

ORGANIZATION AND LIFESTYLE DESIGN

- Characteristics of a nonverbal structural language (*)

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Existing patterns of organization, whether hierarchical systems or associative networks, are proving inadequate in response to societal problems and as a basis for qualitatively superior lifestyles. This is particularly apparent in the rising problems of unemployment and leisure and the obstacle to design initiatives by those most affected. The problem of producing alternative forms of organization of activity is complicated by consensus formation in the design process and its status with respect to those who are supposed to benefit. (These contextual constraints are explored in Annex A, page 160)

A very simple nonverbal structural language can be envisaged as an aid to organization and lifestyle design by those for whom the design is intended. It is based on the use of pieces of stick and string of similar length and has already been used to develop sophisticated tensegrity structures familiar to architects. Such structures -- considered as a binary structural code -- can be used to order and interrelate non-dualistic complementary functions distinguished as essential (by the user) to an organization or a lifestyle. (This is explored in Annex B, page 164)

The language is user-oriented in that it is how the user group interacts with and interprets the structural elements which is significant for the viability of the resulting organized whole. It is the instructive questions raised by the language which lead the users on to improved designs. It is probable that the language can be used in association with an understanding of traditional symbol systems. As such it is also likely to prove of value in non-western cultures (specially with problems of unemployment) as an aid to the development process. (The educational and practical considerations are explored in Annex C, page 166)

Since the language is a nonverbal one, which is understood, to the extent possible, through manipulation of its elements, the presence of the remaining pages is really inconsistent with the philosophy behind the language and with the increasing recognition of the limited practical value of papers such as this. It is not however acceptable academic practice in the social sciences to present or demonstrate 3-dimensional models when illustrations are inadequate. The following annexes are therefore an unsatisfactory compromise.

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CONTEXTUAL CONSTRAINTS

1. Organization : This paper is concerned with how organization (or order) is envisaged, comprehended or represented (1). With regard to the themes of this conference, this is particularly relevant to
 - the organization of human groups and inter-group organization (2)
 - the organization of lifestyles and inter-lifestyle organization (3)

It is also relevant to the organization of concepts (1, 4) and to that of whatever elements an individual recognizes as active in his (or her) own personality integration or fragmentation. These both have an impact on group and lifestyle organization, and indeed the significance of isomorphism between all such systems of ordering may be raised (5).

2. Hierarchy vs Network : Due to limitations in the information processing capacity of the brain, the most favoured basis for ordering information is the hierarchy (1, 6). It is these limitations which allow some to justify their belief in hierarchical ordering as reasonable (7). The hierarchical order clearly predetermines the dominance of some elements with respect to others, which in many current situations is viewed as unacceptable because of the abuses to which it tends to lead (8) and its fundamental inability to respond adequately to a turbulent problem environment (5). Such hierarchical systems of organization have been deliberately rejected by many in favour of some form of network (9, 10, 11, 12). Associative networks have become increasingly fashionable, but already their weaknesses (due to the absence of any ordering principle) are becoming apparent (13, 14).
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3. Ineffectiveness of existing organization : Despite the enthusiasm of their respective advocates, neither the hierarchical nor the network mode of organization can be said to be making significant impact on the total complex of 2600 "world problems" currently recognized (5), even if their relative importance is being effectively adjusted. Nor does either mode appear to have led to the generation of viable lifestyles characterized by a significant improvement in the quality of life of the many, rather than of the few (3).
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4. Unemployment as an example : As evidence of this, one may note the singular failure to respond to the challenge implicit in the rising problems of unemployment, underemployment, and malemployment,
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whether evident or disguised. It is unnecessary to detail the corrosive effects that these have on individuals (particularly youth) and on society as a whole. The hierarchical mode is frequently under pressure to reduce labour costs. It's acceptable option of "job creation" is opposed by recognition of the abuses of the market economy (e.g. increasing the rate of product failure) and the limits to growth. Under the kinds of pressure foreseen, it's options are paid leisure, creation of jobs by de-automation or, ultimately, organized work forces (work camps, collective farms, Arbeitsdienst, etc). The network mode, as an alternative, has failed to demonstrate ability to generate significant enterprise of an economically viable nature, other than in isolated instances. The failure rate of western-style communes, and their subsistence level of operation, is a case in point (even when their members are all committed to non-Western political ideologies).(*)

