



laetus in praesens

Alternative view of segmented documents via Kairos

1975

World Problems and Human Potential a data interlinkage and display process

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Introduction

Abstract: 'World problems' have been the subject of intense debate for some time. Concern and action have tended to focus on 'important' problems as determined by their visible effects and consequent political significance, so that it is rare for more than ten problems to be named in the same context. The author argues for the representation of problems, and the organised resources brought to bear on them, by interlinked networks, thus permitting computer-assisted, non-quantitative analysis and display of such structures to aid detection and comprehension of their strengths and weaknesses of policy-making significance.

A version of this paper appeared in *Futures (the journal of forecasting and planning)*, Vol. 7, 3, June 1975, pp. 209-220. It was based on a paper prepared for presentation to a course on future studies, Inter-University Centre of Post-graduate Studies, Dubrovnik, March 1975 and to a session at the 2nd General Assembly, World Future Society, Washington, DC, June 1975. [Version française] A subsequent report appeared as *World Problems and Human Potential: significance and preliminary results of the World Problems Project, International Associations*, 28, 1976, 2, pp. 102-108. (For the current situation with regard to this project, and the status of the *Encyclopedia of World Problems and Human Potential*, see: <https://www.un-intelligible.org/projects/homeency.php>).

A preliminary investigation in 1971 by the Union of International Associations showed that there was very little in the way of systematic descriptive listing of world problems, awareness of how many there were, or views about whether such information would be useful. An attempt had been made by Hasan Ozbekhan in 1968, which listed 28 Continuous Critical Problems,' and this was later extended to 48 in an internal document of the Club of Rome before the Limits to Growth exercise.

Such extended lists begin to include problems which are not of importance in their own right but primarily by their relationship to the other problems in the problem complex or network. If some problems are commonly dependent on reinforcement from apparently insignificant and little-known problems, these latter may acquire considerable importance in any policy relating to the problem complex. Furthermore, if it can be shown that response to them is impeded by other problems, these last may acquire even greater proportional significance in the network.

The relationships and significance of each of the lesser-known problems may well be recognised in the appropriate sectors of the available literature, but may thus only influence a limited sector of society. This means that information systems, organisations and programmes often recognise only one particular set of problems and over-identify with them (Hasan Ozbekhan, 1969; Donald Schon, 1971). This results in a multiplicity of candidates for 'the kg problem' requiring maximum allocation of resources to parties, none of which may intercommunicate, even though each may stress the importance of defining its own problem in relationship to other problems. Hasan Ozbekhan makes the point:

This almost subconsciously motivated attempt, that of a sector to expand over the whole space of the system in its own particular terms and in accordance with its own particular outlooks and traditions, compounds the problem by further fragmenting the wholeness of the system. For sectors cannot become systems, they can only dominate them; and when they do they warp them. Hence this tendency toward the spreading of sectoral primacies over the full social space must be viewed with alarm. It is a portent, and an ominous one, of the conflicts and dislocations that await us unless a system-wide integrative approach is worked out ...

There is the suspicion that the network of problems may be better integrated than the networks of organisational and conceptual resources which could be brought to bear upon them. In Donald Schon's words:

The map of organizations or agencies that make up the society is, as it were, a sort of clear overlay against a page underneath it which represents the reality of the society. And the overlay is always out of phase in relation to what's underneath: at any given time there's always a mis-match between the organizational map and the reality of the problems that people think are worth solving . . . There's basically no social problem such that one can identify and control within a single system all the elements required in order to attack that problem. The result is that one is thrown back on the knitting together of elements in networks

which are not controlled and where network functions and the network roles become critical.

Our information on society is not yet sufficiently well organised to permit us to construct detailed maps of organisational and problem networks in order to identify clearly, simply and with precision the areas of weakness and strength.

