional. Having defined Preferences, Music, Places and Times the first time user is asked to define the Scope of their search. In the case of regular users this list comes up at the beginning of a session:

SCOPE WHY
1. Everyday, Emergency
2. Business
3. Culture
4. Education, Learning
5. Environment
6. Government
7. Health
8. Legal

9. Leisure
10. Religion

Let us say that the user chooses Everyday as their purpose or goal[83]. This leads to a further list of choices:

SCOPE WHY
EVERYDAY
1. Emergency
2. Classified, Shopping
3. News
4. Sports
5. Telephone
6. Traffic
7. Weather

If the user chooses the second of these options they are given the following list:

CLASSIFIEDS, SHOPPING
1. Announcements
2. Careers
3. Cars
4. Connections
5. Food, Drink
6. Gifts
7. Merchandise
8. Real Estate
9. Rentals
10. Travel

The seventh of these options leads to a list such as the following which will be customizable in keeping with individual tastes:

MERCHANDISE
1. Bargains
2. Books
3. Computing
4. Fashion
5. Pets

If the user chooses the third option in the Everyday list, the system prompts them to decide on:

NEWS HOW
1. Internet
2. Newspapers

3. Radio
4. Television

If the user chooses Newspapers the system prompts them to decide on:

NEWSPAPERS WHEN
1. Daily
2. Bi-Weekly
3. Weekly

If the user chooses Daily, they are prompted to decide on:

NEWSPAPERS WHERE
1. Local
2. Regional
3. National
4. International

If they choose Local, they are given the appropriate choices:

NEWSPAPERS
LOCAL DAILY
1. Globe
2. Star
3. Sun

If they had chosen Weekly the list becomes:

NEWSPAPERS
LOCAL WEEKLY
1. Eye
2. Gutter
3. Now
4. Shift

If the user chooses Star they are asked to make further choices:

NEWSPAPERS WHAT
1. News Types
2. Subjects

NEWS TYPES
1. Headlines
2. Articles
3. Cover Story
4. Editorials

5. Focus
6. Letters
7. Reports
8. Special

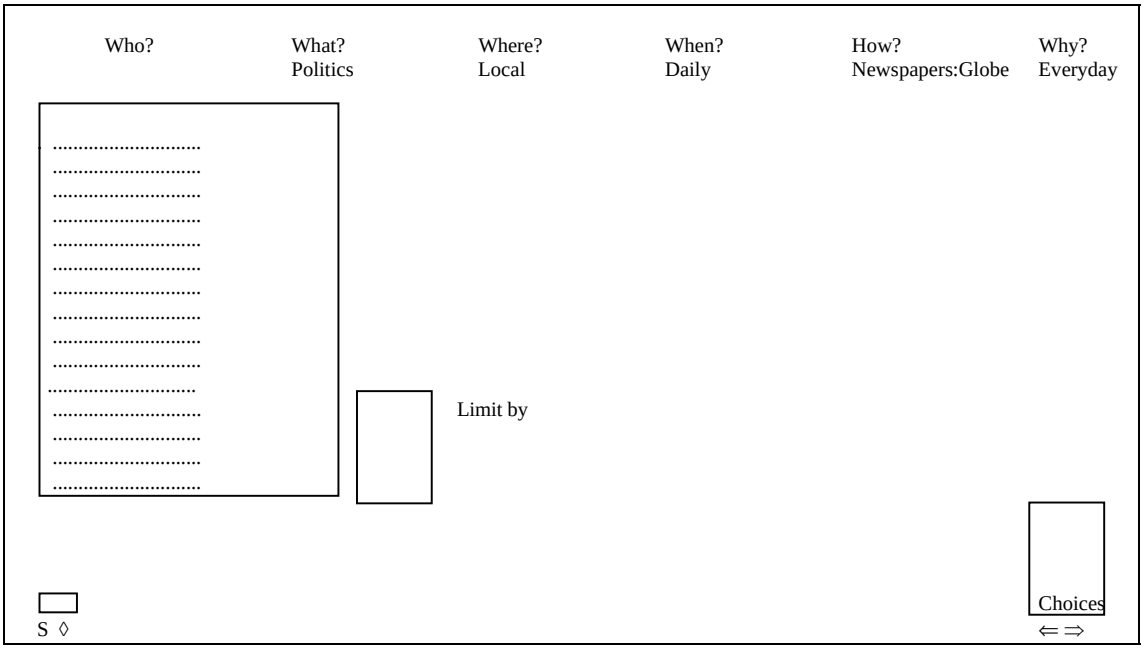


Fig. 19. Opening Screen in light of answering initial questions concerning why, how, when,where, and what?

NEWSPAPERS SUBJECTS
1. Arts and Entertainment
2. Business
3. Community
4. Courts/Crime
5. Fashion/Gossip
6. Politics
7. Science/Technology
8. Religion
9. War
10. More Subjects

If the user chooses 2. Business, they are again asked to choose:

NEWS BUSINESS
1. Headlines
2. News
3. Reports (Dawes)

If the user chooses 6. Politics then the screen appears as above (fig. 19). All this information now becomes part of the Source which can be recalled at any time under Levels, Internal Analysis, Books. The entries under questions on the screen itself are cleared except for What Politics.

The list of choices now continues in order to hone in on the subject:

POLITICS WHERE
1. Local
2. Regional
3. National
4. International

If the user chooses International they are asked to choose a continent:

POLITICS INTERNATIONAL
1. Africa
2. Asia
3. Europe
4. North America
5. South America

14. As they make these choices users can decide whether they wish these choices to become a regular part of the setting/configuration or whether they constitute a one time search.

15. Not all lists are basic. If there are more than ten choices the list appears in a column in the left hand of the screen as in figure 2. This list is scrollable. Immediately to the right of this list is a “Limit by” list which allows the user to view the material in alternative forms: e.g. alphabetical, chronological, etc.

If, for example, the user chose Africa a longer list of all African countries appears. From this list the user might choose Egypt. They would then be asked to define Who:

POLITICS EGYPT
WHO
1.Persons
2.Professions

If the user chooses persons they receive an alphabetical list of persons in the news. From this list they might choose the name Mubarak. They are then given all articles in the *Globe* on Mubarak for that particular day. This will again appear in a list.

16. It is foreseen that these longer lists can be operable by the same remote device which contains the basic choices using the equivalent of a remote mouse function.

17. At this point the user may decide they wish to learn more about Mubarak. They may simply wish to find earlier articles in the *Globe*. In which case they go to one of the ten basic choices, Time, choose Calendars Gregorian, define a date span, say 1990-1996 and then receive a list of all articles in the *Globe* on Mubarak in chronological order. The limit by function would allow this list to be changed to an alphabetical one.

The extent to which they examine the contents of all these articles is governed by Levels (of Knowledge) which involves ten choices:

LEVELS
1. Terms
2. Definitions
3. Explanations
4. Titles (Headlines)
5. Partial Contents (Abstracts)
6. Full Contents
7. Internal Analyses
8. External Analyses
9. Restorations
10. Reconstructions

On the basis of this list users can decide whether they want just the titles or headlines, abstracts or full contents.

