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Internet Domain Names and Indexing

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Introduction

Once upon a time the question of domain names seemed simple. There was a small community and the remarkable Dr. Jon Postel had everything under control. Unfortunately Jon Postel did not live happily ever after. He died (16 November 1998) soon after the advent of the Internet Corporation on Assigned Names and Numbers (ICANN).[1] This paper reviews a) changes in the Internet over the past decade and b) the background of Domain Name Spaces (DNS); c) notes growing links between Internet and the methods of memory institutions (libraries, museums and archives) and d) suggests that these can be used to meet challenges facing the Internet.

The Internet began quite pragmatically, without carefully defined methods of naming and indexing. This made sense as long as it entailed a small group of researchers. But as the Internet potentially becomes our chief means of access to knowledge, its continued growth threatens to bring an exponential degree of chaos. This could well destroy the original dream for universal access, which originally inspired the Internet. The Internet needs a more logical naming structure.

To this end, reforms in the Top Level Domains (TLDs), Second Level Domains (SLDS) and Third Level Domains (3LDS) are suggested. The obvious advantage of such reforms is that professionals will be able to orientate themselves much more efficiently. Less obvious, but at least as important this will allow search engines, browsers and intelligent agents to search, pre-select and arrange materials more systematically for the inexperienced user. A further advantage to expert and novice alike will be a greater ability to identify authenticity and quality of sources. This will inspire the trust that is prerequisite for a healthy future of the Internet.

Needed is a semantic web. Here there are competing visions. Some seek a machine-readable web with a-temporal, common sense, "intelligent," robotic agents which might one day replace human intervention altogether.[2] While this approach may be acceptable to a technocratic elite, it cannot answer the needs of ordinary citizens using the web. We need Internet addresses, which provide citizens with a basic orientation. sense to

For this reason, we strive for a web, which includes historically changing symbolism, meaning, interpretation, nuance and the subtlety of the human condition. We need to reflect the needs of humans, rather than the specifications of machines. To achieve this we need to add cultural and historical knowledge to our databases. We need to move from static to dynamic models of knowledge. Accordingly, a long-term project called MEMECS (*Metadonnées et Mémoire Collective Systématique*) is recommended, which could be achieved through a network of centres of excellence in keeping with the vision of a European Research Area (ERA).

September	1998	147 million
“ “	1999	201 “ “
“ “	2000	368 “ “
August	2001	513 “ “

Figure 1. Internet Growth from 1998-2001.

Developments in the Internet

The Internet began by linking a small group in high-energy physics and the military. With the advent of the World Wide Web (1990), the Internet began to grow very quickly. From March to September of 1998 it more than doubled in size from 66.6 to 147 million. In the past three years it has grown to 513 million (figure 1).[3]

The role of English has also changed radically. Initially the Internet was almost exclusively in English. By 1996, there were some 40 million English language users (80%) and 10 million non-English users. In September 2001, there were 220 million English language users (43%) and it is predicted that by 2005 there will be 320 English language users (25% of 1120 million users).[4] In 2001, Chinese became the second most used language of the Internet (9.2%). It is predicted that by 2007 persons with Chinese as their first language will be the most numerous group on the Internet. By now over 70 of the world’s 6,500 languages are represented on the Internet. As the vision of “Internet for all” gradually changes from being a handy slogan to a reality, we clearly need a framework with a coherent approach to multi-lingualism on the web. Fortunately, a new Multilingual Internet Naming Consortium (MINC) established on the occasion of INET 2000 (Yokohama) specifically addresses these problems.

The size of the Internet content is a matter of considerable debate but there are claims that is growing by 7 million pages per day[5] and that the deep web, which includes databases, intranets and other materials not readily accessible to search engines may extend to 550 billion pages.[6] Given such enormous change, there are many challenges with respect to knowledge organization and to gaining access to this ever growing content on the Internet.

