PATTERNS OF N-FOLDNESS

- comparison of integrated multi-set concept schemes as forms of presentation

In order to provide information to facilitate investigations suggested by the previous paper, examples of integrated multi-set concept schemes of the most diverse nature are reviewed. As a cross-cultural, cross-ideological, interdisciplinary experiment, the conceptual organization of the UNU/GPID project suggested comparison with such examples. A method of comparison is tentatively suggested.

The examples to which this paper refers appear in Annexes 0-20 at the end of this volume.

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INTRODUCTION

There are many forms through which new concepts and attitudes can be presented. These are examined in a separate paper (1). In this paper the focus is on how the pattern of concepts to be conveyed tends to be reflected in the organization of the form - and how it may well be constrained in consequence. To what extent is the "conceptual artist" constrained by the "medium of expression"?

PRESENTING GPID RESULTS

The purpose of this inquiry stems from concern about the manner in which the UNU/GPID project will be able to portray the results of its own investigations - and especially the whole pattern of its final conclusions. It will of course be possible to use film, theatre, poetry, posters, and many other methods (1). But, because of their nature, these do not lend themselves to a systematic precise elaboration of GPID concerns. They can only pick out portions of the total pattern for special emphasis. And even if a series of them is used, it is not clear that any such "sequences" would protect the essentially non-linear characteristics of the GPID pattern of conclusions.

When it is required to convey carefully a complex pattern, it is of course possible to do so using conventional text (even with appropriate illustrations). This will probably be done in a general "GPID Rapport de Synthèse". But the more carefully and precisely this is done, the longer will be such a document. And the longer it is, the more it will tend to defeat its purpose as a medium of communication.

This problem is not new. For example, in the case of the famous Capacity Study of the United Nations Development System (the "Jackson Report", 1969), the results were presented in two volumes, the first of which was a short summary volume - itself introduced by a summary. But in order to be "readable", the underlying pattern of concepts had to be distorted and abridged. This method is primarily useful for making a single point (e.g. "something must be done") and not for presenting the pattern of concepts which need to be taken into consideration in ensuring that appropriate balance is maintained. Another widely-used approach is to produce a list of points, as in the International Development Strategy of the Universal Declaration of Human Rights. Such lists may be enriched by annotations. The lists are structured somewhat like conference "resolutions" or "recommendations". Whilst they are convenient as checklists, they imply by their structure a simplistic linear "pattern" of relationships between the points in the list - even if some of the points have sub-points. But unfortunately such lists, as they are used in practice, strongly de-emphasize any relationships between the items (including the linear ones), even if they were recognized when the list was elaborated.

How then is GPID to envisage the formulation of its results? Agreed there will be books, collections of books, films, posters, etc. There may well be many lists of GPID criteria, action points, values, priorities, etc., which will partly determine the content of the former. But how is the underlying "master" pattern to be expressed, protected from "erosion", and rendered widely communicable, given the constraints noted above? For whilst parts of the pattern may be significant in themselves, the special significance of GPID lies in its attempt to harmonize the parts, arising from the sub-projects, into a coherent whole.

INVESTIGATION OF PRECEDENTS

If, as noted above, this is not a new problem, then there may be much to be gained by reviewing a wide range of concept schemes to see whether there are lessons to be drawn which could be of value to the GPID case. In selecting

such examples three major considerations need to be borne in mind:

- examples are required which cover, in each case, more than one single set of concepts (like the single set of 31 articles of the Universal Declaration of Human Rights). The examples should have multiple sets of concepts in which there is some relationship, or pattern of relationships, to be maintained between such sets. This is necessary because GPID sub-projects will each tend to generate concept sets in response to the few sets which govern the whole project's conception.
- some of the examples should be from domains in which the prime emphasis is not intellectual but rather expressive (as in the case of music, art, dance, etc.). This consideration has already been accepted by the GPID group (2).
- some of the examples should be from the non-western cultures which characterize many of the peoples to whose condition the GPID project was designed to respond - especially in a "dialogue" situation. Johan Galtung, coordinator of the project, has, for example, called for daoist, buddhist, and other influences on conceptualization within the project (3).