18. The step by step approach outlined above is designed as a guidance for those who are beginning searches, especially in areas where they are not expert. Anyone who finds these steps too tedious is at liberty at any time simply to type in the terms under the appropriate boxes. Hence an experienced user can simply type in:

Who?	What?	Where	When	How
Mubarak	Politics	Egypt	26 June 1996	Newspaper: Globe

INTERMEDIATE NAVIGATION: Stage A

19. The most basic searches limit the user to ten simple choices. In the case of persons connected with newspapers the list at the basic level of Navigation might be as follows:

WHO NEWSPAPERS
1. Persons in News
2. Reporters of News
3. Publishers of News

Such lists will become increasingly complex in keeping with the user's needs and interests. For instance, a more complex list will include:

WHO NEWSPAPERS
1. Administrators
2. Directors
3. Editors
4. Photographers
5. Proofreaders
6. Publishers
7. Reporters
8. Staff
9. Writers
10. Other

In the case of intermediate navigation this list is expanded beyond ten and might look as follows:

WHO NEWSPAPERS
Administrators
Assistants
Chair
Co-ordinators
Couriers
Directors
Editors
Liaison
Managers
Photographers
Planners
Proofreaders
Publishers
Receptionists
Reporters
Representatives
Staff
Supervisors
Writers

This list is not absolute, has the possibility of additions and has a Limit by function such that it can be viewed alphabetically or hierarchically. The latter choice re-groups the above in a hierarchical list:

WHO NEWSPAPERS
Administrators
    Assistants
    Chair
    Co-ordinators

Directors
Liaison
Managers

Publishers

Editors
Planners
Proofreaders

Staff

Couriers
Photographers
Receptionists
Reporters
Representatives
Supervisors
Writers

These lists can be modified by other choices:

Limit by:
1. Department
2. Function
3. Name

The same principle applies to What. As noted above, at the basic level, in the case of Newspapers, there are nine of these with the tenth leading on to more choices:

NEWSPAPERS WHAT
1. Arts and Entertainment
2. Business
3. Community
4. Courts/Crime
5. Fashion/Gossip
6. Politics
7. Science/Technology
8. Religion
9. War
10. Other Subjects

Intermediate navigation again assumes that these lists are longer than ten choices. In the case considered above choosing More Subjects will produce a list in the left hand margin such as the following:

NEWS SUBJECTS
Arts
Births/Deaths
Books

Business
Cars
Children
Comedy
Comics
Community
Consumer Affairs
Courts
Crime
Current Affairs
Education
Entertainment
Environment
Events
Family
Fashion
Films
Food
Games
Gossip
Homes
Horoscope
Literature
Movies
Music
Politics
Religion
Science
Space
Sports
Technology
Theatre
Training
Travel
War
Womens Issues

This list is again not absolute, has the possibility of additions and has a Limit by function such that it can be viewed alphabetically or hierarchically. The latter choice re-groups the above in an hierarchical list:

NEWS SUBJECTS
Arts
    Books
    Comics
    Entertainment

- Comedy
- Events
- Games
- Films, Movies
- Literature
- Music
- Theatre

Business
- Consumer Affairs
- Cars

Community
- Courts
- Crime
- Current Affairs

Education
- Training

Environment

Family
- Births/Deaths
- Children
- Fashion
- Food
- Gossip
- Homes
- Horoscope

Politics

Religion

Science
- Space
- Technology

Sports

Travel

War

Womens Issues

This principle clearly extends to the other questions: Where? When? How? Why?

19. This hierarchy amounts to a personal classification system which corresponds to a next stage in the development of a serious navigation system. The software includes a tool for the creation of such personal, hierarchical classification systems. From a librarian's viewpoint, such a list corresponds to a shift from a Broader Topic (BT), to a Narrower Topic (NT). The value of such hierarchical lists is primarily in finding related terms.

20. If the user is simply searching for a given term then the alphabetical list is sufficient. It is true that every search engine uses alphabetical lists. Once the term is found the

engines then go to find every occurrence of the term. In SUMMA a user employs the lists to find a term and then applies to this the LEVELS choices to determine the depth of knowledge they seek (see 17 above).

SUMMA also relies on existing classification systems to make distinctions. Hence having chosen the term Politics or Perspective in an alphabetical list, SUMMA searches for the occurences in a classification scheme such as the Library of Congress. This results in a number of different meanings of the term. The user can then choose from amongst these in order to arrive at the particular titles they wish rather than every possible reference to the term in all its meanings as occurs in most search engines.

INTERMEDIATE NAVIGATION: Stage B

21. A next stage shifts from the personalized lists of individual users to standardized lists produced by librarians. A first such list is the subject headings of the Library of Congress which leads the user to three further alternatives to offer five choices, namely:

Broader Topic	(BT)
Narrower Topic	(NT)
Related Topic	(RT)
See Also	(SA)
Used for	(UF)

Hence if the user chooses a term such as News, Politics or Education they are immediately provided with a number of closely associated terms.

ADVANCED NAVIGATION

22. Whereas basic navigation assumes only the existence of a personal classification and intermediate navigation stage B requires the use of one standard system such as the Library of Congress, advanced classification begins from the premise that each classification system offers its own set of cubbyholes into the mental worlds of scholarship. Hence instead of subjecting a term such as politics or perspective to one system, SUMMA in its advanced forms takes a given term and subjects it to an increasing list of these systems. As to the number of systems involved, the same basic methodology applies. The user is first offered a small list of these systems:

CLASSIFICATIONS
1. AAT
2. Bliss
3. Dewey
4. Göttingen
5. Iconclass
6. Library of Congress
7. Ranganathan

8. Universal Decimal Classification
9. Combined List
10.Other

When searching for a term such as news, politics or perspective the user can choose to use only one of the classification systems. Alternatively they can choose a combined list which then indicates all places in which the term is found in any of these systems. If an even more thorough search were desired then a longer list of classification systems would be provided. Some 950 major systems have been identified, some of which apply specifically to specialized fields such as engineering or medicine. Hence a comprehensive search will begin by determining which systems are germane to a given topic. In time many and possibly all of these procedures can be automated.