The lack of any such mapping makes it easy for individuals and agencies to embed themselves in 'communication niches' (the social analogue of environmental niches) and to marshal arguments and limited support for any problem, irrespective of its importance in the problem complex. This does not help consensus formation and formulation of a network strategy to inter-relate the multitude of agencies. Government, agency and media control of information aggravates this situation since it provides an increasingly potent basis for 'adjusting' the outside world so that it is compatible with the survival and growth aims of the agency. Those with any control over information are able to put forth interpretations of 'social reality', the critical nature of a given problem, programmes to deal with it, and evaluations of those programmes as implemented, based on knowledge either unavailable to those who could challenge the interpretation or unavailable when a challenge might be most effective. (Donald Michael, 1968)

Single agencies (if they are not already memorials to past problems) may obtain only inadequate support, resulting in ineffectiveness. Alternatively, they may use their excessive support to dominate and warp their particular social environment, leading to compensating effects which some identify as new problems. The only court of appeal is the political arena of factions, parties and competing schools of thought in which the dynamics are largely dependent upon the ambiguity, oversimplification, or biased projection of any mapping and the aggravation of any consequent consensus instability.

It was these points which prompted the [Union of International Associations](#) [1] to undertake a data-collection exercise early in 1972 using the resources of the network of 2500 international governmental and non-governmental organisations on which it maintains profiles in its [Yearbook of International Organizations](#) and related publications [2]. The exercise was an attempt to elicit information from organisations on the problems they believed to be within their area or particularly relevant to them. The response was not immediately usable. Subsequent searches through international organisation literature suggest that this may have been partly because of the difficulty of identifying and isolating descriptive material on problems in their programme-oriented documentation. In addition few people are equipped to give an immediate response to a request for precise description of the problems with which they are concerned because problems tend to be perceived as embedded in a continuum of interrelated concerns. This set-back precluded any early publication and led to a search for funding a more comprehensive project.

The initial intent had been limited to the production of a compilation of interrelated world problems as perceived by international organisations. The project has since evolved through several concepts of the content and structure of the immediate end-product. It has been funded privately on behalf of Mankind 2000, which is particularly concerned with human development as it relates to world problems now and in the future [3] The joint project of Mankind 2000 and the UIA is continuing in this vein, with informal arrangements for possible future inputs from the Center for Integrative Studies. The first result is a [Yearbook of World Problems and Human Potential](#) produced from text held for updating and cross-referencing on magnetic tape files via the UIA's computer-typesetting software used to produce the [Yearbook of International Organizations](#) (which the new publication cross-references).

Because of the amount of information (about 1000 two-column pages or 9 million characters), structural complexity and manner of production there are difficulties in providing enough copies for examination in proof form. The first edition is therefore to be considered a draft edition.

Data description

The data are organised into a number of series which are very similar in structure. Their elements are cross-referenced both within each series and between series, where relevant. Some series include bibliographies.

World problems (P series)

Contents. The identified world problems are each allocated a 4-digit number in ascending numerical sequence, serving merely as a reference for computer, filing, indexing and cross-referencing purposes. There are at present approximately 2560 problems in the computer system although there are files for 3700. The gaps in the sequence represent candidate problems which have been provisionally excluded, but for which documents have nevertheless been filed. The information held on computer file about each problem is of two types: textual description and cross-references/indexes. The description varies in length from a minimum of three lines in which only the name (s) of the problem is given, to several hundred lines broken down into standard sub-sections, eg, the nature of the problem, its incidence, background (when and how its importance was recognised and the evolution of this recognition); the argument which stresses (possibly with a quotation) the particular importance of this problem and why action is urgent, and the counterargument (if any) which stresses its relative insignificance.

Other sub-sections envisaged but rejected for this preliminary edition include remedies; publications; meetings, and the countries in which this problem has been noted. Some information on the last three items emerges from other series whose elements may cross-reference a particular problem.

Cross-references are processed separately but are printed at the end of each text description to complete the entry. They are of two types: to/from other problems or to/from elements of other series. The following relationships are distinguished, where encountered:

- Problem framework (hierarchical relationships), with contextual, subsidiary and associated problems;
- Problem network (functional relationships), with problems aggravated by and aggravating the problem; and problems alleviated by and alleviating the problem.

Other inter-problem relationships were envisaged for later inclusion, including references to problems perceived as displaced by or displacing other problems (due for example to an increase in the sophistication of analysis or to an increase in the level of education). The cross-references between series that have been included so far are given in Table 1, which shows the total number of items per series and the pattern of interrelationships between series.

