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Simulating a Global Brain

Using networks of international organizations, world problems, strategies, and values

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Abstract

The paper reports briefly on the ongoing process of systematic information collection and web presentation by the UIA of networks of over 30,000 international organizations, 56,000 perceived world problems, 32,000 advocated action strategies, and some 3,000 values -- resulting in a total of 800,000 hyperlinks. These different entities constitute an interesting focal sub-system of whatever is to be understood by an emerging global brain - for which the "problems" might be understood as "neuroses", if not "tumours". This is followed by a description of implemented features to improve the way in which organizations can use this facility to articulate the collaborative networks within which they collectively develop strategic responses to subsets of the network of problems (perceived in the light of networks of partially shared values). The concrete challenge is the manner in which this network of features can become self-aware via its web representation, at least to a degree that is less dysfunctional in partially coordinating world system responses. Steps taken towards facilitating cognitive coherence include dynamic self-organizing visualizations (and sound equivalents) of these network features. The approach is being designed to maximize the degree to which providers of information become users of the resulting knowledge patterns with which they can interact, notably as a means of evoking richer patterning of the complexity reflected in "synaptic" hyperlinks. The conceptual challenge of developing improved hyperlink editing tools and supportive knowledge management methods is addressed, as well as associated tools through which coalitions of users can derive more coherent patterns of meaning from what they access in the light of often significantly incompatible perspectives. The more fundamental concern of the paper is to highlight the conceptual difficulties of providing information in a form that needs to be variously ordered according to user "bias" whilst providing a non-intrusive, facilitative cognitive framework that can maintain some degree of coherence, or allow for its emergence. A particular concern is the dynamic between the necessary diversity of (often strongly held) preferences for meaningful knowledge representation and the need for (often overly simplistic) coherence within coalitions whose consensus is fundamental to any concrete global response. These challenges raise questions about integrating intelligent sub-systems into a global brain, especially if some of the networks might be understood as sub- intelligent from a global perspective. The paper also reports on steps to shift the level of analysis, and representation, from isolated entities to the multitude of feedback loops buried within such patterns of information.

Relevant interlinked knowledgebases: https://www.un-intelligible.org/docs/overview.php#orga
Relevant papers on knowledge organization: https://www.laetusinpraesens.org/themes/aadocnd4.php
Project introduction page: https://www.un-intelligible.org/projects/homeency.php with links to commentaries

0. Introduction

Historians of hypertext such as Boyd Rayward (1994) have recently identified one of the founders of the Union of International Associations (UIA), Paul Otlet (1868-1944), as being one of the key figures in envisaging what has subsequently become known as hypertext. His pre-computer efforts at the beginning of the 20th century were designed to give form to his vision of a 'collective brain' (Otlet, 1934) -- through the organization of some 15 million filecards. These efforts were partly undertaken institutionally through the UIA (founded in 1910). A separate paper (Judge and Fischer, 2001) even explores the possibility that the 'Union of International Associations' was originally, whether enigmatically or unconsciously, envisaged as a virtual organization that could be understood as a practical experiment in global brain simulation.

The focus of the UIA since the 1950s has been on profiling international nonprofit organizations in every field of human activity. Associated profiles have been maintained on their meetings, the problems of concern to them (from 1972), the strategies envisaged in response (from 1986), as well as associated concepts of human development, values, and bibliographic references. This work was

computerized from the mid-1970s. A major pre-web concern was to provide links between entites in any of these databases, as well as between entities in different databases. From 1996, increasing portions of this material have been made freely available on the web (https://www.un-intelligible.org/docs/overview.php#orga) in a manner which ensured that all links became hyperlinks. Most entities are held in such a way as to engender search queries to external web resources.

As a historical footnote in relation to the 'global brain' theme, and H G Wells' early pointers to it (1937, 1938), it is appropriate to note that Peter Hunot, the first post-World War II editor of the UIA's *Yearbook of International Organizations* (https://www.un-intelligible.org/docs/overview.php#orga), was the former personal secretary of H G Wells. In the case of the UIA, Otlet's initiative (more ambitiously articulated in *Monde: essaie d'universalisme* in 1935) subsequently provided a framework for its *Encyclopedia of World Problems and Human Potential* (https://www.un-intelligible.org/projects/homeency.php) now accessible on the web.

1.0 Current status and methodology

The core activity is based on maintenance of profiles of international nonprofit **organizations**, whether governmental or nongovernmental -- in every field of human activity (some 800 subject classifications). Links between profiles, of different types, are also maintained as well as links to profiles in other knowledgebases -- since these organizations are usually associated with **strategies** on **problems,** articulated in **meetings**, in the light of **values** and in pursuit of some understanding of **human development**. The table below provides an overview -- and links to further information. Information is collected from international organizations (or the web) on a regular basis. The work is funded by sale of information services as indicated below, or through occasional projects (eg 1997-2000 through EU Info2000, DG-XIII).

Operational database projects							
Projects	Databases				Comments	Publications	
	Items	Links	Profiles	Maps		CD	Books
International organizations / NGOs	53631	137000	yes	yes	comments	CD	book
World problems	56411	265300	yes	yes	comments	CD	book
Strategies - Actions - Solutions	32695	239963	yes	yes	comments	CD	book
Human development	4817	16130	yes	yes	comments	CD	book
Human values	3257	119545	yes	yes	comments	CD	book
Integrative knowledge	600	-	profile demo	.	comments	.	.
Metaphors and patterns	.	.	profile demo	.	comments	.	book
Metaphors and patterns	.	.	experiment	.	comments	.	.
Biographical profiles	21625	-	yes	.	comments	CD	book
Bibliographies	34158	-	yes	.	comments	CD	book
International meetings	160189	86683	yes	.	.	.	book
Visualization (dynamic spring maps)	.	.	.	yes	comments	.	.
Visualization (virtual reality)	.	.	.	yes	comments	.	.
Sound (music)	.	.	demo	.	comments	.	.
Humour	.	.	demo	.	.	.	.
Totals	364126	864621	.	.	.	.	.

A general commentary on this project is available. Specific commentaries on issues arising from aspects of this work are also available, as noted above where appropriate.

For a **statistical overview** of the development of the Encyclopedia databases, see:

- Development (1976-1995)
- Subsequent development of world problems and strategies databases

2.0 Particular features relevant to the global brain theme

Comprehensiveness and the meanings of 'global': It might be said that there are no biases regarding the areas of human activity on which information is collected for these knowledgebases -- or, better still, that the profiles produced each reflect the strong biases held by particular constituencies. However a significant bias is towards information that is of more than local or national significance. Other kinds of bias might be identified regarding the adequacy of representation of information from non-English, non-western, non-literal cultures -- even though such concerns are assiduously reflected in the preoccupations of many international organizations and the information they provide. Interesting questions might also be raised regarding the bias implict in the notion of 'node' and the kinds of relationship possible. Currently ternary relationships (on which there is an extensive literature) are excluded. [for more on biases]

With respect to 'global' brain however, there are important questions as to the degree to which of the following is the prime emphasis:

- **global in the sense of 'world':** Here the focus is on the geo-political dimension, namely a brain encompassing preoccupations

from around the world -- worldwide. It is this sense that gives rise to 'globalization' and 'global traveller'. Any global ordering here primarily emphasizes the multiplicity of bilateral connections around the geographical world as a set, without any other explicit sense of their meaningful organization. This may include understandings which specifically refer to global 'networks' where these are essentially understood as a pattern of bilateral links, with some significant hubs.