If instead of choosing Newspapers one chooses television, the choices become:

NEWS HOW TELEVISION
1. Broadcast
2. Basic Cable
3. Premium Cable
4. Regional Cable

The user is then taken through the questions again:

TELEVISION WHEN
1. Days
2. Times

TELEVISION WHEN
TIMES

1. Early A.M.	3-7
2. A.M.	7-11
3. Midday	11-3
4. Late Afternoon	3-7
5. Prime Time	7-11
6. Late Night	11-3

TELEVISION WHERE
1. Local
2. Regional
3. National
4. International

A very simple list of What and Who will be as follows:

TELEVISION WHAT
1. Categories
2. Descriptions

3. Keywords
4. Grids
5. Titles

TELEVISION WHO
1. Actors
2. Colleagues, Partners
3. Contacts
2. Personnel

In the case of the BBB, for instance, the second of these choices gives organizations such as the National Council for Educational Technology and the Open University. A number of these categories are already operative in TV Guide at:
http://www.iguide.com/tv/tv/tvguide/jp/search/other.sml

There are items that one wants to know about on an everyday basis. Traditional newspapers effectively perform this function by giving us highlights in all areas. This entails a colossal waste of paper because a politician in Ottawa will have no use for the entertainment, homes, or cars section of a Toronto based paper. In SUMMA a range of possiblities are available. At the simplest level, the standard palette of questions can be used to have information on a given person or subject come up daily:

Who	Mubarak
What	Politics
Where	Egyptian
When	Today
How	Newspaper (Globe and Mail)
Why	News

A variant of this type of template is to choose a particular country, say Africa, have a map of the country on which one identifies the countries, states/provinces or cities in which one is interested, makes a list of the precise topic that concern one, e.g. diamonds, aluminum, oil, and natural gas. The geographical detail one has chosen would then serve as a filter for the level of detailed information that one is given. For instance, if the user stays at the country level thy will not be given information about all the gossip in local newspapers.

At a next level of complexity the user makes a list of a series of subjects and/or persons of interest to them. An insurance representative might, for instance, have a list such as the following:

NEWS WHAT
1. Earthquakes
2. Floods
3. Forest Fires
4. Robberies

5. Storms

At more advanced levels the news itself will not be of interest but rather the patterns of events. There will be whole new fields which link spreadsheet methods to daily statistics to create a kind of ongoing self-updating data-mining process. In the case of forest fire, for example, the interest will be in seeing how their number and magnitude varies over time, to what extent this is affected by climate, i.e. an especially dry or wet year; or how much it is effected by lightning or tourism, i.e. how much the causes are due to nature or man-made.

2. EDUCATION

At a basic level a person begins from the list of SCOPE WHY (see p. 139 above) and choose Education, Learning. They would then be led through the basic questions of why, how, when, where, what, who ?

EDUCATION WHY GOALS
1. Individual
2. Class
3. School
4. Board
5. Province, State
6. National
7. International

If the user chooses 7 the list looks as follows:

EDUCATION WHY GOALS
PROVINCE
1. Common Curriculum
2. Benchmarks
3. Guidelines

The user is then asked to define how:

EDUCATION HOW
1. Alternative
2. Professional Development
3. Regular
4. Sources

If they choose 3, the following choices appear:

EDUCATION HOW REGULAR
1. Methods
2. Kinds of Learning

3. Types of Learning

They are now asked to define what:

EDUCATION WHAT
1. Activities, Learning Tasks
2. Contexts
3. Courses
4. Equivalents
5. Instructions
6. Outcomes
7. Resources
8. Subjects
9. Themes

Sometimes the user wants to ask something directly. Having stated that the scope of their search is education they then press When Events at which time the system offers them a list of education related events:

EDUCATION WHEN EVENTS
1. Conferences
2. Events
3. Exhibitions
4. Meetings
5. Plays

Having chosen one of these alternatives the user is given the appropriate information. Alternatively they may be concerned with finding information about individual persons. Hence they press Who and are given an appropriate list of categories:

EDUCATION WHO
1.Administration
2. Persons Studied
3. Students
4. Teachers

The first of these leads to a series of new choices:

EDUCATION WHO
ADMINISTRATION
1. Administrators
2. Contacts
3. Institutions
4. Organizations
5. Staff

The second of these in the previous list leads to a series of new choices:

EDUCATION WHO
PERSONS STUDIED
1. Artists
2. Explorers
3. Mathematicians
4. Poets
5. Scientists
6. Writers

The third of these leads to a series of new choices:

EDUCATION WHO STUDENTS
1. Students
2. Peers

The fourth of these in the previous list leads to:

EDUCATION WHO TEACHERS
1. Teachers
2. Experts
3. Facilitators
4. Innovators
5. Mentors

Some aspects of Learning also come under the scope of other basic choices. For instance, if one is interested in publications one goes to LEVELS Titles Books, which category then adjusts to one's educational scope and the level at which one is studying. An advanced list might, for instance, look as follows:

BOOKS
1. Books
2. Catalogues
3. Journals
4. Directives
5. Magazines
6. Manuals
7. Texts
8. Reports

If one chooses catalogues the results will adjust for the area in question. For example, if one is in Toronto and chooses regional catalogues then the list will be something akin to the following:

CATALOGUES
1. CCC
2. CESS
3. Curriculine
4. OCRMC
5. Smart Shop
6. TéLéPEC

Other materials pertinent to education and learning are to be found under MEDIA Internet WWW. In a national context in Canada, that list might include the following:

INTERNET WWW
1. ERIC
2. MET
3. OISE
4. Schoolnet

Under the heading MEDIA Television one will find other choices:

TELEVISION
1. Cable
2. PDTV
3. TFO
4. TVO

In short SUMMA presents the user with the relevant information based on their needs defined by the series of questions why, how etc. rather than simply trying to find all information on a given topic.

3. BUSINESS

If the user's scope is business they are given the following list of choices:

BUSINESS
1. Companies
2. Financial Services
3. Information
4. News
5. Organizations
6. Products

The first of these leads to the following choices:

COMPANIES
1. Consumer
2. Energy

3. Finance
4. Industrial
5. Media
6. Medical
7. Technology
8. Transport
9. Utility
10. Other

If one chooses Financial Services there is a new list:

FINANCIAL SERVICES
1. Banking
2. Insurance
3. Interest Rates
4. Loans
5. Mortgage
6. Retirement (RRSP)
7. Savings Bonds
8. Stock Market
9. Tax

This leads progressively to more details.

4. TOURISM

If a person is interested in tourism they will choose SCOPE LEISURE:

LEISURE
1. Culture
2. Entertainment
3. Food and Drink
4. Games
5. Home and Garden
6. Outdoors
7. Romance
8. Sports
9. Tourism

From this list they will choose number 9:

TOURISM
1. Culture
2. Entertainment
3. Events
4. Information

5. Lodging
6. Restaurants
7. Sightseeing
8. Transport

If they choose culture they are given the list:

CULTURE
1. Archives
2. Galleries
3. Libraries
4. Museums
5. Performing Arts

If they choose 3 this leads to the following:

CULTURE LIBRARIES
1. Communal
2. Special
3. University

If they choose 5 under Culture they are given the list:

PERFORMING ARTS
1. Ballet
2. Opera
3. Revue
4. Symphony
5. Spectacle
6. Theatre
7. Tickets

If they choose entertainment in the Leisure list, they are given the following choices:

ENTERTAINMENT
1. Bars
2. Cafés
3. Clubs
4. Comedy
5. Dancing
6. Movies/Cinemas
7. Music
8. Radio
9. Television
10. Videos

Movies leads to other choices:

MOVIES
1. Top Ten
2. First Run
3. Repertoire
4. Classics
5. All
6. Reviews
7. Television
8. Video