Table 1: Cross-referenced inter-relationships between series (included to date)																
	A	C	D	E	H	J	K	M	P	Q	S	T	V	Series content	Classification	Approx. total entries(*)
A	X	.	.	.	.	.	.	.	.	.	.	.	.	International organizations	.	2750
C	X	X	.	.	.	.	.	.	.	.	.	.	.	Commodities	(UN/SITC)	400
D	X	.	X	.	.	.	.	.	.	.	.	.	.	Disciplines	.	1850
E	X	X	X	X	.	.	.	.	.	.	.	.	.	Economic sectors	(UN/ISTC)	100
H	X	.	X	.	X	.	.	.	.	.	.	.	.	Human development	.	200
J	X	.	X	.	.	X	.	.	.	.	.	.	.	Jobs / Occupations	(ILO/ISCO)	150
K	X	.	X	.	.	.	X	.	.	.	.	.	.	Integrative concepts	.	150
M	X	X	.	X	.	.	.	.	.	.	.	.	.	Multinational corporations	.	600
P	X	X	X	X	X	X	.	.	X	.	.	.	.	World problems	.	2560
Q	X	.	.	.	.	.	.	.	X	X	.	.	.	Human diseases	(WHO/ISCO)	100
S	X	.	X	.	.	.	.	.	X	.	.	.	.	Periodicals / Serials	.	1200
T	X	X	.	.	.	.	.	.	X	.	.	X	.	Multilateral treaties	.	1000
V	X	X	.	.	X	.	.	.	X	.	.	X	X	Human values	.	700

(*) Others may be cross-referenced within an entry without being made the subject of a separate entry

Key to classification: UN-United Nations; SITC-Standard International Trade Classification; ILO International Labour Organisation; ISCO International Standard Classification of Occupations; WHO World Health Organisation.

Definition of problems. No satisfactory definition was encountered (Bertil Nordbeck, 1971) and no positive definition of a problem was established; only a list of characteristics by which some candidate 'problems' could be excluded. In the main these were the theoretical, methodological, operational, administrative and technical problems which are the ongoing *internal* concerns of well-defined social systems. This exclusion list then made it possible to accept any other unforeseen kinds of problem which might otherwise have been excluded by a simplistic definition. Thus the emphasis has been on including those problems noted mainly in international organisation documentation, because they are perceived, defined and acted on as problems by that constituency-whether or not some more sophisticated or alternative analysis would show the perception to be incorrect or inadequate. In some cases where a problem was made up of a well-defined multilevel hierarchy of subsidiary problems, a selected lower level would be cross-referenced by name only but not given a number/description in the series. Clearly this could be done in a future edition if the extension to further detail is considered useful, but the technique does permit cross-referencing of many more problems than are numbered in the series.

Human development (H series)

The juxtaposition of world problems and human development may at first sight seem strange, but they are complementary extremes of focus (for example, Aurelio Peccei, 1975). World problems are generated in society by the actions and perceptions of human beings pursuing ends considered essential to their own development. Conversely, individual human development is frustrated by world problems. While world problems are the conventional area of organisation concern, the purpose of organisation activity is ultimately to help human development, but the meanings attached to this term are many and varied and rarely encountered in the same context. It is therefore appropriate that they should be placed within the same framework as the world problems.

Just as with the problems, no positive definition of human development was attempted, only a list of characteristics by which some extreme concepts could be eliminated. A wide range of literature was then consulted to extract definitions of concepts relating directly to the psychological development and integration of the individual human being and the meaning of this process for the individual.

Values (V series)

Initially a deliberate effort was made to avoid any focus on values. It was expected that the fuzziness of definition would be considerably

greater than in the case of problems, which could be looked upon as relatively hard evidence for unactualised values. Later various systematic literature searches were made and a tentative list of values, value synonyms and value antonyms was established. An important reason for this approach was the realisation that many problems of political significance were in fact labelled by the value which they infringed: 'peace', 'development', 'education', etc.