In addition to the above considerations, it would also be valuable to examine:

- traditional concept schemes which have retained their significance and communicability (above all at the village level), despite the passage of considerable periods of time since they were elaborated.
- elaborate modern concept schemes which attempt to respond either to the complexity of our condition using the full benefit of the range of western disciplines, or to a complex body of data.
- concept schemes elaborated in the light of problems of comprehensibility and communicability.

Clearly the schemes selected should preferably be as independent of one another as possible.

ORDERING CONCEPT SCHEME MATERIAL FOR COMPARISON

Any such investigation can easily run the risk of being overly ambitious and falling victim to the problem of "presentation" it is designed to clarify. A "filium ariadnis" is required as a guide through the conceptual labyrinths to be investigated.

An earlier paper considered the role of number in the formulation of complete sets, and the associated problems of their representation, comprehension and communication (4). Since the concept schemes it is proposed to investigate are supposedly made up of complete sets, it could well be that the number of elements in any such set would provide a relatively simple and unambiguous way of ordering the material. The earlier paper in fact reinforced the arguments of other authors in favour of such an approach. The question of whether the GPID sets are necessarily "complete", and therefore whether more can be learned from this investigation of relevance to the actual integration of the GPID concept scheme, is dealt with in a separate paper (5).

CONCEPT SCHEMES SELECTED

The information on the selected concept schemes is given in the Annexes to this paper, one scheme per annex. Details concerning the criteria whereby material within each annex was selected, are given on an introductory page to the set of annexes.

Given the criteria listed above and the details at the beginning of each annex, the individual concept schemes were selected for reasons summarized on an introductory page to the set of Annexes. It should be stressed that the exercise was undertaken (as a data gathering exercise) in an attempt to bring together a rich collection of concept sets and without being able to determine in advance what kinds of conclusions could be drawn, or whether all the concept schemes were equally appropriate in this context. The investigation is conceived as open-ended with the possibility of adding other concept schemes from other domains if this seems to be of value.

PRELIMINARY COMMENTS ON CONCEPT SETS

In the earlier paper mentioned above (4), arguments were presented to indicate that, depending on the number of elements in a given complete concept set, different qualitative characteristics would tend to be associated with that set or the relationship between its elements.

It is perhaps necessary to stress that this investigation is not concerned with number symbolism which is a veritable quagmire, as discussed in the earlier paper. Although as it was pointed out, phenomena characteristic of that historical preoccupation are now recurring in the scholarly and administrative tendency to enumerate lists of fundamental issues, principles, values, criteria, problems, etc. (to be compared with the medieval predeliction for N virtues, sins, principles, etc.)

This investigation is more concerned with how sets of a given complexity (which necessarily increases with the number of elements) can be comprehended and communicated. But it is especially concerned with how the different sets within a scheme are interrelated, and how they can be comprehended and communicated.

If there is any substance to the basic argument, then it should be possible to read "horizontally" through the annexes (examining only sets of a given number of elements) and find some degree of equivalence between them. One example is for a 5-set:

- Annex 15 (Systematics), indicates that 5-foldness establishes the limits of a bounded significant entity, its connectedness to its environment, and its potential in relation to it.
- Annex 4 (Tibetan Buddhism), indicates (in point 5.10) that the Buddha took into account 5 conditions before taking physical form.
- Annex 17 (Synergetics), indicates (in point 5.2) that generalization is conceptually imaginable independent of frequency. But frequency, as the fifth characteristic, is the unique special case variable. Physical experience is dependent not only on the four generalizable characteristics, but also on the fifth (which is associated with size).
- Annex 0 (UNU/GPID), indicates (in point 5.1) that the project is characterized and defined by 5 features.

Despite the dissimilarity of the concept schemes, the notion of specificity and delimitation is characteristic of all of them. If this is the case, why is it not explicit in other annexes? There are several possible reasons:

- The scheme may not possess sets of a given number, or they may be implicit rather than explicit. (The implication of this will be considered below)
- Sets of the given number may reflect "secondary" rather than fundamental preoccupations, namely, they may be derived from more fundamental sets which may (or may not) be characterized by the quality in question.

- It may be difficult for a non-specialist to understand the significance associated with the particular set in its own context.

The last point brings up the very interesting challenge which the variety of material poses. A shift in perspective is required to avoid being distracted by a stress on : topological features, gods, principles, concepts, tones, strategies, physical movements, colours, etc. These must simply be considered as vehicles for the expression and comprehension of an underlying pattern. This point is specifically made in Annex 7 (point 0.12):

"The hymns describe the numbers poetically, distinguish "sets" by classes of gods and demons, and portray tonal and arithmetical relations with graphic sexual and spatial metaphor."