Choice 7 leads to the following alternatives:

TELEVISION MOVIES
WHAT
1. Top Ten
2. Movies
3. Hotline

One can of course choose:

TELEVISION MOVIES
WHO
1. Stars

If the user chooses the third option in the Leisure section, they obtain a list:

FOOD AND DRINK
1. Drink
2. Food
3. Bistros
4. Cafés
5. Diners
6. Delis
7. Restaurants

The second of these choices gives the following list:

FOOD
1. Bakers
2. Butchers
3. Dairies
4. Fishmongers
5. Greengrocers
6. Prepared Foods
7. Provisioners

8. Specialists
9. Supermarkets

The seventh of these choices leads to the following:

RESTAURANTS
1. Cosmopolitan
2. Haute Cuisine
3. International
4. Nationalities
5. Neighbourhood
6. Seafood
7. Steakhouse
8. Vegetarian

The third of these gives the following choices:

INTERNATIONAL
1. African
2. Asian
3. Caribbean
4. European
5. Middle Eastern
6. Moroccan
7. International

The second choice leads to a new list:

RESTAURANTS ASIAN
1. Chinese
2. Indian
3. Japanese
4. Malaysian
5. Thai
6. Vietnamese
7. Other

The fourth choice leads to an equivalent list for Europe:

EUROPEAN
1. French
2. Greek
3. Italian
4. Portuguese
5. Other

The above choices are not just theoretical. The categories already exist online at:

http://www.tor-lifeline.com/cgi-bin/tor-search.cgi. Persons creating web sites at present are using standard categories as a vehicle for their creativity. While this may sound exciting, and provides excellent short term job opportunities it is problematic and ultimately counterproductive because it means that there is no uniform way of getting at the same materials in different cities. SUMMA starts from the premise that the paths to the materials should be universally standardized and creativity relegated to the local site. In the case of restaurants this means that the categories for finding them become uniform whether one is in Florence or Toronto. The creative element enters only at the home page level.

In large cities users will have an option of browsing a list of all restaurants in a city, in the manner of a yellow pages with limit bys in terms of alphabetical, nationality, price range, times (i.e. whether they are open on Sundays and how late they are open). Choice 3 in the Tourism list leads to the following choices:

EVENTS
1. Attractions
2. Conferences
3. Congresses
4. Exhibitions
5. Family Activities
6. Lectures
7. Literary Scene
8. Meetings
9. Social Events

Choice 4 in the Tourism list gives the following alternatives:

INFORMATION
1. Consulates
2. Guides
3. Tourist Bureaus

Choice 5 in the Tourism list leads to the following choices:

LODGING
1. Bed and Breakfast
2. Campsites
3. Hostels
4. Hotels
5. Motels

The resulting lists can then be subjected to limit by functions such as the following:

Limit by
1. Location
2. Price
3. Stars

Each of which then breaks down into subcategories:

Limit by Location
1. Central
2. Downtown
3. Near a Station
4. Particular Section
5. Suburbs

Limit by Price
1. Under $50
2. $50-99
3. 100-149
4. 150-199
5. 200-299
6. 300-499
7. 500-999
8. 1000+

Limit by Stars
1. *
2. **
3. ***
4. ****
5. *****

Choice 7 in the Tourist list provides the following choices:

SIGHTSEEING
1. Archaeology
2. Architecture
3. Monuments
4. Natural Sites
5. Parks
6. Zoos

The second of these might break down as follows:

SIGHTSEEING ARCHITECTURE
1. Castles
2. Churches
3. Forts
4. Houses
5. Palaces
6. Villas

Each of these will again generate lists which can have further limit by lists

Limit by:
1. Entrance Fees
2. Opening times
3. Rules and Regulations

Choice 8 under Tourism leads to the following list:

TRANSPORT WHERE
1. Local
2. Regional
3. National
4. International

The first of these alternatives provides the following options:

TRANSPORT LOCAL HOW
1. Car
2. Bus
3. Local Train
4. Taxi
5. Subway

The second option in the preceding list gives a slightly different set of options:

TRANSPORT REGIONAL HOW
1. Car
2. Bus
3. Plane
4. Ship
5. Train

In cases such as this where the information concerned is fairly standard the user can be offered choices concerning a number of questions at once:

TRANSPORT HOW
PLANE
1. Who Contacts
2. What Airline Companies
3. Where Locations
4. When Schedules

These transport options can be combined with the information in standard guide books such as the Guide Michelin and GPS functions such that a person wishing to travel from

one city to another will have options to choose the shortest route, most picturesque route and the possibility of choosing to see other sites within a given range of miles.

If the Scope EVERYDAY is telephone the user is again prompted about where the scope applies:

TELEPHONE WHERE
1. Local
2. Regional
3. National
4. International

If one is searching for a specific name, the user simply enters that name under who and the system searches for it using the criteria defined above. If a more general search is wished then the user clicks on what:

TELEPHONE WHAT
1. Academic
2. Business
3. Frequent Numbers
4. Personal
5. Residential
6. Yellow Pages

Users will typically have these settings predefined. Hence an office phone would typically be linked with the local business numbers, a home phone would typically be linked to fequently dialled, personal, and residential numbers. If a person were in the midst of something else and wanted to make a telephone call they would simply use Tools, Output, Telephone. If they need a number they type in Scope, Telephone and the system will adjust. Because the vocabulary of the entire list of choices is very limited this would be ideal for a personalized voice recognition system, something which would have a great advantage because it would give users a chance to arrive immediately at some point in the system without going through a whole list of choices.

At present the phone companies are busily linking decision trees strictly with aural command. This is highly inefficient because the user has to listen to all the alternatives before choosing one. In SUMMA because these lists are visual and usually made up of 7-10 choices, the eye can peruse the alternatives and one can decide almost instantaneously which choice is the proper or desired one. The disadvantage of this approach using visual lists is that one still may have to go through a number of levels of lists to arrive at what one wants. A combination of aural and visual methods would mark an improvement over both of the above methods in isolation. The aural prompt can combine more than one level in a Booleian fashion. The user may, for instance, want Restaurants, Thai. The system then goes through the questions Where, When etc. to determine whether enough information has been provided. If so the user is given the appropriate list. If not the user is asked to provide the necessary context for an answer.

linking decision trees strictl

5. SPORTS

If one chooses sports one is given list of eight choices:

SPORTS
1. Fighting
2. Racing
3. Running
4. Skating
5. Skiing
6. Swimming
7. Matches
8. Teams

A number of these in turn lead to further lists of choices:

FIGHTING
1. Boxing
2. Wrestling

RACING
1. Cars
2. Dogs
3. Horses

MATCHES
1. Badminton
2. Golf
3. Squash
4. Tennis

TEAMS
1. Baseball
2. Basketball
3. Cricket
4. Football
5. Hockey
6. Rugby
7. Soccer

Choosing one of these leads to a list of teams. If one chooses a team one gets a brief description of the team, plus a series of criteria for further exploration such as games, opposing teams, scores etc.