Integrative disciplines (K series)

Partly in response to the complexity of the network of world problems, a surprisingly large range of 'integrative disciplines' and concepts has emerged. It was considered useful to supply definitions of these in the same context as the world problems. The series therefore includes interdisciplinary techniques, policy sciences, general systems, cybernetics, etc., to the extent that the material highlights the integrative aspects considered necessary for an adequate response to world problems or the interlinking of normally unrelated concepts. The bibliography is particularly important as a collecting point for material which is otherwise lost in conventional subject-oriented documentation systems [4].

Intellectual disciplines (D series)

In the course of a search for references to 'interdisciplines' for inclusion in the previous series it was discovered that there seemed to be no systematic listing of intellectual disciplines. Partial listings tend to be embedded in subjectmatter listings, usually for documentation purposes. It can be argued that the individual disciplines as collections of conceptual tools constitute an intellectual resource, which in some cases is (or could be) brought to bear upon world problems, so that here cross-referencing highlighted the emergence of interdisciplines. No final definition of disciplines was formulated; only an exclusion list to eliminate 'non-intellectual' disciplines and particularly manual skills.

International organisations (A series)

The UIA maintains computer files on the series of international organisations, partly to make computer typesetting of its [Yearbook of International Organizations](#) easier. An important reason for developing the world problems series was to clarify which organisations were concerned with which problems, if any. In addition, the existence of an organisation may legitimate the problem with which it claims to be concerned.

Parallel development of other series suggested that even when an organisation was not apparently concerned with any of the identified problems, it could sometimes be meaningfully cross-referenced to the values it was attempting to promote, to disciplines as a professional organisation, to jobs as a trade union, to commodities as a trade-regulating body, etc. This series therefore appears as a very highly abridged extract from the *Yearbook of International Organizations* with cross-references added to entries as appropriate [5].

Multinational corporations (M series)

These enterprises are claimed by their advocates to be the solution to the world's problems, while being identified by their opponents as representing one of the major world problems and the origin of many others. On either count it is useful to place them in juxtaposition to the problem series and to cross-reference them to the commodities or economic sectors with which they are particularly concerned, specially when the list of countries in which their subsidiaries operate is given. Previous UIA work was used as a basis for identifying a preliminary list of multinationals (Anthony Judge, 1968).

Multilateral treaties (T series)

A major goal of international diplomacy faced with an emerging world problem is the establishment of some kind of international treaty, convention or agreement to regulate the actions giving rise to the problem or to coordinate action in response to it. As in the case of some organisations, the existence of a treaty may legitimate official concern with the problem to which it relates. In addition, the names of non-ratifying countries (taking regional restrictions into account) in some cases indicate countries where the problem may occur, which may be vulnerable to the problem, or at least where it may not be taken seriously as a world problem. Treaties can also be cross-referenced to the international organisations to which they may give rise, to the commodities which they regulate, etc. Assistance on this series was received in the form of information from the *World Treaty Series* project [6].

International periodicals or serials (S series)

These constitute a major means for disseminating information on the current status and expected development of world problems and actions in response to them. The existence of a periodical may legitimate concern with the problem or discipline which is its principal subject matter. Many such periodicals are produced by or for international organisations. (UIA, 1975)

Jobs or occupations (J series)

Many world problems are related to the working conditions of people in specific job categories or to the self-protective excesses of particular professions. The range of job categories also represents the pool of human skills which can be brought to bear on the world problem complex. The International Labour Organisation has elaborated an *International Standard Classification of Occupations* in terms of which various international statistical series are formulated, and this has been adapted as the basis for this series.

Commodities (C series)

Traded commodities may give rise to problems as well as constituting the range of natural and manufactured resources. A *Standard International Trade Classification* has been elaborated by the UN to help formulate statistical series.

Economic and industrial sectors (E series)

These sectors may give rise to problems although they act as the motor of world society. An *International Standard Industrial Classification* has been elaborated by the UN and has been adapted for use as this series.

Diseases (Q series)

Some merit treatment as "world" problems. The *International Classification of Diseases*, developed by the WHO for statistical purposes, has been adapted. There is considerable advantage in using the structure of such internationally established series, since they provide an interface between some problems and statistics available on them.