Annex 7 is in fact a scheme which uses 5-sets extensively. Its material does not clearly convey the same notion as the examples above (although perhaps 5.1 may be significant to musicologists in that sense). But the constraints governing the "birth" of a tone in a yantra frame (see Annex 7,0.9), for example, could well prove to be interpretable in the light of the conditions governing the "birth of the Buddha"(Annex 4,5.10) interpreted metaphorically.

There are many other examples of comparability between the annexes. The problem is then to decide how the material can best be investigated further. There is little advantage in simply pointing out examples such as those above, for, as such, they only have curiosity value and do not lead us forward. In a second part of this paper some of these equivalences will be examined to discover where they lead us. But at this point we need a better "handle" on the material than the many annex pages provide, even if specially ordered.

PATTERN GENERATION AND COMPREHENSIBILITY

One way of presenting the range of schemes in the annexes, for a better overview, would be simply to produce a table in which the columns were used to indicate the presence of sets of a given number of elements. The rows would then each be used for a different concept scheme. But even this table would be too unwieldy, because of the large number of sets in some of the schemes.

Anticipating somewhat the investigations of the second part of this paper, two of the annexes in fact provide an interesting alternative. Both Annex 7 (Rg Veda tones) and Annex 17 (Synergetics) lay considerable stress on the significance of powers of prime number integers in basic pattern formation (e.g. Annex 7,30.1, 17,0.16 and 17,0.17). Why should this be the case?

Taking 2 as the first "genuine" prime number, any sets which have the number of their elements definable by 2^n only can be matched to one another, such that within a scheme the larger sets are effectively regular subdivisions of the smaller. This can be made visually obvious (e.g. with concentric circles). No new patterning effect enters, however large n becomes (see Annex 7.2.2). New patterning effects are only introduced when other prime numbers, or their powers, are required to define the number of set elements.

As to why the stress is placed on integers, these are clearly important to the definition of sets with an integral number of elements. A complete set obviously does not contain 6.25 elements. Furthermore it is the powers of prime numbers which ensure that the set subdivisions are "rational" and, as such, more comprehensible to the human mind. The stress on powers of the smallest integers also ensures patterns which are more comprehensible and memorable than would otherwise be the case. These criteria imply that the most "conceptually compact" sets will tend to emerge in any scheme prior to the less comprehensible and less memorable sets.

CONCEPT SCHEME FACTOR TABLE

In this light a more compact table can now be produced in which the columns indicate the prime number factors of the sets characteristic of the concept scheme indicated in the rows (see Table 1). The powers of the factors required are indicated in the body of the table in each case. Presenting the information in this way raises several interesting possibilities:

1. It is probable that concept schemes with similar prime number factors and powers will be more obviously comparable (equivalent, isomorphic), than those without. It is not surprising therefore that a number of authors have explored the relationship between the Chinese Book of Changes (Annex 2) and the genetic code (Annex 5), for example (6).

2. Concept schemes with few prime number factors will tend to differ significantly from those with more. Thus those whose sets are primarily defined by 2^n appear to group their elements at a very "general" or abstract level. Those including 5 as a factor introduce more specific notions (as indicated earlier). Higher primes may well encompass even more concrete, "real-world" aspects of phenomena.

3. Whilst there may be some value in viewing the concept schemes with prime factors as "richer", more "mature" and more "comprehensive", it may be even more useful to consider concept schemes based on different patterns as performing different functions in the psycho-social system. What sorts of concepts tend to be carried by what patterns?

4. The previous point raises the question of what the full range of patterns is through which concepts could be usefully presented - what is the criterion for "pattern stability", or "viability"?

5. Within the framework of the previous possibilities it is then useful to consider the problems of "developing" a concept scheme from a simpler pattern to a more complex one - by introducing sets based on a larger prime as a factor.

6. In the light of the previous point, special attention should perhaps be given to the sets of a concept scheme based on higher primes - because, since they are necessarily less memorable and less comprehensible, it is these that are most vulnerable to "erosion" when the set is communicated through simplifying channels, particularly those which emphasize "communicability" in its popular sense.