META-SEARCHING

The above cases entail searches for a specific person, thing or place. In research we often do not know exactly who or what we are looking for. We may, for instance, be studying mediaeval poetry and wish to know names of poets of the thirteenth century. This is merely a question of asking for a universal category and then requesting a list of particulars/individuals under that heading. In other cases qualitative descriptors and relators will provide ways of exploring the context without necessarily knowing the details. A model for how this could work is outlined in the article on Images and Words: Fractals and Fuzzy Logic (chapter 9 above).

ORGANIZING

As was noted in the *Briefest History of Questions* (chapter 10 above) the basic choices of SUMMA reflect distinctions found in the trivium and quadrivium in mediaeval learning. This is no co-incidence. The combined choices provide the equivalent of an electronic bucket for organizing the materials one finds. Because the complexity of this bucket varies with the complexity of the user it offers a dynamic rather than a static approach to organization. As object oriented programming evolves closer connections can be established between the classing, searching and organizing functions of the system.

One possible scenario is as follows. A user defines their vocabulary for classing knowledge, which amounts to the basic terms they wish to use in doing searches and for organizing what they find. It suffices that they simply list the terms orally. The system assigns them an appropriate position in a hierarchy. The finished hierarchy becomes the parameter with which they define the limits of their searching and helps the system to adjust the complexity of the choices which the user is offered. For instance, if the user has only one level of hierarchy in their distinctions, they will not be offered choices with complax hierarchical choices. Each level of the educational system will have its own standard configurations of choices which will function in the manner of templates. Individuals with their own variants can submit these for consideration. If accepted these become available for users wishing to have alternative methods of organizing the materials. The system thus remains open while at the same time having a coheren, integrating framework which assures that every additional contribution continues to contribute to something more than the sum of the individual parts.

LEARNING

The same framework used for 1) classing, 2) searching and 3) organizing knowledge, will serve also for 4) learning in new ways. At the lower levels the same personal classification list used for the first three will be used for this fourth purpose. In more advanced levels this list will be substituted by a) database fields b) a standard subjects list (such as Library of Congress), c) a standard classification system (such as Dewey, Göttingen or Library of Congress, and d) multiple classification systems (cf. fig 14 above). Each of these successive steps provides a greater range of vocabulary and a greater precision in terms of defining the parameters of what one wishes to learn.

From one's educational level the system will have a basic framework for knowing what it might expect of the learner. The reasons for learning also need to be established. Is this

being done for leisure enjoyment or will the lives of persons depend on one's performance in a critical job such as a dam supervisor or a squadron leader? The system will trace one's progress, will provide periodic tests as needed or as wished, and will continue to add to the complexity of the materials presented in accordance with one's preparation. If a person has no knowledge of French they will not usually be shown French texts or manuscripts. As they learn languages materials in that language become available. There are, of course occasions when I may wish to peruse a manuscript in a language which I cannot read. Provisions for overriding the usual arrangements will exist and it is likely that this would have a fee attached to it. The system will encourage all serious study and discourage incidental browsing unless this browsing can be defended as part of some larger plan.

An essential aspect of the complete project will be a new contextualization of anything learned such that one can see where any fact fits into an exam, where this fits into a text, a course, a curriculum and the corpus of knowledge in the field. A second dimension of this contextualization will be cultural. A third aspect will be historical. As a result one will, for instance, be able to choose the term China and watch how the territory associated with that country varies historically from a Chinese viewpoint and then examine how the same territory varies historically when examined from a Russian, Japanese or Indian viewpoint. Hence there will be historical, cultural dynamic maps. These maps will serve in helping to trace not only the growth of answers but also the growth of questions. Perreault[84] has offered a fascinating enumeration of categorical and relational tabulations for major thinkers including Aristotle, Lull, Kant, Mills, Pages, Kervagent, Gardin and Farradane. Such a list, linked with the six questions could provide a framework for showing how the filters of study have evolved over time.

There will also be the equivalents for ideas. There will be new kinds of spreadsheets to visualize the growth of manuscripts and books devoted to a given topic, the development of new branches within a given field. Hence just as there is gradual development in the complexity of a personal classification scheme, one will able to trace the evolving complexification of classification schemes culturally. The interest here will not be in some revival of the phylogenetic-ontogenetic analogies but rather in a new awareness of learning which is the secret behind all true growth.

NOTES

CHAPTER 1
A PROPOSAL CONCERNING THE REORGANIZATION OF KNOWLEDGE

[1] Given the renown of the Germans for thoroughness and for historical precision it would be wise to create this chair at a German university. Among German universities it should be one with a great library and one where computer methods are already being explored. Göttingen is, in these respects, an ideal place, all the more so because of its close links with the Herzog August Bibliothek, which ranks among the greatest of rare book libraries.

[2] Such as the Herzog August Bibliothek.

[3] A great library, in a small town that is also centrally placed in the European context is, therefore, ideal. Wolfenbüttel is such a town.

CHAPTER 2
REALITY, KNOWLEDGE AND EXCELLENCE

[4] And, in addition, be transferred to Wolfenbüttel where a research team would enter these records within a master programme.

CHAPTER 3
THE CONCEPT OF KNOWLEDGE PACKAGES

[5] Initial programming was done by Dr. Richard Dolen (1986-1987), then continued by Mr. Alan Brolley (1987-1989), and Mr. Paul Chvostek (April-August 1990) and is now being developed by Mr. Jonathan Shekter, David Pritchard and Jordan Christensen. Their help has made this project possible and I am grateful for their patient contribution.

[6] Cf. John Walker, *The Autodesk File*, Thousand Oaks: New Riders Publishing, 1989, p.251-2.

[7] Cf. the following articles in books: “The Electronic Highway and Education: New Doors to keep Open", *Proceedings of Learntec '93*, Karlsruhe (1994, in press); "New Media and New Knowledge", *Proceedings of the Third Canadian Conference on Foundations and Applications of General Science Theory: Universal Knowledge Tools and their Applications*, Ryerson, June 1993 (in press); "Can Museum Computer Networks Change Our Views of Knowledge?", *Museums and Information. New Technological Horizons. Proceedings*, Ottawa: Canadian Heritage Information Network, (1992), pp. 101-108; "Databanks in Education", *The 12th E.C.O.O. and the 8th I.C.T.E. Joint Conference***,** Toronto, (May 1991), pp. 412-418; "Knowledge Packages", *The 12th E.C.O.O. and the 8th I.C.T.E. Joint Conference***,** Toronto, (May 1991), pp. 757-759; "Multidimensional Bibliography and Classification, Eröffnungsvortrag": *Anwendungen in der Klassifikation. Proceedings 8 Jahrestagung der Gesellschaft für Klassifikation eV*, ed. Rolf G. Hensler (Teil I), (Hof Geismar, 1984), (Frankfurt, Indeks Verlag, 1984), pp. 57-75.(*Studien zur Klassifikation*, Bd. 14 SK 14).
See also the following articles in refereed journals: "A System for Universal Media Searching, (SUMS)", *Computers and the History of Art*, London, 1994 (in press); "Conceptual Navigation: Views beyond Windows", *Sistema Terra*, Rome, 1993 (in press); “A Front-end for Multi-valent, Multi-cultural Searching”, *ALT News 04, Applied*

Learning Technologies in Europe, February 1994, pp. 8-9,14; "Past Imprecision for Future Standards: Computers and New Roads to Knowledge", *Computers and the History of Art*, London, vol. 4.1, 1993, pp. 17-32; Guest Editor of the first issue of *Knowledge Organization* (formerly *International Classification*), including an editorial "Computers and the Visual Arts" and an article "Electronic Media and Visual Knowledge", Frankfurt, vol. 20, no. 1, 1993, pp. 2-3, 47-53; "McLuhan, Museums and Education", *Museums and Technology*: special issue of *The Muse*, Ottawa, vol. IX, no. 2, (Summer-Fall, 1991), pp. 78-85; "Computers and a new Philosophy of Knowledge", *International Classification*, Frankfurt, vol. 18, (1991), pp. 2-12.