5. Limitations of analysis : These problems are analyzed in terms of lack of jobs and how to employ peoples time "productively". Simultaneously some others are preoccupied, to a much lesser extent, with the increase in leisure time and the problem of how to occupy people "creatively" - particularly as the working week is reduced. It may well be asked, given the lack of breakthroughs to date, whether an analysis based on the dualistic concepts jobs vs leisure, (i.e. productive vs unproductive) exhausts the possibilities of insight. It should be noted that such an approach reflects a particularly simplistic image of the individual during a period when this is changing (and probably needs to change) rapidly (15). It is particularly inappropriate during a period when, ironically, there is considerable pressure to ensure that jobs are "creative", satisfying, and a contribution to the development of the person, whatever that is held to mean (16).
6. Redefining the problem : This paper takes the position that it is useful, if only as a temporary measure, to abandon the categories of "job" and "leisure" and to search for a new approach (17). Employment and leisure are both ways of being active, allocating attention, or spending (i.e. "using") time. For want of a better term, let us consider them as sub-categories of a larger category called "activity", whatever else this should include (**). Useful questions are then :
 - (a) how can one proceed to subdivide "activity" so as not to impede emerging awareness of possible new or alternative categories of activity ?
 - (b) how can individuals be encouraged to engage in this process themselves in order to discover whatever possibilities their abilities and inclinations enable them to recognize ?
 - (c) how can this be done so that attributes of "activity" associated with initiative, imagination, entrepreneurship, innovation, risk-taking, self-reliance, independence, etc. are not automatically excluded ? (As is the case with conventionally labelled

(*) The hierarchical mode includes cases where a group elects, or is represented by, a select body or individual (as in large communes).

(**) "Activity" here includes such "inactivity" as "doing nothing", thought, sun-bathing, passive resistance, meditation, and "non-action" in the Taoist sense. Just as the conventional concepts of Western "science" or "time" cannot be validly projected onto other cultures (or, for that matter, onto all the sub-cultures of any given society) as recent studies demonstrate (18), so one should be cautious about projecting any westernized concept of "activity".

. job-slots and packaged-leisure experiences, which preclude any creative individual or group response outside an imposed list of options quite possibly considered as unfulfilling from the start.)

(d) given that a satisfactory variety of categories of activity can be identified, what non-directive assistance can be provided to ensure that the balance between them is acceptable (to those engaged in the process) ?

(e) how can those engaged in the process ensure that this balance is reflected in some viable pattern of organization which respects the necessary relationships between the different categories of activity ? (And which avoids the automatic tendency to fall into the hierarchical trap at one extreme or the network mode, if the trap is avoided).

7. Nature of the problem : The problem may be considered as merely the structuring of activity. The challenging difficulties lie however in :

- The tendency to respond in a simplistic manner to the problem, leading to premature closure on unnecessarily mechanistic options
- The lack of understanding of the variety of activities which could be activated and of the kinds of functional patterns which they can form (*)
- Distinguishing activities (or functions) of different and complementary nature at the same level of abstraction, namely determining which functions make up a set constituting a viable whole (1).
- Avoiding static forms of organization by explicitly embodying three forms of change :
 - dynamism in response to the immediate environment (i.e. some form of functional or activity cycle).
 - growth or development in terms of the favoured pattern.
 - evolution or development through new patterns successively selected as favourable.

8. Problem of dialogue : The "technical" problem above is considerably complicated by the context in which it needs to be faced :

- much confusion is created by the difficulty of providing unambiguous labels to activities or functions whose nature is :
 - essentially pre-verbal or non-verbal or in other ways intimately bound into the psyches of those expected to be "objective" (1)
 - defined to a large extent by the relationship to other functions in the selected pattern
 - easily distorted by use of some conventional label with an established pattern of connotations

(*) There is widespread incapacity to comprehend structures and patterns (i.e. "structural illiteracy" or "visual illiteracy" ?) (See ref. 1 and 19).

- conventionally conveyed, to the extent possible, by use of verbal labels demanding of the user a mastery of a particular set of connotations which thus attempt to embody the meaning associated with the term, namely the problem of "jargons" (20, 21, 22).
- irrespective of any use of jargon, there is the difficulty of language and all the ambiguities to which it can give rise (23).
- the background, experience and existing pressure of circumstances influence
 - the number of functions a person or group is prepared to recognize as important
 - the level of abstraction which is considered acceptable
 - the degree of difference that can be tolerated between the functions
 - the richness of content attributed to the functions.
- difficulties of responding to different preferences for grouping functions into a whole that is believed to be viable.
- ensuring a non-directive dialogue with, and between, those attempting to identify new patterns of organization (24). But dialogue itself is inadequate unless the emerging insights are anchored in some comprehensible organized pattern.