- **global in the sense of 'unitary':** Here the focus is on the unity of the world (often symbolized by a photograph of Earth from space, or the notion of Gaia). This focus tends to lack any ability to deal specifically with the complexity and diversity from which that unity is understood to emerge. The unity is taken as a given posing no conceptual challenges. This focus is a basis for reflection and campaigns about Earth as a whole. The phrase 'think globally, act locally' is associated with it, as are notions of 'planetary consciousness' and Teilhard de Chardin's 'noosphere'.
- **global in the sense of 'integrative':** This relatively obscured sense emphasizes the degree of integration of the brain, in the mathematical or systemic sense of a global, rather than a local, solution. Such a connotation is characteristic of higher degrees of order whether embodied in cybernetics, theories of complexity, complex organizations, or the levels of understanding that are purportedly an attribute of wise (mature, well-integrated) people. It raises fundamental issues about how any higher orders of integration are achieved, function and may be understood.

In relation to these distinctions, the UIA has produced a database of some 600 integrative, transdisciplinary and unitary concepts (https://www.un-intelligible.org/projects/homekno.php). The web however provides an interesting bridge between all three of the above understandings of 'global' (Judge, 1996). The UIA information collection focus relates primarily to entities that are integrative in the first sense, namely interrelating perspectives from different parts of the world. But the concern is to build into the access facilities features responding to the challenges of the third -- especially the challenge of coherence as suggested by the need for interdisciplinarity and comprehension of complexity (**). However a more radical question might also be raised as to whether a global brain should, at some stage, also reflect non-human intelligence.

Interrelating different kinds of conceptual entity: To avoid the challenges of information overload, the focus of this work has been on a range of quite distinct, and specifically defined, conceptual entities that are handled in separate databases. Entities within each database may be extensively hyperlinked together in addition to hyperlinks between entities in different databases. For the pupose of the global brain perspective of this paper, these entities may be viewed as follows

Interrelating different kinds of conceptual entity		
Entities	Explanation	Global brain relevance
international organizations	non-profit intergovernmental or nongovernmental organizations	globally connected distributive knowledge systems
world problems	identified as preoccupations by international organizations and other constituencies. Care is given to distinguish such entitiers from topics of study, and there is a requirement that they be well-named with negative-value descriptors (eg **literacy** is not a problem, **illiteracy** is)	collective phobias, neuroses, etc
global strategies	advocated by international organizations or other constituencies in response to world problems. Care is given to ensure that these are named with action-oriented descriptors to avoid confusion with topics of study or interest.	collective procedure, best practices
human values	values implicit in recognition of world problems, in strategies in response to them, or exemplified by human development	collective attractors / repulsors
international meetings	organized by international organizations in response to problems, to articulate strategies or to celebrate values	binding moments within global brain
human development	concepts of human development and modes of awareness as an important objective of many strategies and embodiment of values	goals and processesd to be facilitated by global brain?
integrative knowledge	understandings of transdisciplinary, integrative, unitary and globality	articulations of coherence potenjtially associated with a global brain
bibliographical references	whether the products of international organizations, about them, or about the issues with which they are concerned	
biographical profiles	on key executives of intrnational organizations	

Interaction with information sources: The knowledgebases are maintained through various degrees of interaction with providers of information, especially international organizations having issue and strategic preoccupations. International organization information is obtained annually via (email) questionnaires (as well as via the web) as a basis for the *Yearbook of International Organizations* and its electronic variants.

To the extent that the universe of international bodies may be said to reflect deliberately organized responses to the complete range of human preoccupations, it can be said that they constitute focal nodes in a form of global brain through which facets of human social reality are perceived, defined, and given relative significance. Whether this is to be understood, as with any encyclopedic undertaking, as one precursor or a subset of some larger understanding of a global brain is clearly a matter of discussion.

The web facility is being designed to facilitate and encourage continual amendments to profiles and links by interested parties, notably international organizations, whether through a comment facility or through online distance intelli-work.

Hyperlink context and generated links: The knowledgebase is not designed as an isolated system. Every entity is named with titles rich in keywords that are used to enable query links to web search engines offering access to relevant resources. Experimentally such keywords are also used to pull into the profile visible to the user generated hyperlinks to entities in other parts of the knowledgebase. This technique is used where resources have not been allocated to providing hard links to selected entities in other databases.

With respect to the global brain, this raises interesting issues about the values of associative links which may or may not be relevant.

Hypertext editing: The databases are very much understood as knowledgebases. A major challenge is to provide links between entities whose relationship may often be neglected or represented only in secondary literature. Clearly when such links are explicit in accessible texts they can be incorporated. However many problems arise where link information is crudely given in the literature. An example would be if Entity A is described as directly linked to Entity D in one source when other sources make it clear that this link is only via Entity B and Entity C.

Resolution of the class of challenges of this kind requires a combination of software and knowledge skills that will probably be the basis for a future profession through which the quality of a global brain will be maintained and enhanced. Effectively this is a process of synapse editing!

Use of multi-media for conceptual integration: The quantities of information involved, and the manner in which the system is normally used in text mode, raise concerns about simply reinforcing user tunnel vision -- a concern fundamental to any discussion of a 'global' brain.Whilst hyperlinks are usually present to points outside the user's immediate domain of preoccupation, there is a need to provide useful contextual frameworks to facilitate any desire for a broader overview. Several experimental approaches have been taken to this and made available to users:

- **Virtual reality:** A number of approaches have been investigated for the projection of complex networks onto different kinds of structure that could be explored using readily available virtual reality browser plug-ins. The key here has been decisions on the integrative design metaphor of the surface onto which nodes and relationships are projected. The intention has been to offer to the user choices of geometric design metaphor (sphere, spiral, etc). The structures are generated over the web on request.
- **Spring maps:** This approach, pioneered by Gerald de Jong, takes advantages of properties of elastic interval geometry to resolve the basic problem of how usefully to distribute elements of a topological network over a restricted plane surface (what might be called the 'automated subway map design problem'). Essentially links are defined mathematically as springs allowing any network to self-organize over a given surface. Various tools may then be offered to the user to explore such networks (zooming, panning, etc), to drag and freeze parts into meaningful positions, or to redisplay the map with other colour codes. Currently software permits spring maps with up to 2300 nodes to be explored.

In both these cases the features of the display are active in that users could either choose to obtain text profiles corresponding to nodes or generate a new structure centred on the selected node.

Data sets have also been ported into proprietary packages:

- **Decision Explorer:** This enables more detailed analysis of networks from a decision-making perspective. It has its own display and modelling approach. This facility is directly available as an option to web users. [*** sample]
- **Netmap:** This sophisticated tool allows millions of entities to be positioned around the circumference of a cricle, with links between them displayed as coloured lines across the circle. In this way the single circle provides an overview of the complete data set (one experiment with UIA data used 150,000 entities; see more). Zooming facilities allow display of individual entities. Analytical features allow subsets of the data to be clustered in a variety of ways meaningful to investigative decision-making. [**** ppt]

Currently developments are focusing on the association of tones and music with spring maps in order to use sound effects to provide the user with a soundscape matching the visualization. The emphasis is on how users can themselves associate sound effects with complex structures in order to sustain integrative understandings of complexity.