CHAPTER 4
ELECTRONIC MEDIA AND LEVELS OF INTERPRETATION

[8] See the author's "A System for Universal Media Searching (SUMS), *Computers and the History of Art*, London, 1994, (in press) and "Electronic Media and Visual Knowledge", *Knowledge Organization*, Frankfurt, vol. 20, no. 1, 1993, pp. .47-53.

[9] Michael Giesecke, *Der Buchdruck in der frühen Neuzeit. Eine historische Fallstudie über die Durchsetzung neuer Informations-und Kommunikationstechnologien*, Frankfurt am Main:Suhrkamp, 1991.

[10] For a more thorough discussion see the author's "Past imprecision for Future Standards: Computers and New Roads to Knowledge, *Computers and the History of Art,* London, 1993, pp. (in press).

[11] Louis Réau, *L'Iconologie Chrétienne*, Paris: Presses Universitaires de France, 1955-1958, 3 vol.

[12] See the author's "Can Museum Computer Networks Change Our Views of Knowledge?": *Museums and Information. New Technological Horizons. Proceedings*, Ottawa: Canadian Heritage Information Network, 1992, pp. 101-108 and the articles cited in notes one and three above.

[13] The extent to which reformulation is possible depends on the topic. Scientific facts are less flexible than some artistic terms. For instance, the temperature of boiling water has clear parameters once one has defined a scale of measurement.

CHAPTER 5
SIX STEPS IN THE DEVELOPMENT OF SUMS

[14]Looking back to the example of printing would suggest that a much greater time scale is required. Moveable print was invented around 805 A.D. in Korea, moved slowly to China where it was used to censor knowledge. (That the Chinese now want to use the Internet to censor knowledge thus comes as no surprise to an historian). It was not until 600 years after the invention of printing that Gutenberg had the idea of using it to spread knowledge. And it was a good 150 years thereafter before the full fruits of a corpus of printed knowledge began to manifest themselves. The electronic revolution may be speeding everything enormously, yet it is sobering to remember that computers were invented over a century ago and we are still talking of them as if they belong to the future.

CHAPTER 6

[15] The footnotes that follow contain a series of references to projects being developed on the Internet. These are introduced by the letters http (hyper-text transfer protocol).

[16] For a recent example in the realm of games see: *Police Quest Swat*. I am grateful to Jeremy Meaghan-Cargill for this reference.

[17] A major project, led by the Gesellschaft für Mathematik und Datenverarbeitung (GMD), concerns Distributed Video Production (DVP). See: http://viswiz.gmd.de/DVP.

[18] http://www.soe.oeaw.ac.at/w4g.

[19] Hiroshi Ishii, Naomi Miyake, "Toward an open shared workspace: computer and video fusion approach of team workstation." *Communications of the ACM*, vol. 34, no. 12, December, 1991, pp. 37-50. Hiroshi Ishii, Minoru Kobayashi, Jonathan Grudin, "Integration of interpersonal space and shared workspace: clearboard design and experiments", *ACM Transactions on Information Systems*, vol. 11, no. 4, October 1993, pp. 349-375.

[20] http://gopher://zserve.nist.gov:79/0:docs/atp/94010169.

[21] http:// www. nwu.edu/CoVis_Wellcome.html.

[22] http://nu-gna.mit.edu.8001/uu-gna/text/cc/moo/what.html.

[23] For a more detailed examination of the relative values of synchronous and asynchronous communication see the author's "Space, Time, Information and Knowledge," *Proceedings of the Simposio Europeo Eco-Crea 1996. Spazio tempo informazione nella scienza, cultura, economia*, Venezia 24-25 maggio 1996, (in press), pp. 1-5.

[24] The Neurope Lab, the Centre de Recherches d'Informatique de Montréal (CRIM) and the Telecommunications Research Institute of Ontario (TRIO) through their Knowledge Connection project have been protagonists in this field.

[25] See: Alfredo Ronchi, "Virtualità reale", *Bolletino D'Informazioni. Centro di Ricerche Informatiche per I Beni Culturali*, Pisa, IV, n. 1, 1994, pp. 7-31, especially pp. 26-27.

[26] For a significant description see: Linda Harasim, *Global Networks: Computers and International Communication*, Cambridge Mass.: MIT Press, 1993. For a critical review of same see: Robin Mansell, *Intermedia*, London, vol. 22, no. 1, February 1994, pp. 44-45.

[27] For a more detailed discussion of this topic see the author's "Content Ordering or Ordered Content? Active versus Passive Knowledge."

[28] Nicholas Negroponte, "Object-Oriented Television," *Wired*, San Francisco, July 1996, p. 188.

[29] The latest PDA is the Pilot from U. S. Robotics. See: Maarten Heilbron, "U. S. Robotics' Pilot soars above the rest of the PDA pack," *Globe and Mail*, Toronto, Saturday, 22 June, 1996, p. B20.

[30] This is called ECO: Sistema informatico vocale interattivo.

[31] James Sullivan, "Invisibly Interactive," *Wired*, San Francisco, July 1996, p. 64.

[32] http://www.omega.it/million/synopsis.html.

[33] For a description of these and a good survey of developments in virtual reality see Alfredo Ronchi, "Virtualità reale", as in note 11 above, pp. 7-31, especially p. 21.

[34] http:// pubweb.parc.xerox.com/hypertext/services.html.

[35] http://www.argusmap.com.