9. Design : The importance must be stressed of making the design process accessible to those for whom the organization or life-style design is intended. Clearly an "international" design is counterproductive in terms of responding to individual requirements. But even a "local" design is counterproductive unless the process is made available to those most affected :

- To design for a group is to exclude from the design those creative activities which are associated with the process of design. It defines the "client" group as being of a type requiring that such initiatives be taken for them.
- Depriving the group of such responsibilities permits (and even encourages) them to behave irresponsibly in response to the design - it is not their creation and can therefore always be rejected as an imposition. Its defects can be blamed on "experts", "authorities" or any suitable "them".
- Furthermore, unless a group is in command of the design process it is unable to redesign in response to change. Consequently, there is always a tendency for it to be a victim of change and in need of periodic external assistance. It is not in command of change and consequently perceives itself as a victim of circumstances. This attitude is in fact widespread.

This paper is not however concerned with the principles of design in the larger sense. (On this topic see ref. 25). The purpose of the preceding paragraphs has been to identify the contextual constraints on a proposed design tool - namely a new structural language. This is discussed in the following section.

LANGUAGE

1. Basic requirement : The previous section suggests that what is required is some kind of design tool which allows a group (or an individual) to work and learn in terms of its own interpretative ability. However, built into the use of the tool should be features which facilitate and guide the user(s) towards viable patterns of organization - and from them, when appropriate, to even more useful patterns of organization.

As noted above, the need for general design tools has been explored. But these tend to be tools for professional "designers" who are consequently caught up in the dynamics between those that want to change others, the others they want to change, and the general confusion as to who needs what. These are difficult constraints to circumvent.

It is however possible to conceive of a simple non-verbal structural language which can be learnt - to the extent desired - through manipulation of its basic elements :

- Being non-verbal it circumvents the difficulties, noted above, which arise from the use of words in unending culture-bound discussions.
 - Being structural, it immediately provides comprehensible blueprints for organization and indications of what design are practical.
 - Being simple, it is accessible to anyone rather than yet another inaccessible expensive educational gimmick whose dissemination is determined by the vagaries of market forces
2. Designing a language : How should one set about designing such a structural language ? And how should the element of paradox implied by the preceding sentence be met ?

- (a) A one-element language : A structural language could be based on one type of element - for example, with the characteristics of a stick of a standard size. Structures of many kinds could be built by linking together the sticks in different patterns. Both hierarchies and networks can be modelled fairly successfully with such sticks - as can chemical molecules or small-group communications (*)

There are disadvantages, however, including :

- such a language is essentially linear and does not favour unforeseen patterns with the integrity indicative of a viable organization.
- the sticks delineate without performing any functional role which could provoke further insight (because of this it is usually irrelevant whether they are real sticks, or simply drawn marks on paper)
- such a language is in effect what is already in use in many forms to describe structures, and it has not led past the obstacles noted in the previous section.

(*) The reasons, relevant to this argument, for the sterility of the large amount of experimentation on small group communication nets are examined, elsewhere (2).

- (b) A two-element language : Supposing a 2-element language is considered. Sticks of 2 different colours could be used, for example. But this really does not go beyond the previous case, for the distinction is a superficial one (*). If the 2 elements are considered to be so fundamentally distinct, this should be reflected in the structural characteristics of the elements themselves. Supposing therefore, to complement the stick characteristics, an element having the characteristics of string is selected.

Do such distinct types of elements provide a basis for the emergence of new structural patterns ? They do indeed, as is demonstrated by tensegrity structures, which are the basis for the recently invented geodesic dome (26, 27).

Whilst this evidence is encouraging, it also suggests a need for caution. If this approach has already been explored, why has it not led to more widespread innovation in organizational patterns ? The response would appear to be that it was developed by those primarily (if not solely) interested in design as applied to the architecture of buildings. And yet the analysis can be generalized to organization in general (28, 2). The reason why it is difficult to construct a 3-element language, in the above sense, is discussed elsewhere (1, 29).