Another fundamental change of the past decade has been an incredible increase in the processing speed, and storage capacity of computers as well as the potential throughput speeds of the Internet. In the 1980’s modems typically had 200 or 400 Baud/second. By 1995, at the G7 Exhibition on the Information Society throughputs of 27 Megabytes were demonstrated in a transatlantic connection between Canada (Vancouver, Ottawa and St. John) and Belgium (Brussels via Berlin). By 1998, there were demonstrations of one terabyte/second connections. In 1999, this increased to three terabytes. Experts predict that within a decade connectivity will increase into the petabit range and computational power will increase one million-fold. As a result, many of the technical limitations, which faced the early users of the Internet will disappear at least for users on earth. Those engaged in the emerging, interplanetary Internet will have other problems, which are beyond the scope of this paper.

Early Domain Name Spaces

When Jon Postel began using Top Level Domains (TLDs) in 1984 they served as a simple method of classing the main categories of users. This approach was formalized in March 1994 (RFC 1591), when generic TLDs established seven elementary classes, namely, government (.gov); education (.edu); business (.com); military (.mil); organisations (.org); network (.net) and international (.int).[7] This basic list of seven top level domains is being expanded to include seven further categories, namely: .aero, .biz, .coop, info, museum, .name, .pro.[8] In retrospect, all of these domains could all be seen as examples of different kinds of organization.[9] In which case, technically speaking the Top Level Domain .org has thirteen sub-classes.

These TLDs are part of a hierarchy. Hence, top level domains (TLDs) contain second-level domains (SLDs), which in turn contain third-level domains (3LDs) and are positioned from right to left. Hence, in the internet address www.icann.org, there is a third level domain (www) in a second level domain (.icann) in a first or top level domain (.org). The logic of this approach is questionable because one goes from a class (an organisation as a TLD) down to a subclass (a specific organisation such as icann as a SLD) and then back to a super-ordinate class (www as the container of all organizations as a 3LD).

As the Internet spread around the world, these hierarchical domain names were combined with the two letter country codes from ISO-3166, such as .fr for France and .de for Deutschland (i.e. Germany). There were also proposals to add additional codes for continents, namely, .eu for Europe. These developments implicitly play havoc with the initial hierarchies of domain names. For instance, using the American logic of the TLDs in the address www.louvre.edu.fr, the top level is now theoretically the country (.fr); the second level is the generic class (.edu); the third level is the specific institution (.louvre) and the fourth level is again a super-ordinate class: world wide web (www).

Moreover, since Americans assumed that no country code was necessary for their own country, the original logic of TLDs, SLDs and 3LDs soon applied only to the United States and not to the rest of the world. The introduction of a new suffix .us (November 2001),[10] means that the original logic of the domain names no longer applies anywhere. In 1969, when the Internet began on the West Coast of the US this was not a problem. In a world, where the Internet represents a global, multilingual and multicultural population, in which the US statistically represents 4% of the world population, another solution needs to be found.

Logically, it makes much more sense to have a consistent hierarchy going from universal to particular (namely, world, continent, category, institution: e.g. www.eu.fr.museum.louvre).[11] However, this interrupts a geographical hierarchy (eu.fr), with a conceptual hierarchy (museum) and then goes back to a geographical hierarchy (louvre). Hence it would be even more consistent to begin with a strictly geographical hierarchy and follow this with a conceptual hierarchy beginning with generic content

descriptors. Hence one would begin: world, continent, country, institution, category: e.g.. www.eu.fr.louvre.museum. If every institution is then given Global Positioning System (GPS) and Geographical Information System (GIS) co-ordinates, then the Internet "address" can allow geographical searches. Indeed, it can be linked with gazetteers such that www.eu.fr.louvre.museum implicity reveals the province, city and section of the city (*arondissement)*, as if the address were www.eu.fr.[iledefrance. paris.6earondissment.] louvre.museum.

Intuitive novices with little knowledge of geography may not immediately see the value of this feature until search engines and browsers are able to show them precisely where an edifice or monument is on a map.