[36] http://tracy.esrin.esa.it:5555/query.html.
[37] http://www.hyperreal.com/~mpesce
[38] Most of us have become inured to the fact that we are being observed by video-cameras every time we enter a bank, a subway or some other public building, largely because we assume that all these snapshots of our lives are restricted to the context in which they are being recorded. But what if all these snapshots can be co-ordinated? What are the consequences for privacy especially with respect to persons who work in downtown areas where almost all the space is public. Theoretically it would be possible to "follow" persons as they moved from building to building, subjecting them to an unconscious version of candid-camera.
[39] http://www.eccs.uic.edu/~ddpape/gallery/RemSens.html.
[40] http://viswiz.gmd.de/cwall/cwall.html.
[41] http://www.ifi.uio.no/~sigar/vroslo/queau.html
[42] Philippe Queau, "Televirtuality, Virtual Communities, Real Time Image Processing, Facial Synthesis" (1996) at: http://www.ifi.uio.no/~sigar/vroslo/queau.abstract.html. See also the books by Philippe Queau, *Le Virtuel: Vertus et Vertiges*, Champ Vallon: Editeur INA, 1993; *Metaxu: Théorie de l'Art Intermédiaire*, Camp Vallon: INA 1989; *Eloge de la Simulation- De la Vie des Langages a la Synthèse des Images*, Champ Vallon: INA 1986.
[43] http://www.bekkoame.or.jp/~goto-co/GOTO_home.html.
[44] Howard Rheingold, *The Virtual Community*, Reading: Addison-Wesley, 1993.
[45] http://nemo.ncsl.nist.gov/~sressler/projects/nav/nav.html.
[46] Giovanni Valerio, "RV e arte. L'affresco che parla," *Virtual*, Milan, no. 31, May 1996, pp. 35-37.
[47] http://gopher://zserve.nist.gov:79/0/doc/atp/94030012.
[48] See:hans-guenter.thonemann@mch.sni.de.
[49] Ivan E. Sutherland, "The Ultimate Display", *Proceedings of the IFIP Congress*, 1965, pp. 506-508. Cf. Ivan E. Sutherland, "A Head-Mounted Three-Dimensional Display," *Fall Joint Computer Conference 1968*, pp.757-764.
[50] "Report on Business," *The Globe and Mail*, Toronto, 18 June 1996, p. B27.
[51] http://silicon.montaigne.u-bordeaux.fr:8001/HTML/TUNISIE/sites.html.
[52] http://www.nww.co/ruscrypto.html reproduces an edict of Boris Yeltsin which provides a rather frightening insight into how cryptography is being used to achieve these ends. Only slightly less obvious techniques are evident in the United States which is trying to make the spread of encryption technology into a serious crime. Cf. Brock Meeks, "Major loss for U.S. in Internet privacy war," *Now*, Toronto, June 13-19, 1996, p. 23. Related to this is the proposed use of clipper chips which potentially censor free speech.
[53] See, for instance, an article in the *Toronto Star, (*13.6.1996), "U.S. court blocked as unconstitutional a new federal law prohibiting indecency on computer networks," reproduced in http://www.aclu.org.
[54] Another example involves pictures. If Mr. *x* lives in one of the large cities, and not just the obvious ones such as Amsterdam, Hamburg or Brussels, they have no problem seeing naked ladies (or men). How they are referred to may differ: call-girls, escorts, geisha girls but their function is constant. If Mr. *x* wants pictures of such naked persons

levels of choices present themselves. He can go to almost any local store and buy a copy of *Playboy*. If he wants more dramatic pictures specialized stores offer him a whole range of magazines and videos. In some places these materials are considered pornographic and yet for the most part, assuming a basic amount of discretion, no one would think of Mr. *x* as a criminal for buying *Playboy* or even something slightly more risqué. And yet, if he were to download the same images from the Internet onto his computer his activity would in many cases be considered criminal by the present laws.

[55] Why, for instance, do some prefer text-based discussion groups (MOO's) when they could have conference calls or video-conference calls? One reason, of course, is that the more primitive text based mode, provides a greater sense of anonymity.

[56] Cf. Ben Shneiderman, *Sparks of innovation in human and computer interaction*, Norwood, N.J.: Ablex Publishing Co., 1993.

[57] http://www.bbb.caltech.edu/hbp/design/html.

[58] Warren Robinett, "Electronic Expansion of Human Perception," *Whole Earth Review*, San Francisco, 2 May 1991, pp. 2-8, figures 1-7.

[59] M. Hemmje, "Lyberworld- Eine 3D basierte Benutzerschnittstelle für die computerunterstützte Informationssuche in Dokumentmengen", Der GMD-Spiegel 1, 1993, Bonn-Sankt Augustin.

[60] Ulrich Kling, "Neue Werkzeuge zur Erstellung und Präsentation von Lern- und Unterrrichtsmaterialien", *Learntec 93, Europäischer Kongress für Bildungstechnologie und betriebliche Bildung, Tagungsband*, ed. Uwe Beck, Winfried Sommer, Berlin: Springer Verlag, pp. 335-360.

[61] Brenda Laurel, *Computers as Theatre*, Reading: Addison-Wesley, pp. 35-92.

[62] http://debra.dgbt.drc.ca/chat/chat.html.

[63] http:/www.ina.fr.

[64] *G7 Ministerial Conference on the Global Information Society. Round-table meeting of business leaders*, Brussels, 25 and 26 February 1995, Luxembourg: Office for Official Publications of the European Communities, 1995. H. Von Bose, *G-7 Information Society Conference Pilot Projects, Executive Summaries*, Brussels: European Commission, 1995.

[65] John Browning "Cyber View. Playing Facts and Loose," *Scientific American*, New York, June 1996, pp. 30, 32.

[66] See also the author's: "Computers and a new Philosophy of Knowledge", *International Classification*, Frankfurt, vol. 18, (1991), pp. 2-12.

[67] http:// www.perseus.tufts.edu/oldIndex.html.

[68] For additional thoughts on the these themes see the author's vision statements and essays concerning the System for Universal Media Searching (SUMS) at the website for the Perspective Unit at http://www.mcluhan.utoronto.

[69] See: Consiglio Nazionale delle Ricerche. Progetto Finalizzato Beni Culturali, "Strumenti di Realtà Virtuale e simulazione per il testing delle ipotesi archeologiche e per la esposizione e divulgazione al pubblico," in: *Musei Virtuali in Rete. Progetto Beni Culturali*, Maggio 1996.

[70] See: William J. Mitchell, *The Re-configured Eye. Visual Truth in the Post-Photographic Era*, Cambridge, Mass.: MIT Press, pp. 56-86, 163-189. See also the author's "Electronic Media, the Rebirth of Perspective and the Fragmentation of Illusion": English translation of : “Elektronische Medien, Die Wiedergeburt der

Perspektive und die Fragmentierung der Perspektive": *Illusion und Simulation*, ed. Stefan Iglhaut, Munich: Klaus Boer Verlag, 1995 (in press).

[71] Douglas Waller," Onward Cyber Soldiers", *Time*, New York, Vol. 146, no. 8., August 21, 1995, pp.30-38.