- (c) A problem of interpretation : Taking the question further poses an intriguing problem of distinctions and their interpretation. For what is effectively called for is a language based on the most fundamental functional distinction the user is capable of making. And to assist the user, some physical elements are required onto which he (or she) can project the distinction in the expectation of an appropriate degree of supportive reinforcement.

In the architectural case the functional distinction is adequately contained by the verbal labels of compression element (stick) and tension element (string), and many tensegrity structures can consequently be modelled on this basis without confusion (27). But architectural structures (or physical structures found in nature) constitute a limit condition of organization in which the varieties of "activity" are indeed well-reflected in the tension-compression dichotomy. In types of organization with a greater variety of "activities" or "functions" (namely those relating to organization of human society) :

- the fundamental distinction is richer in connotations than in the physical case, and indeed Fuller conveys some of this richness in his own attempt at generalization (ref. 26, p. 359).
- the fundamental distinction is more susceptible to being made or interpreted in a variety of ways, depending on the perceptiveness and perspective of the user (1)
- the clarification of the nature and relationship of less fundamental distinctions is of considerable importance to the emergence of viable patterns of organization.

(*) Such superficial distinctions are frequently used to increase the power of what is effectively a one-element language, but in doing so they only obscure any possible convergence on new structural patterns of any significance. (see ref. 40)

Clearly a certain amount of confusion enters whilst some of this is undoubtedly (and necessarily) due to my own difficulties of comprehension and explanation (*), it is also due to :

- the interpretative freedom necessary to reflect the reality of the situation and the variety of user perspectives,
- the creative confusion necessary to the innovative process itself.

The language must serve as a patterning device to focus and clarify interpretative confusion wherever possible.

3. Illustrative analogies : The nature of the proposed language can be clarified by considering the degree of analogy to the following :

- (a) To the binary code : This is the conventional code basic to digital computer operations (**). In such operations, the quantitative value is indicated by the presence (or absence) of digits progressively allocated to positions in an ordered linear sequence. This is based on the unambiguous logical distinction: yes/no, on/off, etc. (***). In a structural analogue, where qualitative values are to be distinguished, these can be envisaged as oriented structural elements progressively allocated to positions in an ordered space. In the first case a 2-valued condition can be used to convey information on a larger number of quantitative distinctions, whereas in the second it is used for a more complex pattern of functional distinctions, where the interrelationships between the elements is explicit as part of the structural pattern.
- (b) To atomic stability : The stability of an atom (one of the most basic units of structure) can be viewed as resulting from an equilibrium between its positive and negative constituents. Irrespective of the number of such constituents (****), if there is an excess of the one or the other, the stability of the isotopes diminishes to the point at which they cannot exist, even briefly. Construction of the tensegrity structures mentioned above exhibits similar constraints. If there are too many compression elements (sticks), structures collapse. If there are too many tension elements (strings), they cannot be brought into tension to create a viable structure. A balance between them is necessary (although not necessarily one-to-one). Again, depending on the number of elements, there are discontinuities at which no stable pattern can be created (*****).

(*) On the assumption that this whole argument is valid.

(**) Note that the one-element predecessor to this is the simple one-to-one scratch mark system used in primitive counting.

(***) It is interesting to note efforts to move to alternative and richer interpretations (29, 30)

(****) Although beyond those stable enough to occur in nature there are however discontinuities (stability gaps) and then "islands of stability" associated with certain very heavy elements.

(*****) It would be useful to create a structural equivalent to the various isotope charts (e.g. Chart of the Nuclides, Washington DC, US Atomic Energy Commission, Division of Isotope Development, 1970).

- (c) To the binary hexagram code : A number of authors have remarked on the binary coding associated with the I Ching (The Book of Changes), which is a traditional Chinese effort to codify the complete range of qualitative changes (21, 31, 33, 34). As noted earlier (21), the connotative richness associated with the fundamental distinction (Yin-Yang) is explicit, although notoriously elusive in accordance with the level comprehensiveness and understanding which the system purports to reflect. But aside from the six-line hexagrams into which the binary coding is embodied, the system does not develop structures. Compression and tension elements can however be used in an attempt to explore the structural analogues to the system. These cannot be discussed here because of the variety of issues which they raise (*).

Whilst these three analogies clearly have common features, it is worth noting that the first is purely quantitative and logical, the second is associated with qualitative and structural distinctions (the properties of the atoms), and the third is an integrated philosophical system of great precision from one viewpoint and of enigmatic, poetic confusion from another. The system itself both nurtures and explains such a paradox and one is reminded of the mathematical elegance in fundamental physics associated with Heisenberg's uncertainty principle as embodied in Bohr's principle of complementarity (36, 37). This has been extended to the human and social sciences (38).