Such an approach has been justified for similar reasons in efforts (under the term 'protein music' or 'genetic music') to associate tones with features of DNA structures, notable by computational biologists. Web resources include: http://education.llnl.gov/msds/music/midi-dna.html; http://www.whozoo.org/mac/Music/index.htm; http://ndb-mirror-2.rutgers.edu/NDB/archives/MusicAtlas/proj.1.html. A useful discussion of such approach is given in http://www.whozoo.org/mac/Music/Sources.htm; http://www.aber.ac.uk/~phiwww/pm/. These efforts have given rise to a *Nucleic Acid Database Musical Atlas* (http://ndb-mirror-2.rutgers.edu/NDB/archives/MusicAtlas/index.html).

Feedback loops: The major emphasis on hyperlinking conceptual entities means that these semantic networks can be analyzed to detect various characteristics, notably the presence of loops. Such loops may be an indication of possible errors but may more interestingly be a basis for shifting the level of analysis and understanding beyond the common focus on individual entities in isolation or simply as part of an unordered set. [see discussion]

The notion of "loops", and its relevance, requires some further explanation. As defined by Colin Eden and Fran Ackermann (*Making Strategy,* 1998) in describing the value of *Decision Explorer* : a loop represents a description of a chain of consequences that produces a dynamic outcome by feeding off itself (positive feedback = "vicious" or "virtuous" loops), or by controlling itself (negative feedback). Typically a feedback loop will be an important strategic issue in its own right. The purpose of detecting feedback loops is to raise the level of analysis of individual issues to a higher, systematic level. It is a technique which has the potential to add extra meaning to basic data, particularly relevant for policy makers (one significant user group for this product) and others concerned with understanding the interrelationships and root causes of environmental problems, notably those relevant to biological conservation.

A self-reinforcing ("vicious") problem loop, then, is a chain of Problems, each aggravating the next, and with the last looping back to aggravate the first in the chain. An example is:

> *Man-made disasters > Vulnerability of ecosystem niches > Natural environment degradation > Shortage of natural resources > Unbridled competition for scarce resources > Man-made disasters.*

Such cycles are "vicious" because they are self-sustaining problem cycles. organisational strategies and programmes that focus on only

one problem in a chain may fail because the cycle has the capacity to regenerate itself. Individual "vicious problem cycles" also tend to interlock, forming tangled skeins of interlinked global Problems which implicate single environmental problems in chains and complexes of multi-sectoral issues. Without the means to untangle the relationships, the response to a conservation challenge may be ineffective, self-defeating or, even, harmful.

It is important to recognise that it is precisely through the detection of such loops that attention can be drawn to defects in the pattern of relationships in the data. It is possible for some loops to be the result of incorrect relationships rather than being representative of genuine feedback, and so "accidental" loops appear. Detection of loops is therefore in the first place an editorial tool for hyperlinkage within a relational database. It raises questions as to the appropriateness of certain links which otherwise may go unquestioned. It also sharpens the discussion on how distinctions are made, using verbal categories and definitions, and how system boundaries are drawn grouping what is represented in this way. The results indicate this is a very interesting area for further exploration.

An indication of the numbers of loops detectable (of different size) is given below for the case of problem entities linked by the 'aggravating' relationship (namely Problem A aggravates Problem B):

Progressive Refinements of Problem Loops					
.	Prior to Project	EU INFO2000 Project			
Date	1995	1999	1999	2000	2000
.	Column 1	Column 2	Column 3	Column 4	Column 5
Machine	386/486	486	Pentium III	Pentium III	Pentium III
Processing Time	many weeks	Some days	37 hours	12.5 hours	500 hours
Chains tested	9,519,722	15,000,000	46,474,882	16,091,877	1,239,769,768
Profiles	-	-	6,891	1,217	12,397
2-Loop	-	-	-	-	5
3-Loop	35	-	-	-	173
4-Loop	115	-	-	-	230
5-Loop	527	-	-	-	473
6-Loop	3,058	-	-	-	1,163
7-Loop	3,568	-	-	-	3,473
8-Loop	excluded	excluded	excluded	excluded	10,600
9-Loop	excluded	excluded	excluded	excluded	35,438
Total	**7,303**	**6,000**	**15,958**	**8,253**	**51,555**

Reflection of real-world preoccupations: By using international organizations as a prime source, the resulting web knowledgebase endeavours to hold the widest possible spectrum of perspectives on matters and dimensions of concern to the world. It can at any time be 'confronted' with new entities in knowledge space for inclusion within whatever hyperlink framework is appropriate. The result is relatively compact and internally ordered in a way that is to some degree self-organizing.

With respect to a global brain, this raises interesting questions about the way any global brain mirrors reality. Clearly the knowledgebase is both a limited map and a distorted one. Clearly it is itself not the brain but a reflection of entities in knowledge space that perform brain-like functions through their interaction with one another. It might perhaps be likened to an ECG readout or a cat-scan.

Perceptions vs Facts: With respect to several kinds of entity included (notably world problems), the emphasis is much more on perceptions of reality rather than on verified assumptions about reality. Briefly, for example, 'invasion by extraterrestrials' will be the subject of a problem profile if there is a constituency acting as though this was an important dimension of its members psycho-social reality. Briefly again, equivalent attention will be given to 'rust', 'refugees' and 'wrinkles', notably because of the economic significance of the first and the last.

With respect to a global brain, it might well be asked to what degree it might be designed only around 'facts' if major constituencies have significant doubts about those facts and articulate their concerns as though 'non-facts' were effectively 'facts'. The major challenges around this matter have recently been evident in the dubious articulation of 'facts' by political and scientific communities regarding BSE, foot-and-mouth disease, GM products, hormones-in-meat, etc. Perceptions have proven to be as significant as facts to the dynamics of the international community. At this point it is impossible to distinguish between perceptions and facts on the web.

Exaggerated claims and contradictory statements: Again, with respect to several kinds of entity included (notably world problems), an effort is also made to include (in a separate field) claims in language that reflects the dominant significance that particular perceptions may hold in the minds or emotions of some constituencies (for example with respect to issues of sexism or abortion). Equal effort is however also made to include counter-claims denying the significance of such claims or of the issue profiled -- or possibly of the misrepresentation to which such claims are typically subject.

The system is designed to handle statements that may be considered highly biased and inaccurate from another perspective. The purpose of such information is to give some feel for the dynamics of the perceptions around particular issues -- and the radically opposed opinions that may be active in society. Clearly some of these perceptions, and perhaps mutually reinforcing clusters of them, may be usefully understood as indicators of collective neuroses, phobias, denial-mechanisms, and the like. However judgements to this effect are

as significant in practice as are those with respect to individual obsessions.

With respect to a global brain, it might be asked how such exaggerated perceptions -- clearly identified as misleading from other perceptions (possibly otherwise biased) -- are to be handled so as to reflect the dynamics and dilemmas to which a global brain might aspîre to provide a coherent response.

Non-closure and incompleteness: The knowledgebase is necessarily designed to avoid closure. Because of constraints on resources, many entities in it are sparsely populated with text, especially where priority is given to hyperlinks to other entities. No profile is considered complete. Profiles continue to be modified in response to clearer articulations or recognition of errors. Entities may at any time be split or combined. Their hyperlink context may be significantly amended at any time. Incompleteness may be significantly determined by lack of resources to include or amend texts. Priorities may be given to relatively insignificant entities where these help to enlarge the scope and range of the knowledgebase, as opposed to further amending entities covered by many websites (to which links are provided) on which libraries of information may already be available.

With respect to a global brain, this raises issues about incompleteness, ignorance, learning and erosion of collective memory. It is strikingly exemplified by the challenge of modern libraries with respect to archival material and the degradation of media.