Internet and Memory Institutions

When the Internet began it was largely an experiment with respect to new kinds of communication particularly with respect to new personal knowledge (e-mail, MUDs, MOOs, MUSHs) and collaborative knowledge. Since the advent of the World Wide Web (1990), the Internet increasingly entails the enduring knowledge of memory institutions. Some visionaries predict that within the foreseeable future the whole of enduring knowledge will be accessible on-line. A challenge remains how to integrate new forms of personal and collaborative knowledge with enduring knowledge. Since the custodians of this enduring knowledge (in the form of librarians, curators, cataloguers, and indexers) have patiently been developing their skills for over two millennia it is reasonable to profit from their experience.

Already a decade ago there was concern that those contributing to the World Wide Web inevitably did not have the discipline of librarians with professional skills in indexing and cataloguing knowledge. A project initiated (1995) by the (Dublin) Ohio Computer Library Center (OCLC) called the Dublin Core (Metadata Initiative) identified a minimal set of fifteen categories, which can be used to describe new electronic content on the Internet. The Dublin Core efforts began as an American project. In the past years, the Dublin Core has greatly expanded its activities and is now truly international in scope. There are increasing efforts to use the Dublin Core categories both to describe new materials on the web and to create mappings or bridges with cataloguing systems of memory institutions (e.g. MARC records in the library world).

Our proposals complement this vision. Adding keywords to domain names, which are controlled vocabularies of subject headings and classification systems will serve as a first orientation concerning the location of a site and the nature of its content. The Dublin Core initiative will provide more extensive (albeit still quite elementary) descriptions with respect to content, which originates in electronic form. With respect to digitized versions of memory institutions more thorough cataloguing and indexing methods will be available.

Within the library world in particular and memory institutions generally, there has been a further trend to link the fields of classification systems in libraries such as Dewey,

Library of Congress, and Göttingen, with both fields and titles of catalogue records in order to provide new access strategies. A similar trend is evident in classification systems for art such as Iconclass and the Art and Architectural Thesaurus. This is important because it introduces controlled vocabularies known as authority lists, which effectively standardize one's search terms.

If one applies these methods to internet addresses one can use official subject headings, such as the Library of Congress Subject Headings (LCSH); the Medical Subject Headings (MESH) or the Art and Architectural Thesaurus (AAT) Subject Headings as controlled vocabularies for the next stage(s) of content description. These can then be linked both with web contents and with materials originating from memory institutions.

In the case of a specialized collection this will require the addition of only one word to the address. In the case of comprehensive collections such as the Louvre different departments will simply have different suffixes: e.g. the section on Italian painting would be www.eu.fr.louvre.museum.italianpainting. This could even be specified by a further spatial and/or a temporal qualifier such as Florentine and Renaissance as in www.eu.fr.louvre.museum.italianpainting.florentine.renaissance. If all the terms used in such descriptors come from controlled vocabularies then searches for on-line museum collections can be automatically co-ordinated with literature searches from libraries, museums and archives. Trademarks such as IBM or Coke would function in the same way as names such as the Louvre and would thus not be compromised by this new system.

In the interests of efficiency, different levels of searching can be introduced. If a beginner is doing a general search, the system might only scan the first five categories of the address: i.e. www.eu.fr.louvre.museum. Meanwhile, the detailed addresses can be cross indexed such that experts interested specifically in Florentine painting of the Renaissance could access not only the Louvre but also the Uffizi, Brera, National Gallery of London and so on.

There are at least three advantages in linking the domain names of Internet addresses with the controlled vocabularies of subject headings and classification systems in libraries, museums and archives:

1) These systems are in many cases translated into a number of different languages. Hence the French version of address of the Louvre site could read www.eu.fr.louvre.musée.peintureitalienne.florentin.renaissance and it would potentially make no difference if a person typed an address in French, English or another language.

2) The enormous efforts of the memory institutions to create mappings and bridges between systems for new access to their collections can be applied to electronic collections on the Internet with a minimum of effort.

3) These different classification systems can provide us with insights into how different cultures organize knowledge very differently.