The proposed language is effectively a device to explore non-dualistic complementarity in patterns of functions, namely, when the complementarity may be more than simply dual (e.g. where 5 functions are mutually complementary) as in the case between the functions or activities essential to an organization or a lifestyle. It uses a dualistic system, as in the three analogies above, to transcend the constraints of dualism. This "transcendence", discussed elsewhere (1, 2), is best comprehended through a language based upon the 3-dimensional tensegrity structures introduced by Fuller (*). An interesting feature of such a language is that it reflects an integration of recent thinking concerning the left brain orientation to deductive thinking (hierarchies) and the right brain orientation to associative, geometric thinking (networks).

4. Elaboration of the language : The reason why it is unnecessary to discuss the further elaboration of the language is explored in the next section.

(*) For example, the hexagram can be coded onto a tetrahedron, the form fundamental to Fuller's approach to tensegrity (26) and the trigram onto a triangle. But these are not structurally stable in the conventional sense. One may suspect that "stability" at this level is dynamic and similar to that associated with Kekulé's interpretation of the benzene molecule. (For a justification of such explorations, see ref. 35)

(**) Intuitively there is a special elegance, indicative of validity, in using the dualistic constraints as a means of transcending or circumventing the limitations which they impose.

EDUCATIONAL AND PRACTICAL USE

1. Limitations to date : As mentioned above, the two complementary structural elements enable a wide variety of structures to be elaborated. Some of these are stable in 2-dimensions, others in 3-dimensions. If they are simply considered as structures, they are merely of interest to some architects and those with an appreciation for the aesthetics of form. That is their current status and as such they are of no interest to the design of alternative social structures. Fuller has not taken their use any further, nor have his followers (39).

2. Interpretation support : If the elements and the resulting structures are treated as features of a language, and the focus is on interpreting the significance which can be associated with the patterns possible within the language, then they could be highly significant to the design of alternative social structures. But here we meet the paradox. For the language is essentially a non-verbal one. The value of any particular verbal explanation is limited to those with the same background as the person providing the explanation. It is the discovery process whereby an explanation is elaborated by the user which is of importance.

There is a parallel with the well-known Cuisenaire coloured rods used in mathematics education (40). But in what is proposed here, as noted earlier, the elements are structurally different and not simply distinguished by superficial variations in rod colour and size. And indeed it is such superficial distinctions which render the Cuisenaire rods useful for exploring quantitative, logico-mathematical relations but useless for understanding structures. But the discovery process, however, how the rods are used, resembles that for the proposed language.

3. Instructive questions : It is a language which provokes or elicits interesting questions. There is not necessarily an absolute best answer to those questions :

- the acceptable answer may well depend on the amount of learning undergone by the user group through the discovery process. "Acceptable" here means understandable and valuable to the group for itself - something it can use.
- the experience, background, and creative interest of the user group may later lead them on to better answers which will enable them to design better structures.
- the language is such that it is the most basic elements (e.g. the stick and string and the simplest structures) which constantly call for reinterpretation (*)
- an answer can of course always be provided by an outside "expert", if creative ambiguity is intolerable and the possibility of premature closure (obscuring further insight) is acceptable. This is likely to be counterproductive and the answer will most probably be perceived as unsatisfactory.

(*) For example, I am personally indebted to Catherine Mozer for pointing out that the sticks should really be thought of as expanding forces (e.g. pushing springs) and the strings as contracting forces (e.g. pulling springs) in agreement with Fuller. I am indebted to Tatjana Globokar for pointing out that the orientation of the sticks in a structure is important thinking about movement of energy

But even if there is no absolute best answer, the user group can at any time work out its own best answer - the one most meaningful to it at the moment. And this is the significance of the language, it is an interpretative support which assists consensus formation, avoiding some of the traps of purely verbal discussion. It stabilizes any consensus which depends more upon visual reinforcement concerning the nature of a balanced pattern of structural relationships, than upon verbal reinforcement concerning isolated factors connected solely by a linear argument (*). The kinds of structure which can be produced encourage: better (i.e. more instructive) questions to be asked with a view to designing a better structure. Users have full control of the design process (**).