Global modelling and simulation: The 1970s and 1980s saw much enthusiasm for global modelling of a particular kind. The value of such models has now been played down and their success is now acknowledged only where they are applied to rather specific domains (trade, climate, etc). Such models are in almost all cases equation driven. In contrast, the UIA knowledgebase is essentially topological in nature and calls for the use of techniques from that discipline [see comparison with conventional global modelling]. Its visible outputs are not graphs in the statistical sense but cognitive representations in which design elements to facilitate comprehension of complexity are a significant factor.

With respect to the global brain, this raises interesting questions about the contrast between an equation driven brain (following the style of chess programs) and one based on structures of semantic associations. To what extent is the debate about the bicameral nature of mind relevant to discussion of a global brain? (see below). Can right and left-hemisphere functions be identified and how are they to be integrated?

Subject matrix: In an effort to provide an integrative emphasis to subject organization, the knowledge base items are classified in terms of a matrix of subjects (https://www.uia.org/topics/aaintmat.htm) rather than a nested hierarchical structure as is typical of much knowledge organization. This sets the stage for exploration of interdisciplinarity and transdisciplinarity as patterns of links between cells across the matrix. [see detailed review]

Humour: A humour database is associated with particular entries in several of the UIA knowledgebases. The rationale is that humour appears to be intimately related to the deprived or stressed social circumstances documented -- and often seems to be engendered by them. The vital role of humour has been recognized for people in oppressive regimes, conditions of social deprivation, prisons, ill-health and monotonous occupations, namely diminished quality of life. By introducing humour as a dimension this may therefore provide integrative insights and patterns of associaztion otherwise unobtainable. This raises the question as to how humour might be associated with a global brain (a topic occasionally explored in science fiction).

3.0 Challenges

Mathematical limitations: Because of its institutional and financial setting, the UIA has been unable to bring to bear on the knowledgebase the quality of mathematical expertise which the data structure could be said to merit. Although it should be borne in mind that priority has been given to an integrated solution that resulted in user access to results generated with particular generic software rather than laboratory analysis of data sets using tailored software. So, for example, the following are primitive and more akin to proof of concept:

- analysis of loops
- identification of meaningful network properties and sources of potential error (redundancy, etc)
- algorithms to generate virtual reality frameworks to interrelate entities

See elsewhere for a discussion of some relevant mathematical challenges for systems scientists (Judge, 1999). A related concern arises from the fundamental conceptual challenge faced by the international community concerning territorial conflicts (Kashmir, Northern Ireland, Middle East, etc), namely dilemmas over the division of bounded space between two or more claimants -- which effectively sustain dangerous rifts in global society. It might be argued that responding in new ways to these challenges would be fundamental to any assessment of the value of a global brain -- and its 'global' attributes. It has been argued that the kinds of integration required can only be based on application of more complex mathematical techniques (Judge, 2000) -- following the principle of Ashby's Law.

Provision of meaningful integrative tools: There is a major issue about how to present knowledgebase complexity to a user. This increasingly stimulates investment in knowledge visualization techniques. Many of the more interesting packages are targeted to high-budget organizations. However it is unclear to what degree some of the more interesting questions and possibilities are being addressed. It is for this reason that the UIA is exploring use of sound in relation to visualizations (as noted earlier).

Given the current interest in memes as a semantic equivalent of genes (eg Blackmore, 1999), there is a strong case for exploring the relevance of arguments made for 'genetic music' as they might apply to 'memetic music' as a means of comprehending knowledge complexes within a global brain. This suggests a 'memetic reading' of the points made in M A Clark's review of genetic music sources (http://www.whozoo.org/mac/Music/Sources.htm) which he introduces as follows:

In his landmark book *Godel, Escher, Bach* (1980), Douglas Hofstadter comments on similarities between genes and music. The

analogy is explicit in the following quote:

> Imagine the mRNA to be like a long piece of magnetic recording tape, and the ribosome to be like a tape recorder. As the tape passes through the playing head of the recorder, it is "read" and converted into music, or other sounds...When a "tape" of mRNA passes through the "playing head" of a ribosome, the "notes" produced are amino acids and the pieces of music they make up are proteins. (p. 519).

Hofstadter also discusses how meaning is constructed in protein and in music:

> Music is not a mere linear sequence of notes. Our minds perceive pieces of music on a level far higher than that. We chunk notes into phrases, phrases into melodies, melodies into movements, and movements into full pieces. similarly proteins only make sense when they act as chunked units. Although a primary structure carries all the information for the tertiary structure to be created, it still "feels" like less, for its potential is only realized when the tertiary structure is actually physically created. (p. 525)

As Hofstadter first suggested, music is a natural medium for expressing the complex patterns of proteins and their encoding DNAs. Both consist of a linear sequence of elements whose real meaning lies in their combinations.

Later Clark suggests possibilities which are again of great potential interest to comprehension of the high order conceptual complexes that might usefully be a characteristic of a global brain:

> Musical renditions of DNA and proteins are not only interesting as music, but as an alternative mode of studying genetic sequences. It might be argued that the folding patterns (tertiary structure) of proteins are the most conserved elements of living organisms. The genes and the primary protein structure (amino acid sequence) that underlie the protein folds and the diversity of the species that house them seem to be free to vary, so long as the protein continues to fold in a way that allows it to serve its function. Protein folding depends on the interaction among the amino acids and between the protein and its immediate environment. With a few exceptions, the specific identity of the amino acids seems less important than the preservation of the correct relationship. I believe that music is a way of representing those relationships in a type of informational string to which the human ear is keenly attuned.

Maybe the traditional notion of the 'music of the spheres' is of significance to discussion of the design of any global brain. Certainly David Rosenboom's (2000) arguments as a musician are relevant to many of the epistemological challenges and traps. The bibliographical and other references of the International Community of Auditory Display (http://www.icad.org/) provide a strong rationale for this approach.

Integrating multimedia tools into the hyperlink editing process: It is increasingly clear that what amounts to synapse editing calls for software and visualization tools to enhance the conceptual capacity of the editor -- somewhat along the lines of the tools now being envisaged for brain surgeons. The question is what kinds of tools would facilitate the task of a researcher constructing useful links in a knowledge structure in the light of paterns of information supplied from other sources.

One experimental approach envisaged would make use of 3D virtual reality representations, based on a gardening metaphor, to allow knowledge structures to be cultivated and gardened with the aid of musical cues (Judge, 2000). The elastic interval geometry software technology under continuing development by Gerald de Jong and the Struck Community has already been adapted by him to 3D dynamic displays, notably in relationship to construction of virtual worlds. There are interesting further possibilities using elastic angle geometry. The question is what design metaphors might be envisaged to increase the cognitive dimensions of such habitats so as to emphasize highlight meaningful integration. This is necessarily some stages beyond Douglas Englebart's early vision (1962). UIA data has been parsed into XML as a basis for populating such constructs.

Role of metaphor: Appropriate metaphor is increasingly and explicitly appreciated as fundamental to design advances in software. As noted above some of the design constraints for knowledge structure representation are associated with geometric metaphors. However it is also clear that there is vast scope for use of design metaphors to this end based on other aesthetics -- whether colour, sound, shape, dynamics, or any combination (Judge, 1995).

It can be readily argued that the brain uses metaphor to provide coherent patterns of associations as a framework for knowledge. It might well be supposed that this would also be true of any global brain. The question is what metaphors might be useful to what end, and how might users be offered facilities enhanced by such options. Would such use of metaphor be an attribute of the right-hemisphere of the global brain?