Changes in Nomenclature

We noted how the initial TLD, SLD and 3LD hierarchy was problematic because it went from a class (TLD), to a subclass (SLD), back to a super-ordinate class (3LD). This confusion was increased by the introduction of country names, which applied everywhere except in the United States and which also mixed conceptual (e.g. organization, museum) with geographical (e.g. Louvre, France) hierarchies.

Our proposed reform is to begin Internet addresses with a geographical hierarchy (which can then be augmented through links with GPS and GIS systems) and follow this with a conceptual hierarchy. This requires an adjustment in the nomenclature of the TLD, SLD, 3LD hierarchy. The TLD as the initial class will retain its original meaning but the SLD and 3LD would in future refer to subclasses of the TLD written to the right of rather than to the left of the TLD. Further clarity can be gained by renaming the Top Level Domain a First level Domain (1LD) and creating a consistent spelling form for abbreviations of all three levels: namely, second Level Domain (2LD) and (3LD). All domain names would, moreover, be aligned with subject catalogues and classification systems. This allows a new integration of Internet addresses with classification methods[12] and bibliographic principles of memory institutions. It also restores a logical order into Internet addresses.

Challenges to Knowledge Organization and Access

Global, National, Regional and Local

In the past, the place where information was stored frequently gave important clues concerning its provenance and as such also some clues concerning its status. Materials in a local village library, aside from a handful of standard reference works (e.g. atlases, dictionaries, and encyclopaedias) were typically materials relating to that village. Materials in a regional library typically focussed on that region. National libraries reflected first and foremost collections from their own country. Finally, a very few universal libraries such the Vatican, the Herzog August Bibliothek, and more recently the British Library, Bibiothèthque Nationale de la France and the Library of Congress aimed to collect materials on a global basis. A problem remained that persons at each level developed their own rules for cataloguing and indexing materials such that there were no common standards to gain access to this very disparate materials.

In the latter half of the nineteenth and throughout the twentieth centuries there were increasingly efforts to arrive at international standards. A series of international organisations arose such as the International Standards Organisation (ISO); the international Telecommunications Union (ITU); the International Federation of Library Associations (IFLA); the International Committee of Museums (ICOM); and the United Nations Economic, Social and Cultural Organisation (UNESCO).[13] A tacit assumption arose that local standards had a limited value, regional and national ones were better and international standards were ultimately needed. There was a hope that if one could only reach international agreement then all one's problems would be solved.

In science, technology and many aspects of medicine this is undoubtedly true. For instance, with respect to definitions of zinc, or a chemical formula, it is essential that scientists agree if there is to be science on a global scale. Similarly, with respect to definitions of the left aorta of the heart, it is absolutely vital that medical doctors agree if operations in Rio and Sydney are to be as safe as in London and Toronto.

In the case of the arts and culture, however, the situation is very different. To take a prosaic example of beer, there may be an international definition and there may be international standards to ensure that the fermentation process is safe, but ultimately beer is so fascinating through its national, regional and local variants. In science the universality of global agreement makes a particular law, rule, or principle important. By contrast, in culture it is precisely the richness in the national, regional and local variants of a rule or principle that make it important. If science seeks to find the unchanging aspects of a rule, culture seeks to record the changing exceptions to the rule, and changing interpretations of these exceptions for therein lies the uniqueness and originality, which we associate with art and culture.

Hence, while global organisations may answer the needs of the sciences, global organisations such as UNESCO and ICOM alone cannot answer the needs of culture if they aim only at global standards and definitions from head offices in Paris and Geneva. Needed is a new co-ordination of knowledge at the global, national, regional and local levels. Only in this way can we attain insight into the richness and diversity of cultural expression: not just principles expressed in the great centres but also the variants and alternatives in different countries, provinces, cities and towns. This is our only hope of transcending the dichotomies of regional (jihad) versus global (McWorld) proposed by Barber.[14]

The World Wide Web marks an enormous step forward in that it contains materials from all levels. For the first time we have a communication medium which has local, regional, national and international knowledge. However, a fundamental drawback of today's web is that there is no systematic method to indicate from which level a given site came. To be sure we have the .int suffix for international organisations, and we have the country codes to indicate different nations, but we have no way of determining whether materials are national, regional or local.