Data handling and uses

From the start, the limited funds available for a project of this type have meant that a healthy compromise had to be reached between the requirements of data collection, updating, cross-referencing/indexing, research and the ability to print something which could be distributed through commercial channels to generate sufficient funds to repeat the exercise.

It is clear that the range of information covered makes it very difficult for any one group to assemble all the necessary documentation and skills to process it, even if this were possible or desirable. Thus the aim has not been to establish a definitive end-product, but rather to establish a data-processing framework to enable interaction amongst the network of (preferably international) organisations willing to respond to successive representations of the problems, other series, and their interrelationships. A yearbook proved to be the best vehicle.

It is not possible to verify the 'facts' included as represented in the documentation available, nor to undertake research to establish the existence of new problems or relationships. These are activities which are well-reported in specialised journals and other literature. The aim here is to reflect the perspectives of international organisations and constituencies on the problems and relationships to which they are sensitive, and to register the existence of others that have been reported to which they might be sensitive. Organisations act on the basis of their perceptions of what the facts are, not necessarily on the basis of what the facts really are according to the latest piece of research. (The 'counterargument' permits juxtaposition of a corrective sub-section and an 'erroneous' problem statement.) The concern is therefore less with whether a problem or relationship 'exists' than with the possibility that an organisation may be acting in the belief that it does. For the user the value of the information provided will lie less in the description of the particular problem about which his (or her) organisation is already well-documented, and much more in the perceptions of the relationships of this problem to others and the relative importance attached to them by their constituencies.

As responses are received to each edition of the yearbook (and to proofs sent to the organisations), the texts and patterns of relationships will be modified. In some respects the process is a Delphi-type dialogue with a network of correspondents. The data framework does not disguise the inadequacy of information on some problems, nor the tentativeness of the candidacy of others. No polished, final result is sought, but stimulus to further contribution. As other such series may be added, the amount of information held in any series may be considerably increased, as may the degree and type of cross-referencing within or between series.

Classification schemes

One group's system of categories is another group's straitjacket and therefore an obstacle to communication. Category systems tend to become concretised in information-retrieval systems and the hierarchical structure of organisations and their programmes. Modification is then difficult, costly, slow and administratively inconvenient. For these reasons an attempt has been made to keep the purely administrative task of filing data and relationships for the different series distinct from the subsequent intellectual task of continually experimenting with a variety of different classification schemes. Some of these experiments may be included in a particular edition of the yearbook, as with the last four series mentioned.

Research possibilities

The project to date has been, and should continue to be, a data-collection exercise. The existence of an updated data base of this kind should, however, facilitate some types of research which have hitherto been almost impossible. The data collected will not, for example, contribute directly to research using quantitative models, although it may suggest some problems and relationships for inclusion in such models. A precondition for conventional model building is a minimum of quantitative information on the dynamics of the relationship between two or more selected levels or quantities in the system. The 'problems' become evident by interpretation of the results of the quantitative analysis. In the absence of quantitative information, or where the latter is vulnerable to criticism, no other systematic analysis has been possible. One use of the data collected in this project will be to test whether results can emerge from analysing the networks of relationships as networks in which qualitative rather than quantitative values are attached to the links between the nodes. The readily available tools of graph theory and topology, for example, have not yet been applied with computer assistance to such data. [7]

For example, it should prove useful to conduct computer comparisons of the degree of isomorphism of a network of interrelated problems and the corresponding network of agencies (or treaties, or disciplines) which purport to focus upon them. If the functional interlinkages, particularly communication channels, of the latter do not correspond to the linkages (or degree of structural complexity) of the problems, then it is probable that that problem complex is uncontained, and uncontainable, by the programmes of the agencies as they are currently implemented. It would seem that in a world system characterised by a number of relatively complex networks on which information is largely unavailable or inadequate for numerical analysis, such techniques could be used to identify and analyse clusters and critical points on which some action might be taken [8].