Quality intelli-work and enabling fruitful input from external parties: As with work on expert systems, maintaining and extending a knowledgebase requires a level of continuing professional attention to detail which is usually associated only with the setup phases of knowledgebase development. Institutionally the continuity of attention required calls for distributed editorial research work and facilities to manage the relationship between the interventions of contributors with differeing skills and priorities. Specifically there is a challenge of ensuring that careful work on systems of hyperlinks is not inadvertently wrecked by careless new contributions.

4.0 Concerns

Cultural assumptions: There is an extensive literature indicating the particularity of western cultural styles of thought (Posey, 1999). Because of its apparent dominance in science and the media, it is easy to neglect the existence of other styles of thought -- which may also in fact be operational as sub-cultures within western societies. This literature touches on assumptions about the nature of intelligence and the possibly of quite different kinds of intelligence (see summary of some contrasting systems).

For example, Magoroh Maruyama (1980) distinguishes 4 contrasting mindscapes each of which might suggest a different kind of global brain:

- **H-mindscape** (homogenistic, hierarchical, classificational): Parts are subordinated to the whole, with subcategories neatly grouped into supercategories. The strongest, or the majority, dominate at the expense of the weak values, policies, problems, priorities, etc). Logic is deductive and axiomatic demanding sequential reasoning. Cause-effect relations may be deterministic or probabilistic.
- **I-mindscape** (heterogenistic, individualistic, random): Only individuals are real, even when aggregated into society. Emphasis on self-sufficiency, independence and individual values. Design favours the random, the capricious and the unexpected. Scheduling and planning are to be avoided. Non-random events are improbable. Each question has its own answer; there are no universal principles.
- **S-mindscape** (heterogenistic, interactive, homeostatic): Society consists of heterogeneous individuals who interact non-hierarchically to mutual advantages. Mutual dependency. Differences are desirable and contribute to the harmony of the whole. Maintenance of the natural equilibrium. Values are interrelated and cannot be rank-ordered. Avoidance of repetition. Causal loops. Categories not mutually exclusive. Objectivity is less useful than "cross-subjectivity" or multiple viewpoints. Meaning is context dependent.
- **G-mindscape** (heterogenistic, interactive, morphogenetic): Heterogeneous individuals interact non-hierarchically fur mutual benefit, generating new patterns and harmony. Nature in continually changing requiring allowance for change. Values interact to generate new values and meanings. Values of deliberate (anticipatory) incompleteness. Causal loops. Multiple evolving meanings.

To what extent are such dimensions ignored in considering the nature of a global brain? Is the debate effectively skewed in favour of design criteria for a western-style global brain (H-mindscape)? How might a global brain be understood through other cultural and epistemological lenses? How are such divergent perspectives to be integrated within a genuinely global brain? How might the nature of such integration be articulated without falling into the traps of particular understandings of integration? (see more on the epistemological challenges of East-West integration).

A particular example in the UIA initiative is the reconciliation of the Western and Eastern systems of health -- and the hyperlinks to which they give rise in a knowledgebase.

Intriguingly one author has indicated how some of the fundamental epistemological issues in relationship to cross-cultural music may clarify new ways of thinking about the nature of emergent order (Rosenbloom, 2000).

Styles of global brain: It is useful to clarify the qualities sought in a global brain by different constituencies and to compare such goals with existing operating initiatives, or their fictional analogues, that reflect these in part. A point of departure is the work of Gareth Morgan (1998) on *Images of Organization*, who identifies 7 metaphors describing contrasting styles of organization which might be adapted to understandings of a global brain (GB):

- GB as machine: "Mechanistic approaches to organization work well under conditions when machines work well." A machine can be 'built' -- and engenders a need for maintenance.
- GB as organism: "The image of an organism seeking to adapt and survive in a changing environment offers a powerful perspective for managers who want to help their organizations flow with change." An organism needs to be 'grown' or 'cultivated' -- and engenders a need for care.
- GB as brain: "What if we think about organizations as brains?" A brain needs to be 'educated' -- and engenders a need for testing, new challenges and distraction.
- GB as culture: "When we view organizations as cultures, we see them as minisocieties with their own distinctive values, rituals, ideologies, and beliefs." A culture needs to be 'enriched', 'enhanced' or even 'sung' -- and engenders a need for recreation.
- GB as political systems: "When we see organizations through the lens of politics, patterns of competing interests, conflicts, and power plays dominate the scene." A political system requires some form of 'indoctrination' -- and engenders a need for 'commisars.'
- GB as psychic prisons: "What if we view organizations as systems that get trapped in their own thoughts and actions?" A prison requires imposition of rules, regulations and correctional measures -- and engenders a need for security measures.
- GB as instruments of domination: "The negative impact that organizations often have on their employees or their environment or that multinationals have on patterns of inequality and world economic development is not necessarily an intended one." This is the Big Brother archetype.

Each style effectively implies a different design, construction and maintenance challenge. Each also implies a very different style of relationship of an individual to it through any interface. It might be argued that it could be all these -- preferably to be understood as complementary images -- which might each be undertood positively or negatively. Clearly other metaphors might also be explored. Especially interesting are those implicitly suggested by the above list. For example, why the focus on a 'brain' when other organs of the body might carry other valuable insights for some. A 'global heart' would appeal to a quite different range of people as evidenced by the number of websites for 'global heart' initiatives. What does a 'brain' lack that is carried by the 'heart' metaphor? What might be the vital systemic relationship between a global brain and a global heart -- and other organs (such as a 'global stomach') implicitly omitted for reasons that could be usefully explored? Is this a useful warning indicator?

How might such archetypal forms be compared to some operating examples:

- information systems / web search engine / intelligent agents
- corporate 'situation room' or military 'war room' (with academic applications)
- expert system
- belief system
- traditional knowledge system (*Jataka* tales of the Hindu culture, etc)
- think tank / brains trust / councils of the wise
- interlocking patterns of dialogue
- knowledge ecosystem

An interesting line of investigation into styles of brain design is the range of centro-symmetric geometric structures. These are helpful in focusing attention on whether the brain 'centre' is occupied or whether the design is based on an 'empty centre' -- namely where there are a range of peripheral centres configured around it. Parallels may be seen in clustering computers and in the design of supercomputers based on a hypercube. The cybernetician Stafford Beer, known for his early work on the *Brain of the Firm* (1981), subsequently (1994) focused on the use of icosahedral structures in seeking 'syntegration' of perspectives and issues. An interesting question is whether some structures are inherently more comprehensible or resonant with an individual interacting with them -- as suggested by meditational mandala geometry.

Another line of investigation is suggested by Howard Gardner's *Multiple Intelligences* (1983).He has suggested eight types of intelligence and learning style that merit consideration in relation to a global brain and how it might learn (or fail to learn): musical, bodily-kinesthetic, logical-mathematical, linguistic, spatial, interpersonal, and intrapersonal (see also David Lazear, 1999). Also of interest is the relevance of emotional intelligence, as popularized by Daniel Goleman (1995) and the consequences of any lack of attention to this dimension in envisaging a global brain. There is now a research consortium on this matter (http://www.eiconsortium.org/).