Here a coupling of a) institutions with b) Global Positioning Systems (GPS) and Geographical Information Systems (GIS); and c) with gazetteers as outlined above would allow us to establish these new links between local, regional, national and international knowledge. This is essential for the evolution of meaningful search engines in the cultural sector. If, for instance, I am searching for examples of the *Annunciation* I can type in the word in Yahoo or Hotbot. Better still I can use the image search function on Google. Even so I am given an enormous list of *Annunciations* with no logical or spatial order. By contrast, if these could be arranged nationally, regionally and locally it would be possible to discover how *Annunciations* in the Euregio around Aachen are quite distinct from those in Tuscany or Catalonia. An European IST project called IMASS[15] is exploring these problems in the context of a Virtual Reference Room.

Timeless and Temporal

Another fundamental difference between the concerns of science and those of culture relates to time. In science, the quest is to discover timeless laws, which are unchanging. In the arts we say that a thing of beauty is a joy forever (Keats) and we speak also of the timeless beauty of a Greek sculpture, a Michelangelo or Rembrandt. And yet there is another sense in which time plays a basic role in culture. In science if a law changes with time it is dismissed as not being a true law. By contrast, if a Greek statue or a Roman temple needs restoring because its original state has changed, no one would dismiss it as being any less true or real –unless perhaps it has become such a ruin that it is no longer recognizable. Hence, while the aesthetics of art and culture speak of timeless beauty, time still plays a vital role therein: when an object was made, when it was altered, when it was restored, sometimes when it was lost and when it was refound and when persons thought what about a given object or a person.

Our web sites need a temporal and thus an historical component. We need a time stamp identifying when a web site was first launched, with a section in the metadata recording not just when it was last modified but all the times a site was modified such that we shall be able at some point to trace how these sites developed.

Dynamic Maps

This temporal dimension needs to be built into all our knowledge. In the case of maps, for instance, web sites such as Map Quest typically provide me with contemporary maps. However, if I am an historian searching for Poland in 1000, I am searching for a small country. If I am searching for Poland in 1440, I am looking for the largest country in Europe at the time. So we need dynamic maps.

Dynamic Knowledge

As noted earlier, in applied science and technology, there is typically one definition of zinc. For modern zinc companies historical definitions are useless. By contrast, in the realm of culture these changing definitions in different locations and over time play a central role. The changing opinions of scholars concerning how many paintings Rembrandt made or concerning the relative importance of Shakespeare are vital for the arts and culture. Static lists of today's knowledge are not enough.[16] We need databases with dynamic lists, which reveal cultural and historical differences through alternative interpretations and theories. Herein lies the depth of our cultural traditions. To achieve this we need a long-term commitment to a MEMECS (*Metadonnées et Mémoire Collective Systématique*) project,[17] which builds on Vannevar Bush's vision for the Memex system.[18]

To achieve such a vision requires new co-operation among universities and research institutions, which might be achieved though a broadband Network of Centres of Excellence in Digital Cultural Heritage[19] in keeping with Philippe Busquin's vision of

European Research Area (ERA). Such a network could subsequently be expanded to include Japan's Digital Silk Roads project and UNESCO's global portal for culture and e-learning. This would lead to a Global Research Area and a new grid for culture.

A decade ago there was great excitement about virtual reality. The past years have made us increasingly aware of the potentials of augmented reality. Here virtual reality serves as a (transparent) layer, which can be superimposed onto the physical world. Hence, one can superimpose onto a physical ruin of the Greek Temple of Hera in Olympia, a reconstruction of what the temple looked like originally as is being done in the Archeoguide[20] project. This approach can be extended to include different hypotheses and interpretations concerning the same temple, or to visualize how the Greek constellations are different from Persian, Indian, Chinese and Mayan ones. Augmented knowledge and culture can thus literally help us to see how different cultures perceive the world differently.[21]