Hopefully the above remarks explain why detailed verbal explanation of the language tends quickly to become counterproductive and more and more an expression of the person providing the explanation. The stress must be placed on the language as employed by a user group wishing to clarify its own thinking.

4. Language in use :

- (a) Construction : the language elements are very simple (sticks, strings). The only explicit rule (if it is that) is that the elements should be connected end-to-end by flexible links (***). All other rules are implicit in the ways it is possible to manipulate the elements and the kinds of structures it is possible to produce.
- (b) Distinctions : Construction is however only a guide to the consequences of making certain distinctions (****). Users make distinctions according to their experience and creative insight. For example, a group of users might ask themselves how many functions or activities were basic to the organization they wished to create. The problem for them is :
- how to distinguish between complementary functions at the same level of abstraction
 - how to comprehend the interrelationships necessary for them to constitute a viable whole
 - how to distinguish functions at a different level of abstraction.

(*) Why are organization charts increasingly inadequate and why were charts used in the first place by bureaucracies ?

(**) It would seem that a language of this kind responds to the political issues raised by the design of alternative social structures.

(***) Fuller stresses this point, since rigid joints imply a third structural element - a connector.

(****) For an insightful discussion of the relationship between the observer and the distinction, see ref. 41. Unfortunately this uses a powerful notation which is only comprehensible to the initiated.

- how to comprehend the relationships between functions at different levels of abstraction
- how to envisage the various forms of change, discussed earlier, to avoid creating a static organization unable to develop.

Similar distinctions could be made with respect to personal or inter-personal lifestyle organization.

- (c) Interpretation : As users make distinctions they can allow a particular structural element (e.g. a stick) to represent a function that has been distinguished. If six functions are distinguished in this way, they can then explore what inter-relationships are necessary in order for the result to constitute a viable whole. The structures they produce will provoke instructive questions which may encourage them to explore alternatives.

Such questions might be concerned with the meaning they are able to associate with the : basic structural elements (what is a function ?) ; their orientation within the structure ; structural features (delineated areas, great circles) ; integrity of the structure (symmetry elements) ; dynamic stability ; etc. An example of answers to such questions is given elsewhere (2).

In this way users come to a collective in-depth understanding of the structure and dynamics of the whole they are able to bring into being in the light of their own insight and experience. This is very important for it is the inter-subjective reality they are able to share in this way which governs the viability of the organization (until their experience encourages them to redesign it). It is this shared understanding of the whole which legitimates, for them, the pattern of functions and interrelationships which they need to activate and maintain.

- (d) Correctness and expertise : The question now is whether a user group is "correct" in the functions it chooses to distinguish. It is the position of this paper that it is more important that a user group acts in terms of what it believes to be correct. It is the shared belief structure itself which will guarantee, to a considerable degree, the viability of the whole as opposed to the vulnerability of an expertly designed organization whose functional pattern its animators neither appreciate nor comprehend.

A user group may of course accept guidance from experts or books as it engages in the discovery/design/innovation process. But again it is more important that the group feels the "rightness" of such input than that it be correct according to some externally conceived "objective" criterion.

5. Further work possible : There is a multitude of texts concerning the "functions" required for an operating organization (for example, ref. 42). But these usually imply a commitment to some conventional mode of operation and "jobs" : profit-making, non-profit-making, etc. They do not re-examine at a more fundamental level the kinds of functions it may be appropriate to distinguish if these are to incorporate, or blend in, those associated with "leisure". The problem is to recapture the level of awareness prior to the job-leisure split in order to be free to explore the possibility of hybrid organizations outside any conventional mode (see for example, ref. 43).

Faced with the question of alternative ways of ordering a functional whole, one is confronted with the implications of the many patterns of order embedded in the traditions of different cultures. It is not recognized, when advocating or imposing the use of particular sets of functions, that in traditional societies these effectively constitute substitutes for gods or essences believed to be governing those same functions. Each culture has elaborated the relationships which it believes obtain between such entities. It is not improbable that useful insights can be obtained by exploring such symbol systems in order to enrich understanding of alternative patterns of order (1).

Such explorations are not necessary to the use of the structural language as envisaged. They may however catalyze deeper understanding, and they may make it easier to introduce the language in such cultures to enable people to elaborate new types of organization natural to them. As such the language could prove significant to the whole development process.