Discourse about any 'global brain' can usefully be mapped onto dimensions such as the following to avoid fruitless disagreement from narrow perspectives. Other dimensions, such as those reflected by the gaian and noosphere discourse communities, could also be included -- as well as those preoccupied with issues of social control (or freedom from control). It is indeed possible that (as with the complementary wave/particle theories of light), a set of complementary perspectives on any global brain may be vital to prevent premature closure on any definition from an overly simplistic perspective that fails to recognize the necessary higher orders of knowledge organization vital to the operation of a 'brain' that can perform genuinely global integrative knowledge functions.
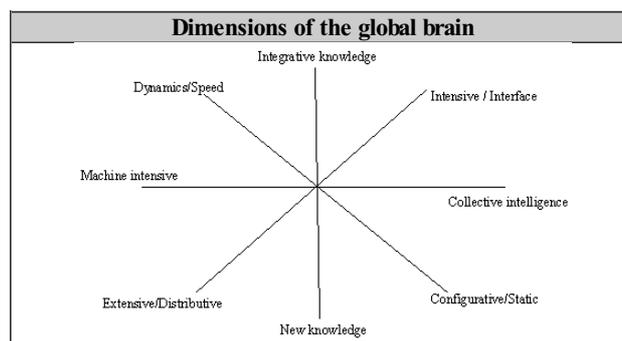
Volatility and coherence within a global brain: A prime characteristic of the international community and world opinion is the manner in which issues are briefly taken up and rapidly set aside in favour of others -- although contrasting issues may compete for public attention. Recent fashions include: development, sustainability, civil society. Political debate bounces around amongst a range of such fashionable themes. Series of meetings touch on particular topics and have other fashionable topics projected onto them. Schools of meditation have disparaging remarks to make about equivalent incoherent processes in their practioners awareness. In historical terms, many collective issues effectively have a lifecycle duration equivalent to that of a butterfly -- fluttering into and out of collective attention.

At issue is whether this really is an issue and a matter of concern. For some the fragmentation and incoherence of world society knowledge processes is a deep concern. For others it is merely a reflection of the rich dynamics of human society. Nevertheless it is useful to ask what level of coherence should be sought from a global brain -- and whether it is precisely such coherence that would distinguish it from the degree of organization currently characteristic of the web or the networks of organizations and disciplines. Just as religions remain in continuing dispute about the nature of 'God', it is important to recognize the variety of understandings of any form of coherence or integration that might be considered basic to the mergence of any global brain. Of relevance also are the dynamics associated with any effort towards such synthesis (see Judge, 2000).

If greater coherence is a matter of concern, how are higher degrees of order to be introduced -- or better how is their emergence to be facilitated? This raises other issues, successfully explored by Ron Atkin (1977, 1981), concerning how people favouring different degrees of order perceive and understand those favouring other degrees and qualities of order. A special challenge derives from assumptions about the universality of relatively simplistic principles of order -- especially across cultures. Some of there problems are evident in the history of classification systems.

Perhaps the most interesting question is to what kinds of coherence might a global brain aspire and how would that be comprehensible from various forms of coherence of lower order? Alternatively, if such a hierarchical understanding of order is itself simplistic, how might alternative forms of high order coherence be mutually comprehensible or held within a larger framework with characteristics as yet to be understood -- especially where 'definition' is itself part of the problem of oversimplification?

Expanding knowledge universe: Much has been made of the explosion of information and knowledge. There is increasing recognition that individuals or groups able to afford it will each have their own websites (as will their pets). It has been claimed that there are 16,000 health sites on the web. It has long been accepted that few have time to read or absorb more than a fraction of the information generated -- even in relatively narrows areas of specialization. This emerging situation can usefully be described by several metaphors -- for example:

- Wild flowers: in which the number of such websites will be competing for attention like flowers in the countryside.
- Galaxies: in which the number of knowledge clusters might usefully be compared to galaxies in a rapidly expanding universe
- Graveyards: in which the rapid accumulation of obsolete sites (whether focused on deceased groups or authors, or on historic concerns) will effectively fill cyberspace with tombstones requiring graveyards (and dutiful maintenance of their links, possibly with spiritual responsibilities)

In this context interesting questions are raised concerning the meaning and value of knowledge:

- In the case of the flower metaphor, is it a matter of perserving ecosystems within which competition is necessarily savage; how might such ecosystems evolve to exemplify higher qualities of 'global' knowledge? How are the myriad re-discoveries and re-articulations of knowledge through learning processes to be positioned within a global brain?
- In the case of the expanding universe metaphor, how might the relativity effects of communication lags in knowledge space be usefully framed? Might the speed of light be usefully recognized as a clue to the constraints on speed of understanding or learning in such a knowledge universe?
- In the case of the graveyard metaphor, what will become the status of the disproportionate amounts of knowledge from the past, and to what extent will web preservation of past cultural initiatives and their initiators become an overriding preoccupation in global brain operations (recalling that of the pharaohs)?

Is there a case for combining the processes implicit in these metaphors into what amounts to an understanding of conceptual evolution in knowledge space? This might be mapped by some equivalent to the astrophysicists Hertzsprung-Russell diagram -- which indicates the evolutionary pathway of stars in terms of changing mass and luminosity. What is required is a sense of the evolution of conceptual attractors in knowledge space in terms of the attraction they exert and their visibility. It is this process that a global brain would presumably encompass.

Of special concern are the implications for creativity and learning in such a space in which the relativity effects of learning and communication delays may isolate, or overexpose, people and groups within knowledge space. This raises the question of the advantages and disadvantages of such isolation to any fulfillment -- that may be undermined by the transparency and speed implicit in assumptions about a global brain. In this respect the work of Orrin Klapp (1978, 1986), on the need for both opening and closing in response to information, is most insightful. James Glanz has written a description of the preoccupations of the annual Seven Pines Symposium with the heading *Turn down that Web, these scientists plead, so we can think* (IHT, 20 June 2001) -- concerned that promising lines of research are abandoned in favour of conceptual bandwagons. How much closure is required in relating creatively to a global brain?

Globality of the person and possible 'resonance' with a global brain: As noted earlier, there is a fundamental challenge in understanding the relationship between a global brain and the qualities of a person capable of understanding the nature of its globality. Briefly, to what extent does the kind of tunnel vision associated with the high-order specialization required to survive in modern society enable any comprehension of what might be hypothesized about the characteristics of a global brain -- or the challenge of designing one? Such a brain would supposedly be characterized by forms of transdisciplinarity at least requiring higher degrees of ordering that are anyway a struggle to comprehend -- even if such comprehension is possible.

Metaphorically is it necessarily the case that any individual is effectively obliged to function with a 'flatland' epistemology in a situation in which an emergent global brain must necessarily ensure 'curvature' of many such conceptual territories to form them into a sphere with global functions? Under what conditions will an individual be able to experience this curvature or the globality that results? Ron Atkin (1977, 1981) has perhaps come closest to articulating in mathematical terms the cognitive challenge of exposure to multidimensional geometry whose curvature can only be implicitly sensed (see more).

It is also of interest that through multi-media representations the mirroring function may allow the user to enter into some kind of cognitive resonance with the map -- as do meditators with a mandala. How can such representations be organized to enhance comprehension and what effect do such maps have on the observer -- and especially on a hyperlink editor endeavouring to introduce linkages to enhance the quality of the global brain? This raises the question of the nature of the existence of a global brain in the absence of a human observer. More problematically there is the question of what degree of order the observer is able to comprehend to identify the quality of existence -- and globality -- of such a collective brain. Is a global brain necessarily unknowable (cf Kurt Gödel, etc)? How might experienced meditators choose to define, design or explain a global brain?

More concretely these questions focus attention on the design of any set of interfaces through which to interact with a global brain.