Machine Intelligence and the Semantic Web versus Culture

There is a quest within the World Wide Web to create a global reasoning web or a semantic web. Here one of the goals is to produce machine-readable information, which no longer requires human intervention. The extreme version of this quest goes much further: to create autonomous, command/decision-making robots and intelligent agents to replace the human beings altogether. This helps explain the growing emphasis on natural language and so-called common-sense ontologies (e.g. CYC). The military attraction of solutions, which no longer require human presence or even human existence are great, but such a robotized vision of the future can hardly answer the needs of humanity and culture.[22]

Conclusions

A review of the Internet during the 1980s and early 1990s revealed how Top Level Domains (TLDs) were initially arranged hierarchically, such that they were preceded by Second Level Domains (SLDs) and Third Level Domains (3LDS). A weakness of this system was a lack of consistency in moving from classes to sub-classes and back to super-ordinate classes. Once the Internet became international and country codes were added, the logic of this construction was further destroyed, especially since the rules for the world remained distinct from those in the United States. There was now a confusion of conceptual and geographical hierarchies. If this confusion is not corrected it could produce exponential chaos with respect to accessing Internet content.

The Internet has also seen three fundamental changes. It now: 1) has over 513 million users; 2) is now predominantly multilingual; 3) its content, which focussed on new kinds of personal and collaborative knowledge, increasingly includes the enduring knowledge of memory institutions (libraries, museums and archives).

A reform in the positioning of domain names within Internet addresses is therefore recommended. This reform separates geographical hierarchies from conceptual

hierarchies. Geographical hierarchies would begin with the (global) network (usually www), potentially followed by a continent code (e.g. .eu for Europe), then a country code (e.g. .fr for France), then an institution (e.g. .louvre). By linking this institution with GPS and GIS co-ordinates and gazetteers one would thus have a systematic way of moving from global maps to local buildings and monuments. This geographical hierarchy would be followed by a conceptual hierarchy beginning with a First Level Domain (1LD, now a class), followed by Second Level Domain (2LD, now a sub-class), followed by a Third Level Domain (3LD, now a sub-sub-class).

This reform in Internet addresses is consistent with other initiatives such as Dublin Core and the semantic web, whereby the experience of memory institutions is being used to provide more systematic description of Internet resources. However, these projects primarily reflect the needs of science and technology with global definitions and a static view of knowledge. Our vision is for the evolution of dynamic and augmented knowledge which reflects the richness of the culture, by creating new links between a) local, regional, national and global sources; b) multiple languages; and c) including historical and cultural changes in symbolism, meaning and interpretation. To this end a long-term commitment to MEMECS (*Metadonnées et Mémoire Collective Systématique*) is suggested, which can be achieved through a new broadband Network of Centres of Excellence in Digital Cultural Heritage in keeping with Commissioner Busquin's vision of an European Research Area (ERA) leading ultimately to a new Global Research Area using a grid for culture. In using the naming and indexing methods of the past we can acheve a new vision of the real in the future.

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I am grateful to Richard Delmas (EC) for inviting me to write this paper, for his helpful criticisms and thank my colleague, John Beckers, for offering helpful suggestions concerning the basic message.

Notes

[1] See: http://www.icann.org/.

[2] This vision was discussed in some detail by the Nobel physicist, Joseph Weizenbaum, *Computer Power and Human Reason. From Judgement to Calculation*, Harmondsworth: penguin Books, 1976, chapters 9-10. It is further discussed by Grant Fjermedal, *The Tomorrow Makers, A Brave New World of Living Brain Machines*, Redmond: Tempus Books, 1986, p. 188. It is discussed by the present author in "Medien, Sprachen und Integration von Kommunikations-prozessen," *Vielsprachigkeit. Transnationalität, Kulturwissenschaften*, Research Institute for Austrian and International Literature and Cultural Studies (INST), 7 December 2001,Vienna, 2002, 10 pages (in press).
See: http://www.adis.at/arlt/institut/termine/saverne.htm.

[3] See: http://www.nua.net/surveys/how_many_online/world.html.