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19. Rudolf Arnheim. Visual Thinking. London, Faber, 1970.
20. The richness and variety of the connotations of "duality", for example, may be seen in : June Singer. Androgyny. New York, Doubleday, 1976.
21. The difficulties of labelling and comprehending fundamental change processes are illustrated by the categories in the traditional Taoist text : I Ching (The Book of Changes). London, Princeton University Press, 1967 (Presented by Richard Wilhelm with commentary by C G Jung).
22. On the problem of specialized jargons, see : G. Sartori, F.W. Riggs and H. Teune. Tower of Babel ; on the definition and analysis of concepts in the social sciences. University of Pittsburgh, 1975 (International Studies Association, Occasional Paper n° 6 ; arising from the work of the Committee on Conceptual and Terminological Analysis, now collaborating with Unesco through the latter's Inter-concept programme).

23. Les problèmes du langage dans la société internationale. Bruxelles, Union des Associations Internationales, 1974 (Compte-rendu d'un colloque).
24. The importance of dialogues is currently being explored by the Goals, Processes and Indicators of Development project of the UN University. See, for example : Johan Galtung. On dialogue as a method ; some very preliminary notes (Project paper, Geneva, 1978).
25. J. Christopher Jones. Design Methods. Wiley, 1970.
26. R. Buckminster Fuller. Synergetics ; explorations in the geometry of thinking. New York, Macmillan, 1975 (Tensegrity : pp. 372-432)
27. Anthony Pugh. An Introduction to Tensegrity. Los Angeles, University of California Press, 1976.
28. A lesson in organization from building design. Transnational Associations, 30, 1978, 5, pp . 248-257.
29. Xavier Sallantin. L'épistémologie arithmétique (communication aux Séminaires internationaux d'épistémologie de l'Abbaye de Sénanque, Septembre 1976). In which a 3-valued logic is proposed.
30. Kinhide Muskakoji. Scientific revolutions and inter-paradigmatic dialogues. (Paper presented to the GPID meeting of the UN University, Geneva, Octobre 1978). In which a 4-valued logic is proposed.
31. J. Needhem. The system of the Book of Changes. In : Science and Civilisation in China ; the fundamental ideas of Chinese science. Cambridge, University Press, 1956, vol. 2.
33. F van der Blij. Combinatorial aspects of the hexagrams in the Chinese Book of Changes. Scripta Mathematica, 28, 1, May 1967, pp 37-49
34. M Gardner. The combinatorial basis of the I Ching. Scientific American, January 1974, pp 108-113
35. Johan Galtung. Structural analysis and chemical molecules. In: Methodology and Ideology. Copenhagen, Christian Ejlers, 1977, pp 160-189
36. Gerald Holton. The roots of complementarity. Daedalus (American Association for the Advancement of Science) Fall 1970, pp 1015-1055
37. T R Blackburn. Sensuous-intellectual complementarity. Science, 172, 4 June 1971, pp 1003-1007 (on countercultural epistemology and its value to the science of complex systems)
38. Niels Bohr. Atomic Physics and Human Knowledge. New York, Wiley, 1958, pp 67-82
39. A possible exception is Keith Critchlow: Order in Space; a design source book (London, Thames and Hudson, 1969); and Islamic Patterns; an analytical and cosmological approach (London, Thames and Hudson, 1976); or Keith Albarn et al. The Language of Pattern (London, Thames and Hudson, 1974). But these are almost exclusively concerned with two-dimensional, patterns and not structures.

40. C Gattegno and G Cuisenaire. Numbers in Colour. London, 1954.
41. G Spencer Brown. Laws of Form. London, George Allen and Unwin, 1969.
42. George A Steiner. Top Management Planning. New York, Macmillan, 1969.
43. Organizational hybrids ; transnational network of research and service communities. Transnational Associations, 29, 1977, 7-8, pp.306-311.

Additional items for inclusion in second draft.