'Bicameral' and 'hemispheric' organization of the global brain: Following the work of Julian Jaynes (1976), the bicameral mind (two-chamber mind) of the individual is one that functions as an unconscious, two-step process. Automatic reactions and thoughts originate in the right hemisphere of the brain and are transmitted to the left hemisphere as instructions to be acted upon. The bicameral functioning is nature's automatic, learned mode of response without regard to conscious thinking. By contrast, following the 'breakdown of the bicameral mind' on which Jaynes has focused, man-made consciousness functions through a deliberate, volitional thought process that is independent of nature's bicameral thought process. A parallel to this might be sought in relation to the awakening of the global brain.

As noted earlier, is there any sense in which the 'globality' or integration of such a global brain may be characterized by equivalents to the functionality widely associated with the right and left-hemisphere? How are they to be integrated? There will clearly be approaches to

global brain design that will focus on 'left-brain' understandings of logical order, whereas others will choose to focus on 'right-brain' patterns of association (cf Gregory Bateson's 'pattern that connects'). The larger challenge faced by the individual is how to integrate these two contrasting epistemological frameworks within a larger framework that is defined by neither of them in isolation. Magoroh Maruyama refers to this epistemological challenge as poly-ocular vision (see more).

Higher order brain functions and self-awareness of a global brain: Animals have brains. Very few animal species are considered to be even remotely self-aware. Is it to be expected that a global brain will however undergo a process of ontogenesis or phylogenesis reminiscent of that of the human brain? Might the globality of the brain of the international community at this point be compared to the brain of one of the mammalian species?

In contrast to the view of Peter Russell (1995), has the global brain awakened yet? Or, if awake, to what degree of brain evolution or growth does this awakening currently correspond? Cynically it might be easily argued that, if indeed awakened, it might well be compared to a 'reptilian' (flight-or-fight) brain, or perhaps a 'bird' brain! But what indicators would suggest that it was indeed self-aware -- given the investment of many in clearly distinguishing the quality of human awareness from that of even the most 'intelligent' animals.

There is a curious irony to the fact that one of the principal academic indicators of self-awareness and introspection is the ability of individuals to recognize themselves in a mirror -- usually achieved in humans between 18 and 24 months. A major breakthrough in 2001 has been the demonstration that dolphins also have mirror recognition ability. It might be wondered whether extraterrestrials have analogous indicators of self-awareness for any global planetary brain -- based on ability of a species to recognize itself as mirrored in its environment. Modern civilization's failure of this test may have resulted in humanity's classification as a pre-intelligent species, just as humans have classified animals as lacking in the kind of self-awareness by which humanity characterizes itself.

In distinguishing functions of a global brain, there is a challenge in articulating a range of levels from the more data oriented to the more wisdom oriented. It is the latter which are most problematic because they raise major issues of comprehension (see). It is not clear on what basis such higher levels might be identified -- let alone given some operational form or recognized as a potential emergent form of order.

The challenge is exemplified in the case of individuals who purportedly are familiar with such higher order functions and articulate a range of levels relating them to those which are more readily comprehended. Most spiritual and psychotherapeutic disciplines describe the emergence of such higher order functions. The UIA has endeavoured to document and interrelate this variety in one of its knowledgebases (see https://www.un-intelligible.org/projects/homehum.php) which covers some 3,000 understandings of human development. Clearly their proponents would have quite particular views about the potential and operation of a global brain. What is the value of the less comprehensible higher order functions -- and what does this suggest for possible analogues in the case of a global brain? Why are meditators cultivating such functions very attentive to the systemic relationship of the functions of the brain with those of other organs?

Classes of knowledge: In any discussion of augmented intelligence emerging from artificial intelligent systems (AI), enhanced human communities, or enhanced individuals, a useful focus can be placed on distinct classes of knowledge and their characteristics -- for which a table such as the following might provide an initial framework:

Indication of classes of knowledge															
Classes	Knowledge		AI only		Enhanced human commun-ities		Enhanced individ.		Enhanced animals		Example applications					
	New (making accessible)	Integrative (patterning)	Cluster	Single	With AI	No AI	With AI	No AI	With AI	No AI	Climate	Traffic	Diseases Cures	Govern. Disputes	Finance	Law and Order (Milit.)
Alpha	?	Paradigm shifting	?	?	?	?	?	?	?	?	?	?	?	Jerusalem N. Ireland	?	?
Beta	?	New patterns	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Gamma	?	?	?	?	?	?	?	?	?	?	?	?	Cure design	?	Stock forecast.	?
Delta	?	?	?	?	?	?	?	?	?	?	?	?	Diagnos.	?	?	?
Epsilon	Data capture	Data represent.	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Zeta	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Eta	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Theta	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
etc???	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?

The value of such a framework is to distinguish relatively trivial forms of novelty in knowledge generation from those forms which serve to reframe and integrate whole disciplines and systems of disciplines. Some forms of knowledge may be valued simply for the degree of social control and predictability they offer ('global' in the world-wide sense) as opposed to those which offer new patterns of understanding ('global' in the sense of integrative paradigms) that need to be distinguished because of their significance for future social evolution.

There is some initial value in distinguishing classes of knowledge by the Greek letter sequence because of the cautionary implications (see http://www.huxley.net/) from Aldous Huxley's *Brave New World* (1932) that used such a sequence to distinguish human social classes -- that might be engendered by some advocated forms of global brain. Whilst qualities of knowledge need initially to be distinguished by some such classification, these need to be set within a much more complex cross-cultural ontological framework to counteract the

simplistic hierarchical implications with their well-known undesirable consequences. Such a periodic table has been advocated by Susantha Goonatilake *(Toward a Global Science,* 1999). Clearly some forms of knowledge can usefully be distinguished as associated with an equivalent to society's autonomic nervous system.

Knowledge 'corruption' and possible 'diseases' of the global brain: An alternative to the self-awareness approach is to view the global brain as indeed already constituted -- but suffering from one or more forms of 'disease' that result in varying degrees of dysfunctionality. Given the various behaviours of the international community -- the fragmentation of disciplines, cultures and faiths -- it is worth debating whether the global brain has come into being with 'congenital malformations'. Such discussions might be guided by a systematic review of the range of diseases as they might apply to networks (see, for example, Judge, 1978).

Another approach could review the range of individual memory disorders as they might affect collective memory (see Judge, 1982) and specifically a global brain. This would certainly be helpful in looking at the manifold challenges of coordination within the international ciommunity which readily lends itself to diagnosis as seriously spastic -- in contrast to views promoted by the Club of Rome (see Judge, 1982).

Individuals are faced with the challenge of striking a balance between remembering and forgetting. Is it to be assumed that a global bain will remain functional if it never forgets? How is a global brain to handle the amount of information that will have been accumulated by the year 3000 given the kinds of problems faced by individuals with eidetic memory? Clearly there is the question of emergent higher orderings of such a brain that would leave what is now considered to be information to be handled by the equivalent of some kind of autonomic system.

How might the knowledge system held by a global brain be 'corrupted'? One threat is most obviously given by the extent of virus attacks on computer systems in recent years. What safeguards against such attacks could be guaranteed -- and by whom? How would a global brain be cleared of viruses? But of greater interest is the potential for what might be termed memetic infection of a global brain -- possibly through new kinds of memetic viruses. It is science fiction that has extensively explored problematic use of artificial intelligence.

However at a more mundane level, there are other forms of corruption of the knowledge process. These are best exemplified by the more vicious patterns of interaction amongst academic institutions and schools of thought vying for resources and status. Their extent and implications are often heavily disguised beneath self-serving rationalizations. It is interesting that global models seldom endeavour to take account of the forms of corruption that are characteristic of non-laboratory reality -- for example the contrast between formal descriptions of governance and the implications of scandals at the highest level (even internationally in governments representated on the UN Security Council). How will it be possible to avoid replication of features or consequences of such patterns within a global brain?