[4] See: http://www.glreach.com/globstats/evol.html

[5] Cyveillance report, 10 July 2000.
See: http://www.cyveillance.com/us/newsroom/pressr/000710.asp

[6] "Web Is Bigger Than We Thought, *San Jose Mercury News*, 28 July, 2000,

See: http://www.nua.ie/surveys/?f=VS&art_id=905355941&rel=true

Mark Frauenfelder, "Deep-Net Fishing," *The Industry Standard Magazine*, June 18, 2001.

See: http://www.techinformer.com/go.cgi?id=490878.

Mike Nelson (IBM) at the INET 2001 Global Summit claimed that in the next 9 years there will be a 1 million fold increase in information. This amounts to the equivalent of 550,000,000,000,000,000 pages.

[7] See: http://www.iana.org/reports/museum-report-30oct01.htm

[8] See: http://www.icann.org/tlds/.

[9] .name entailing a single individual represents a limiting or minimal case of organisation.

[10] See: http://www.dotusa.com

[11] The converse is also possible: e.g. from particular to universal (i.e. louvre.museum.fr.eu.www). This has the disadvantage that persons are accustomed to starting sites with www.

[12] The need for classification is emphasized in the NEW-THINKING@LIST.ADVENTIVE.COM by Gerry McGovern - Email: gerry@gerrymcgovern.com, November 26, 2001 - Volume 6 Number 46.

[13] Cf. Akira Iriye, *Cultural Internationalism and World Order*, Baltimore: Johns Hopkins Press, 1997.

[14] Benjamin R. Barber, *Jihad vs. McWorld*, New York: Times Books 1995. Cf. George Ritzer, *The McDonaldization of Society, An Investigation into the Changing Character of Contemporary Social Life*, Thousand Oaks, Ca.: Pine Forge Press, 2000.

[15] See: http://www.i-massweb.org/

[16] Marshall McLuhan drew attention to the paradoxes entailed in the introduction of the printing press in the West. On the one hand, printing brought an enormous increase in the amount of shared knowledge. On the other hand, printing imposed a static, linear framework on knowledge organization. One of the dilemmas of the Internet is that many newcomers are busily trying to put their printed materials online in the form of web "pages' thus imposing on the web all the limitations of printing rather than exploring the possibilities of digital media which potentially include all five of the senses.

[17] "Cultural and Historical Meta-data: MEMECS (Metadonnées et Mémoire Collective Systématique)," *WWW9*, Amsterdam, 2000 (in press), pp. 1-13. Published electronically as: "Cultural and Historical Metadata, MEMECS (Metadonnées et Mémoire Collective Systématique)," *Cultivate Interactive*, Issue 1, July 2000.
http://www.cultivate-int.org/issue1/memecs/.

[18] This was first described in: Vannevar Bush, "As we may think," Atlantic Monthly, July 1945.

See: http://www.theatlantic.com/unbound/flashbks/computer/bushf.htm

[19] "A (European) Network of Centres of Excellence for Augmented Digital Culture," *CULTH2: Die Zukunft des Digitalen Kulturellen Erbes*, Vienna, 2002, pp. 1-4. (in press). Further information concerning these plans is found on the site of the Maastricht McLuhan Institute which was 0nitially asked by the European Commission to explore this idea in the context of the MEDICI Framework.

See: www.mmi.unimaas.nl and www.medicif.org.

[20] See: http://archeoguide.intranet.gr/project.htm

[21] These ideas are further developed in the author's *Understanding New Media: Augmented Knowledge and Culture*, Munich: Fink Verlag, 2003.

[22] This quest is described at length in Grant Fjermedal, *The Tomorrow Makers, A Brave New World of Living Brain Machines*, Redmond: Tempus Books, 1986, pp. 121 ff. For a review of the arguments see this author's "Medien, Sprachen und Integration von Kommunikations-prozessen," Vielsprachigkeit. Transnationalität, Kulturwissenschaften, Research Institute for Austrian and International Literature and Cultural Studies (INST), 7 December 200, Vienna, 2002 (in press).

See: http://www.adis.at/arlt/institut/termine/saverne.htm.