1. With regard to the participatory nature of the design process and the concept of self-planning, see books by Yona Friedman :
 - architectural self-planning : How to design my home
 - social self-planning : How to live among others without being a chief and without being a slave (J.J. Pauvert, 1974)
 - urban self-planning : Your town belongs to you (Council of Europe, 1974)
 - environmental self-planning (UN Environment Programme , 1976).
2. With regard to the relevance of complementarity to a design process dependent on consensus formation concerning human needs : "Far from restricting our efforts to put questions to nature in the form of experiments, the notion of complementarity simply characterizes the answer we can receive by such inquiry, whenever the interaction between the measuring instruments and the objects forms an integral part of the phenomena!" (Niels Bohr, in Essays, 1958-1962, on Atomic Physics and Human Knowledge. New York, Wiley, 1963).
3. With regard to the need for a structural vocabulary : Johan Galtung. Structural analysis : vocabulary, graphs and structures as indicators. University of Oslo, World Indicators Program N° 12 (Papers n° 39)
A.J.N. Judge. Network-related concepts ; a vocabulary adapted to social complexity and social process. In : Les problèmes du langage dans la société internationale. (Bruxelles, Union des Associations Internationales, 1975, pp. 218-221).
4. With regard to the complementarity between hierarchies and networks in any social structure : A.J.N. Judge. System/Network complementarity. Transnational Associations, 29, 1977, 9, pp. 365-368.
5. As an example of the complementarity between hierarchies and networks, a recent study of development of Polaris using a hierarchically controlled management technique (PERT) shows that the real management was carried out in an intensely personal fashion, through small, informal meetings and frequent telephone calls. Though PERT was "as effective technically as rain dancing, it was nevertheless, quite effective politically" (p.246). The chief utility of the system was not control of the organization, but the appearance of formal rationality which could be presented to outside agencies. (H.M. Sapolsky. The Polaris System Development ; bureaucratic and programmatic success in government. Cambridge, Harvard University Press, 1972).
6. With regard to tensegrity structures as reflecting the complementarity between hierarchical systems and networks, see ref. 2.

7. With regard to the user's need to find ways of decomposing and ordering a whole : "The fundamental finding of this study is that structure looms as the dominant factor in the ordering GIS (Generalized Information System). It seems to be quite evident that oneness stands out as the origin of the structure from whence feasible patterns can emerge as rigidly hierarchical, associative, or sequential. Of these the hierarchical patterns appear to have lasting qualities while associative and sequential features may confer richness and flexibility. Like the patterns, themselves, the human contact with the GIS (Generalized Information System) begins with a oneness. Thus, whether negotiating a computer or a sociological system the human conceives patterns from his singular frame of reference and must see and interpret the learned pattern from this state of oneness. Language and other standard ordered patterns tend somewhat to alleviate the plausible dilemma of a human having to interpret for himself from oneness to many independent patterns. Better intellectual and socio-political ordering of the GIS (Generalized Information System) can alleviate his dilemma further".
- (J.H. Kelley. Entropy of Knowledge. Philosophy of Science, 36, 2, June 1969, p. 195).
8. With regard to the way the conventional graphical representation of organization structure in two-dimensional trees constrains the numbers and kinds of alternative designs that are normally considered, see : Russell Ackoff. A multidimensional organizational structure. In : The Art of Problem Solving. Wiley, 1978, pp. 141-156.
9. With regard to the history of the binary system (linking the I Ching on which Leibniz worked and whose system influenced Wiener, who applied it to computers), see : Jean Gebser. Zur 5000 jährigen Geschichte des Binären Zahlensystemes : Fu Hi - G W Leibniz - Norbert Wiener. München, Belser, 1968.
10. With regard to the striking parallels between the I Ching and the genetic code, see Martin Schönberger. Verborgener Schlüssel zum Leben ; Weltformel I-Ging im genetischen Code. Frankfurt, Fischer, 1977. Also : Frank Fiedler. Die Wende ; ansatz einer genetisch anthropologie nach dem system des I Ching. Berlin, Werner Kristkeitz, 1976. Also, emphasizing the bridge between Eastern and Western modes of thought : Marie Louise von Franz. Number and Time.
11. With regard to the significance of the aesthetic element in the patterns which emerge from use of this structural language. Russell Ackoff (The Art of Problem Solving. Wiley, 1978) notes : "Thus, to make problem solving creative (inspiring) and fun (recreative) is to put art into it. To do so is to reunite work, play, and learning and therefore to reunify man, at least in his problem-solving activities". (p.17). And man "must always be able to generate visions of a more desirable state than the one he is in it is the function of art to provide such visions and to inspire us to their pursuit : to create the creator of visions of the better and to give this creature the courage to pursue his visions no matter what short-run sacrifices are required. Inspiration and aspiration go hand in hand. Beauty is that property of the works and workings of man and Nature that stimulates new aspirations and commitments to their pursuit. No wonder we say of a solution to a problem that inspires us, "it is beautiful" (p.16).