These possibilities, if they prove to be well-founded, would suggest that a fruitful line of investigation can be opened up. There is however an important point to be clarified. The concept sets require for their definition not only primes and their powers, but also multiples thereof (e.g. $2^2.3^0.5^2$ as in Annex 7.30.1) What are the constraints, if any, on forming such multiples and on the powers used?

A further step can be envisaged which might clarify this difficulty. The presentation of the numbers in the table bears an interesting resemblance to that of the electron shell configuration in the periodic classification of elements (Annex 14). The general implications of the closest-packing problem in this classification do emerge from the synergetics scheme (Annex 17.92.1). But, it is three interrelated quantum numbers taking on integer values which determine the energy levels of the electrons in an atom in terms of a radial and an angular component (*) If the periodic classification

(*) Note: Such a relationship is not as far-fetched as might first appear. Relatively little is known about the organization of concept sets in memory. The synergetics omnidirectional "packing" approach has merit as applied to

provides useful guidelines, then these would enable the patterns of a complete set of concept schemes to be interrelated in a form of periodic classification. It would then be probable that these would fall into groups with comparable properties. The existence of as yet undiscovered concept scheme patterns could also be predicted.

This whole approach would then have the merit of setting any particular scheme in an appropriate context. It would help clarify how it is likely to interact with other schemes. But such a framework could then provide understanding of how a new concept scheme should be "designed" in order for it to be viable and have certain desired characteristics. This is its importance to GPID.

But, additionally, it may prove to be the case that some characteristic concept schemes are more "acceptable" and "implementable" than others - by embodiment in organizations. Some may be so "reactive" that they are almost immediately "adulterated" by association with other schemes - this may be a desirable result. Others may be "unreactive", retaining their elemental characteristics - and this may prove undesirable. This possibility of concept scheme "compounds" may be one of the factors hindering recognition of equivalence between the concept schemes in the annexes. We may be comparing "compounds" (or "ores") which disguise the characteristics of the underlying "elements".

TRANSFORMATION PATHWAYS

The previous section focuses on a means for codifying concept schemes, which may fall within a general pattern. The disadvantage of this approach is that any such "flat" tabular presentation (even of an essentially spherical scheme) moves away from the more spherically-oriented presentations which may well contain the key to greater comprehensibility and communicability (4, and Annex 17.0.6). It is therefore interesting to note the basic argument of Annex 17 which establishes the link between prime number factors and polyhedral spherical approximations (Annex 18). Nested concept sets may then be envisaged as "encoded" by nested polyhedra or their topological features, for example (Annex 19). The relationship between symmetrical forms and memorability has been explored in an earlier paper (4). Of greater importance however is the demonstration of the existence of "transformation

concepts. The related problem in the case of an atom is to "pack" electron orbitals in a spherically symmetrical field whose potential energy is dependent on a radius vector. The spherical symmetry of the field permits separation of the Schrödinger wave-function equation into radial and angular factors (compare Annex 17.0.12 and 17.5.2). The angular part is uniquely determined by the symmetry of the field and not by the potential energy. An individual's "field of attention" could be described in similar terms in the light of Annex 17 - with more complex concept sets being represented by higher "quantum numbers". The most stable electron orbitals, which bring the electron closest to the nucleus, are those with the smallest integer quantum numbers. The energy sub-shells are made up of groups of 1, 3, 5, 7,...quantum cells - each corresponding to two electron states, thus giving a maximum of 2, 6, 10, 14,....electrons respectively. Is there a useful "constraining" relationship between the latter numbers and the prime number factors in the table? The number 2 appears (as might be expected) to create a problem, from which it could be inferred that the series 1,3,5,7,... are odd numbers and not prime numbers. Atoms have however not yet been created to establish whether the next number is 9 or 11. (G.S. Zhdanov, Crystal Physics. Edinburgh, 1965, p31).

pathways" between certain polyhedra thus maintaining structural continuity. This effectively amounts to a rational change of "conceptual gear", in that no irrational discontinuity is involved in the transition. Such transformations may be vital guidelines to ways of "compacting" or "expanding" a concept set according to the circumstances of communication. As an indication of how transitions between concept sets might be effected, a preliminary version of a map is included which shows some of these pathways on the basis of information in Annex 19 (see Fig.1).