Display possibilities

This project will succeed to the degree that it can render transparent the complexity it attempts to map. This poses the problem of developing a satisfactory form of display. An advantage of holding the relationships in computer files as components of directed graphs is that such graphs can be plotted (in colour) by computer with appropriate labelling and choice of projection. Detailed problem 'maps' can therefore be produced, printed and bound into 'atlases'-- the argument being that people (whether students, executives, researchers or policy makers) have at least as much need for such visual devices to orient themselves in the social system as they have for road and

other maps.

Comprehension will be made easier by on-line computer graphics devices with display screens to permit the user to interact with that part of the network he chooses progressively to explore, at the level of display complexity which he is prepared to tolerate, and with the ability to call up textual explanation, use computational power, or activate a parallel slide display whenever required. Such exploration can be recorded on videotape for wider use (eg, in a decisionmaking environment) or sectionalised for production as a series of printed maps. Although the hardware exists and some software has been developed to handle network structures in three dimensions and colour, this work has hitherto been confined to engineering design, architecture and chemistry, [9] and its potential for handling the great complexity of social structures is poorly recognised.' just as the structural analysis advocated above falls between the popular extremes of quantitative analysis and (case-oriented) 'qualitative' studies, so the structural display falls between the extremes of tabular output (or the graph equivalent), text output (resulting from conventional information retrieval), and purely aesthetic displays (resulting from the increasing use of computers by artists).

Harold Lasswell's point with regard to policy makers could be made for all those not numerate, within and outside the research community:

Why do we put so much emphasis on audio-visual means of portraying goal, trend, condition, projection, and alternative? Partly because so many valuable participants in decision-making have dramatizing imaginations ... They are not enamoured of numbers or of analytic abstractions. They are at their best in deliberations that encourage contextuality by a varied repertory of means, and where an immediate sense of time, space, and figure is retained

As a descriptive device for highly complex structures, apart from permitting relatively sophisticated analyses, a graph representation can be transformed into much more iconic forms than those conventionally used to describe psychosocial structures, and is thus more comprehensible.

Possible policy implications

The significance of this approach for policy making has largely been covered in the introductory and previous sections. An effort has been made to bring together and cross-reference kinds of information which tend to be kept separate to the disadvantage of decision making. These series represent the problems, the intellectual tools, the legal instruments, the organisational and human resources, and the range of human values which will govern any decision. In addition, series are included drawing attention to the concepts of human development which may integrate different clusters of values, and 'integrative disciplines' which interrelate concepts from different disciplines.

Problems, organisations, concepts and personal development are usually considered as though they were unrelated. But it is necessary to have a progressively more integrated conceptual structure in society before the interrelationships between the newer problems can be perceived. Both are needed before we can attempt to interrelate organisational units to handle the interlinked problems. Our individual ability to tolerate and comprehend the complexity and dynamism of these interrelationships is directly related to our own degree of personal development. Furthermore, a general increase in integration in any of these four domains will tend to increase integration in the other three. Equally, progressive fragmentation in any of the domains will provoke disintegrative tendencies in the others. [11]

A fundamental difficulty today is our predilection for simplistic hierarchical organisation of the interrelationships between concepts, organisations, and problems. And yet we are constantly exposed to evidence that these hierarchies do not contain the complexity with which they have to deal.

It is hoped that through the process outlined here it will be possible to learn more about how information from very diverse sources can be concentrated and structured to the critical level required to provide the kind of integrative overview necessary for all to develop a sufficiently complex and strategically sound response to the world problem complex as it is now emerging.

Notes

1. The Union of International Associations, an international non-governmental organisation, was founded in 1907 and has its secretariat in Brussels. Some of its pre- 1939 activities are interesting in relation to the current project: *Annuaire de la Vie Internationale, Vol 1* (1908-1909, 1370 pages), Vol 11 (1910-1911, 2652 pages) which included information on problems with which international organisations were concerned at that time; *Code des Voeux Internationaux; codification générale des vœux et résolutions des organismes internationaux*, 1923, 940 pages (under the auspices of the League of Nations), which listed those portions of the texts of international organisation resolutions which covered substantive matters including what are now regarded as world problems.