Funding development of a global brain: This issue is very interesting because of its relationship to the challenges of intellectual property and copyright, sponsorship, and commercialization of knowledge in a knowledge economy.

Limits to collaboration in global brain development: The history of global modelling is very suggestive of the future challenges of inter-institutional collaborative work on any global knowledgebase. Briefly it may be argued that collaborative exercises may work well when teams are working together on the basis of imposed tasks carefully defined (as in multinational aerospace projects). However the challenges of collective work by networks that are unconstrained in this way, as is increasingly typical of many coalitions of knowledge generators in society, is another matter -- especially when the topics are not as unambiguously material as aerospace part design. Challenges become especially acute as inter- and transdisciplinarity increases -- and when multi-cultural epistemologies are involved and basic assumptions must be viewed as relative. Operationally such issues have been made painfully real in some multinational corporations, notably when efforts are made to merge contrasting corporate cuoltures. The issues are also apparent to some degree in the erosion in the quality of listserver dialogue over time. One approach to the articulation of possibilities of cooperation is through metaphor (see).

It is fruitful to look at the challenges of distributed 'knowledge-working networks' in the light of such issues as: inter-institutional competition, personal career ambitions, and case studies of issues engendering sub-optimally collaborating global coalitions (peace, environment, governance, inter-faith, etc) or coordinating forums of various kinds (and notably in relation to intergovernmental organizations). The history of competing approaches to knowledge classification is perhaps even more relevant. Many of these initiatives purportedly aim to articulate global frameworks or perform coordinating functions -- analogous in some ways to some envisaged operations of a global brain. Curiously the dynamics engendered by such intiatives, and which undermine them, are seldom considered as relevant to the design process. However it is possible that, counter-intuitively, some degree of 'inefficiency' may, as in nature, be more efficient than more highly ordered designs would suggest. In which case it would be useful to review the relationship between loose networks, implicit in a 'knowledge ecology' metaphor, and the more integrated design suggested by a 'global brain'.

Global brain: what for? It is worth asking why any initiative should be undertaken to construct a global brain. Motivations for doing so might include any of the following:

> 'Because it is possible': The justification being that humans can conceive of it, therefore it is a challenge worth responding to. Unfortunately this justification is of the same kind as highly controversial initiatives such as human cloning, genetically modified foods, nuclear power stations, etc -- on which it is absolutely unclear to many whether those responsible are acting responsibly in the light of unforeseen consequences. It is quite unclear whether the design of a 'brain' needs to be accompanied by equyivalent progress on the design of other 'organs' to sustain not only the brain but also the system as a whole.

> 'Because it is needed': Management of the global system being so problematic, and faced with so many foreseeable challenges, that resources should be devoted to any initiative that could improve decision-making. This ignores the track record of global modelling and its effective irrelevance to the major intiatives faced by the international community and by local populations. It is unclear whether such systems could handle all the non-rational dilemmas -- especially when they are at the edge of our cultural

learning and no acceptable methodologies have been developed (cf the case of territorial disputes). It also ignores the perception of the role of major systems created by segments of the intelligence community (eg Echelon) and the interests which such systems are perceived to serve. The Big Brother issue has been endlessly cited

'Because it is a powerful symbol': Humanity needs a strong symbol of integrated intelligence, or even wisdom, to give focus to thinking about the future of society. This ignores the socio-political dynamics which are typically associated with such initiatives and that tend to favour the few rather than benefit the many -- at least in the eyes of the many. There is also the unasked question of whether this would amount to a transdfer of responsibility to a figure of authority (a Mummy, a Daddy, or some equivalent) -- a perspective that psychoanlysts could explore at length.

'Because it would engernder new learnings': As a major intellectual challenge, it would stimulate new thinking that might be of great benefit to humanity. This argument needs to be seen in the light of the resources devoted to big science projects (particle acceler, space telescopes and planetary missions, etc) and the value of the spin-offs to the non-academic comunity.

'Because it is effectively emerging': The explosion of information systems and the associated development of intelligent agents can be perceived as the emergence of a global brain. In which case it is important to consider ways in which to augment its brain-like functions. This raises issues of how much integration is appropriate given humanity's ability to corrupt such systems the more integrated that they become.

If metaphors other than 'construction' are used to envisage facilitating the emergence of a global brain, other justifications might becpome apparent. How, for example, might a global brain contribute to the arts and to music? Would such an entity then undermine much creative activity? What if it became the prime source of all the best humour?

Global brain discourse: Insight capture? As with the global modelling discourse, it is probable that the global brain discourse -- under whatevr disguise -- will be challenged by how to integrate the variety of perspectives and concerns that are articulated. This situation effectively models that of international meetings in general -- of which some 7,000 are envisaged into the years ahead. As 'binding moments' in Gottfried Mayer-Kress excellent terms, the question is how effectively can they function. The multi-media techniques presented in association with this paper suggest means of real-time concept-mapping of such discourses (and papers prepared to feed them) -- to counter the wastage of intellectual effort they normally represent. However the time scale issues approprioately stressed by Mayer-Kress need to be complemented by the configurative possibilities that are potentially associated with integrative concept mapping. The key issue beyond eliciting patterns (through maps, morphs and melodies) is that of facilitating cognitive resonance with those patterns to sustain new action -- an exercise in time binding to counter the temptations of the ever-rolling present prilmarily characteristic of electronic discourse.

5.0 Conclusion

The merit of the Encyclopedia initiative described lies in its effort to provide a framework to hold the variety of extant perspectives at a global level and to provide means for exploring their relationships. Its future value will lie in its ability to render this complexity comprehensible in useful ways to those refreshing the information. In some measure it may be understand as simulating the global brain constituted by the vast network of international organizations responding to the preoccupations of different segments of humanity -- perhaps like the 'lobes' and 'sites' of a global brain.

Much remains to be done to highlight the major pathways through such a global brain in terms of its integrative globality. This may be based on the existence of major 'pathways' formed by elements of different feedback loops. Such pathways can be envisaged as being like rivers from which local loops break off (as whorls). A number of such pathways may intersect. It would then be the interlocking of these pathways which ensured the integrity of the knowledge system of problems as a whole. The interesting possibilities for the development of more sophisticated displays of feedback loops depend on the identification and implementation of algorithms capable of positioning a multiplicity of loops (hundreds, if not thousands) over the surface of a sphere. To be useful, this has to be organised so the more detailed loops are positioned "locally" whereas the intersectoral loops exploit the global properties of the sphere.

This approach becomes especially interesting if it is hypothesised that such pathways are themselves necessarily circular. The question can then be formulated in terms of the nature of the surface onto which the pattern of loops can be usefully projected or mapped so as best to bring out the systemic integrity.

It might be argued that this approach to the analysis of the data is more complex than other more conventional forms available from graph theory. The assumption made here is that the constraint of representation on a surface comprehensible to the human mind is of immediate relevance to the ability to make informed decisions on such matters at a policy level. The existing ability to provide specialised analysis of what amounts to local loops in isolation has been well demonstrated, as has the inability to act on the larger loops to which these may contribute. A more comprehensive approach is required to 'thinking globally and acting locally', whether in the geographical or the systemic sense (as suggested here).

In terms of higher order knowledge operations, what will be the relationship of a global brain to memetic warfare between sectors and belief systems? Will competing cultures have competing global brains?

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