CHAPTER 7
SEARCHING, TEACHING, REPAIRING ADVERTISING AND SELLING

[72] In the popular imagination agents are discussed as electronic butlers who go out and find everything we need. In this model, the agent is active, the user is passive. It is assumed that this can be accomplished using genetic algorithms, which learn as they go. The assumptions underlying this approach are more disturbing than may immediately be apparent. Genetic algorithms entail a transposed version of Darwinian evolution: triumph of the strongest and the most successful. Hence connections which obtain the desired information or which are popular are re-inforced, while "unsuccessful" ones are weakened or eliminated. This means that success becomes a popularity contest, much in the way that classes are tending to become today. Unfortunately, profound thinkers, who may not be very popular because of the difficulty of their ideas, would lose out in this approach. In analogy with cities the biggest would be best, such that New York and Tokyo would be paradigms for living, overlooking the fact that many of the most successful and interesting places to live are smaller towns, villages and the country rather than the biggest cities. We need more emphasis on the paths, streets, roads of knowledge and less emphasis on the information highway. Hence we need a different kind of agent.

[73] One early assumption was that advertising might disappear altogether. In the past advertising was linked with television and since one could track the number of viewers, the most popular times, such as the six o-clock news, the Saturday night feature, the playoff game were prime time and thus more valuable for advertising than, say, a slot at six a.m. on a Sunday morning. It was feared that the advent of 500 channel television might destroy these simple parameters for quantitative popularity and thus undermine the potentials of advertising.

A second strategy sought to establish new incentives for watching. For example, if a cable channel had pay-per-view movies, then by agreeing to have advertisements in the form of intermissions might give one either a reduced rate on the movie one was watching or some bonus points towards the rental of a further movie.

Internet strategies have focussed on inserting advertisements on the home pages of browsers and the opening pages of indexes of services. Some companies are negotiating their rates for these advertisements in terms of how many times there is actually a hit on the advertiser's logo which takes the user down to the home page. Thought is being given to home pages which lead one deeper and deeper into content and dissuade one from leaving without either making a transaction or at least gleaning some information concerning the web visitor who is a potential customer. There are at least two flaws in this approach. The first is a practical one. If I am searching for something specific, such as medicine or physics, then I will consider any advertisements on home pages along the way as noise, potential distractions from my real purpose. Second, this approach assumes

that the primitive state of today's web pages will continue. In fact, once agents are improved to the next level, they will go directly to the subject being searched, thus bypassing any other topics along the way for the same reason that I ignored them as a user. They are not relevant to what I am searching at the moment.

CHAPTER 8
CONTENT ORDERING OR ORDERED CONTENT?
ACTIVE VERSUS PASSIVE KNOWLEDGE
No Notes

CHAPTER 9
IMAGES AND WORDS: FRACTALS AND FUZZY LOGIC
[74] Just how far one could take this analogy between words and images has long been a matter of debate. Some have argued that words and images can both be viewed as languages, each having their own "grammars". Russian artists and linguists played a key role in this view, which was subsequently championed by American philosophers such as Goodman. Others, such as Gombrich, have claimed that there are fundamental differences between verbal language which emphasizes universals and visual images which favour individuals.

CHAPTER 10
A BRIEFEST HISTORY OF QUESTIONS

APPENDIX
[75] Viewed historically this list is instructive because it reduces logic to its minimal relations. In traditional terms Logic would have included much of determinative and subsumptive relations. For instance, Determination, used to mean rendering a notion more definite by adding attributes, while Subsumption meant a proposition subsumed under another: a minor premiss.
[76] Anthony J. N. Judge, "Envisaging the Art of Navigating conceptual Complexity," *International Classification,* Frankfurt, vol. 22, n. 1, 1995, pp. 2-9.
[77] The original list by Professor Nancy Williamson (Faculty of Information Studies) lists these in a different order under the heading:

Types of Associative Relationships

1. Whole-part
2. Field of study and object(s) studied
3. Process and agent or instrument of the process
4. Occupation and person in that occupation
5. Action and product of action
6. Action and its patient
7. Concepts and their properties
8. Concepts related to their origins
9. Concepts linked by causal dependence

10. A thing or action and its counter-agent
11. An action and a property associated with it
12. A concept and its opposite.

[78] J. Perreault, "Categories and Relators", *International Classification*, Frankfurt, vol. 21, no. 4, 1994, pp. 189-198, especially p. 195.

[79] In Perreault's system state, attitude and energy are subsumed under conditional which in turn is subsumed under ordinal. In SUMS a distinction is made between these qualitative aspects of ordinal and the quantitative aspects, which are listed separately under quantity, space and time.

[80] The best way to present these categories will vary with the individual situation. for example, Perrault (1994, p. 195) chooses to list the first of the above as follows:

TYPE/KIND
1. Principle/Manifestation
2. Genus/Species
3. Species/Individuum

In Perrault's approach each of these divides into duals such as:

Type > Kind
Kind < Type

We have chosen to present the list in its logical order. Alternatively it can be presented alphabetically:

SUBSUMPTIVE
1. Type
2. Kind
3 Part
4. Property
5. Subject
6. Whole

The same alternatives apply to the other three choices.

[81] See note 78 above.

[82] In the case of a corporation such as the BBC the other questions will also have different lists at the point of entry.

For example they might include some items such as the following:

WHAT BUSINESS
TELEVISION BBC
1. Education
2. Facts
3. History
4. Newsgroups

5. Programs
6. Products
7. Services

PROGRAMS SUBJECTS
Adventure
Biography
Cartoon
Comedy
Comedy and Drama
Crime Drama
Documentary
Drama
Fantasy
Horror
Martial Arts
Musical
Mystery
Science
Fiction
Speculation
Thriller
Western

Action/ Adventure
Archives
Cartoon
Comedy
Children
Cooking
Consumer Affairs
Current Affairs
Documentary
Drama
Education/ How-To
Environment
Finance/ Real Estate
Fine Arts/ Culture
Game Show
Health Medicine/ Fitness
Home and Garden
Infomercial
Literature
Multimedia
Music

Music videos
Mystery/ Suspense/ Horror
Politics
Religion
Regions
Science, Technology
Science Fiction
Soap Opera
Special
Talk Show
Teens
Travel
Training Services
Variety
Western
Weather
Cf. http://www.iguide.com/tvguide/jp/search/movie.sml and other.sml.

WHERE BUSINESS
TELEVISION BBC
1. Headquarters
2. Regional Sites

WHEN BUSINESS
TELEVISION BBC
1. Daytime
2. Schedules Weekly
3. Schedules Two Weeks
4. Weekend
5. Year

HOW BUSINESS
TELEVISION BBC
1. Internet
2. Radio
3. Television

WHY
1. CRTC
2. Employment Equity
3. Media Accountability
4. Philosophy

[83] For example, if the goal is education, then the maps will show items listed under:

QUESTIONS WHERE
1. Colleges
2. Libraries
3. Ministry of Education
4. Schools
5. Universities

If the scope is Emergency the choices change to:

QUESTIONS WHERE
1. Doctors
2. Fire Department
3. First Aid
4. Hospital
5. Police

If the scope is Business the list changes to include:

QUESTIONS WHERE
1. Banks
2. Credit Unions
3. Currency Exchange
4. Insurance Companies
5. Stock Exchange
6. Trust Companies

If the scope is religious the list changes to include:

QUESTIONS WHERE
1. Churches
2. Mosques
3. Synagogues

[84] Perreault, as in note 78 above, p. 191.