Paul Otlet, a co-founder of the UIA, produced a book (with a preface entitled 'The Problem of Problems') which attempted a summary of problems in most domains and contained sections on the concept of man and 'la synthèse des connaissances' (Paul Otlet, *Monde; essai d'universalisme*, Bruxelles, Editions Mundaneum, 1935, 467 pages).

2. *Yearbook of International Organizations* (Brussels, UIA, 1974, 15th edition, also in French, 1045 pages); *Annual International Congress Calendar* (Brussels, UIA, 1975, 15th edition, 364 pages); *International Associations* (Brussels, UIA, started 1949, monthly)

3. Mankind 2000, initiated by Robert Jungk in 1964, organised the International Future Research Inaugural Conference, Oslo, 1967, which gave rise to the book of papers entitled *Mankind 2000* (London, Allen and Unwin, 1969) and to subsequent futures research conferences in Kyoto, Bucharest and Rome.

4. As an example of the problem, when the chief cataloguer of one major library was asked how books on interdisciplinary and related approaches were classified, he indicated that the practice was to scan such books and identify the most discussed discipline and use that for filing purposes. A key publication such as *Interdisciplinariy* (Paris, OECD, 1972, 321 pages) would therefore not be retrievable under any interdisciplinary subject heading.
5. In future it will be possible to extend the information to cover units and other sub-sections of organisational hierarchies which have an explicit responsibility for particular problems. From a data-handling point of view such hierarchies may be considered as ordered networks.
6. The information held in a data bank is being published in Peter Rohn, *World Treaty Index and Treaty Profiles* (Oxford, European Bibliographical Center/Clio Press, 1975, 6 vols)
7. C. Berge, *The Theory of Graphs and its Applications* (London, Methuen, 1962); C. Flament, *Applications of Graph Theory to Group Structures* (Prentice-Hall, 1963); F. Harary, R. Z. Norman, and D. Cartwright, *Structural Models; An Introduction to the Theory of Directed Graphs* (Wiley, 1965); Norman Schofield, 'A Topological Model of International Relations' (paper presented to the Peace Research Society International meeting, London 1971); R. O. Anderson, *A Sociometric Approach to the Analysis of Inter-organizational Relationships* (Institute for Community Development and Services, Michigan State University, 1969); L. Tesler, H. Enea and K. M. Colby, 'A Directed Graph Representation for Computer Simulation of Belief Systems', *Mathematical Biosciences*, Vol 2, No 112, February 1968, pages 19-40; K. M. Colby, L. Tesler and H. Enea, Experiments with a Search Algorithm on the Data Base of a Human Belief Structure, *Artificial Intelligence Project*, 1969 (Memo AI-94)
8. This argument has been given in more detail in other papers by the author, 'Computer-aided Visualization of Psycho-social Structures' (Paper at AAAS Symposium on Value and Knowledge Requirements for Peace, Philadelphia, 1971, ERIC ED060613); 'Toward a Concept Inventory; Suggestions for a Computerized Procedure' (Paper at IPSA Committee on Conceptual and Terminological Analysis, Montreal, 1973)
9. The author produced in 1970 a short film *Visualization of Organization* to illustrate the possibilities of manipulating social network representations on a computer's graphic screen.
10. D. C. Engelbart, *Augmenting Human Intellect* (Stanford Research Institute, 1962, AFOSR-3223 and subsequent papers); D. Brown and J. Lewis, *The Process of Conceptualization; Some Fundamental Principles Useful in Teaching With or Without the Participation of Computers* (Educational Policy Research Institute); Jacques Bertin, *Sémiologie graphique: les diagrammes, les reseaux, les cartes* (The Hague, Mouton, 1973); Walter Herdeg, ed, *GraphisIDiagrams: the Graphic Visualization of Abstract Data* (Zurich, Graphis Press, 1974).
11. William Eckhardt. Psychosocial Isomorphism. In: William Eckhardt, *Compassion; Toward a Science of Value* (Oakville, Ontario, Canadian Peace Research Institute, 1972), pages 234-244; Anthony Judge, From Apartheid to Schizophrenia, *International Associations*, 23 February 1971, pages 89-102

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