CONCLUSIONS

It was not the intention of this paper to do more than present the concept schemes collected and to indicate lines of investigation which could be opened up in relation to the presentation of GPID itself. This paper has stressed the structural aspects of pattern formation and has avoided the question of content. Content, in the light of this paper, is examined in relation to the integration of the GPID concept schems in a separate paper (5).

A special merit of the approach outlined lies in the concern with protecting the GPID concept pattern as a whole. A great danger with many exciting "sensitizing" forms of presentation is that they "excite" people's awareness very successfully to levels at which there is no coherent pattern which can ensure the permanent stabilization of their awareness at that level. Such temporary increases in "attention potential" are associated wiht high "forgetability" (witness the track record of various UN public information programmes)(7).Conceived in this way the challenge is to find ways of stabilizing such patterns of nested sets and of facilitating shifts of attention between them. This has been compared to the problem of a "conceptual gearbox" in a separate paper (8). One problem is to find ways of using "higher gears" to mesh more effectively with the rate of social change. This is the question of how to develop more operationally significant concept sets within the GPID scheme.

The more excitingly communicative, audio-visual forms are based on the axiom of minimum number of explicit messages per presentation, thus fragmenting the whole pattern. It would therefor be important to establish what forms are useful to communicate what parts of that pattern. It is important also for people to be able to transfer, from the sets and associated symbols of a concept scheme with which they are familiar (and have faith in), to new ones such as those of GPID, with a sense of continuity - otherwise the latter will be perceived as of ersatz quality. This is a reason for establishing the relationship between a variety of concept schemes.

Whilst further invertigation is of course required, the method of ordering concept scheme material in terms of the number of set elements certainly seems to show promise as a method of classification. Whilst conventional classification focuses on documents, this focuses on concept sets within a document. The presentation also has advantages over linear text abstracts or summaries.

It may also prove to be the case that this approach can provide a useful interdisciplinary, or interparadigmatic, framework which respects the concept sets of each paradigma and facilitates their comparison in an explicit context. The GPID concept scheme will necessary be launched into an environment inhabited by many other concept schemes with some of which it will have to compete (for attention) as in any ecosystem. Its fate will depend upon the ecological relationship it establishes with other schemes (as predator? prey? symbiote? etc.... as indicated in Annex 16), or whether it can to some extent transform that ecology by revealing principles which underly it.

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7. A J N Judge. Mobilization of public opinion; yesterday's response to today's problems. Transnational Associations, 31, 1979, 1/2, pp 8-14

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CONCEPT SET PRIME NUMBER FACTORS (AND POWERS) TENTATIVE TABLE 1

- Cells of Table contain range of factor powers: N - M (e.g. from 3^N to 3^M)
- Parentheses indicate less significant factors/powers in the concept scheme

Factors / Annexes	2	3	5	7	11	13	17	Other primes	Max. set	Annex name
0	0-3	0-1	0-1						30	UNU/GPID
1	0-2	0-1	0	0-1					12	Geometry
2	0-(6)	0-(3)	0-(1)	0-(2)					10^3	I Ching
3	0-(4)	0-1	0-1	0-1	0-1				16	Catastrophe
4	0-6	0-3	0-2	0-2	0-1	0-1	0-(1)	51 111	111	Buddhism
5	0-5	0-1	0-1						64	Genetic
6	0-4	0-2	0-2	0-1				23	10^2	Communist terminology
7	0-9	0-6	0-4	0-1	0-1	0-1		29	10^3	Rg Veda tones
8	0-3	0-3	0-1	0-1					360	Dance
9	0-2	0-3	0-1	0-1					9	Chinese strategy
10	0-2	0-1	0-1	0-1					12	Colour
11	0-3	0-3	0-1	0-1					360	Islamic cosmology
12									10^2	Language
13	0-2	0-1	0	0-1					7	Thermodynam.
14	0-1	0-1	0-1	0-1					10^2	Periodic classification
15	0-3	0-2	0-1	0-1	0-1				(96)	Systematics
16	0-3	0-2							9	Coaction
17	0-4	0-2	0-2	0-1	0-(2)	0-1	0-(1)	31 47	720	Synergetics
18	0-4	0-1	0-2	0-1	0-1	0-2		19 23 31	92	Polyhedra
19	0-6	0-2	0-2	0-1	0-1	0-1		19 23 29 37 41	64	Topological features
20	0-3	0-1								Chladni figures

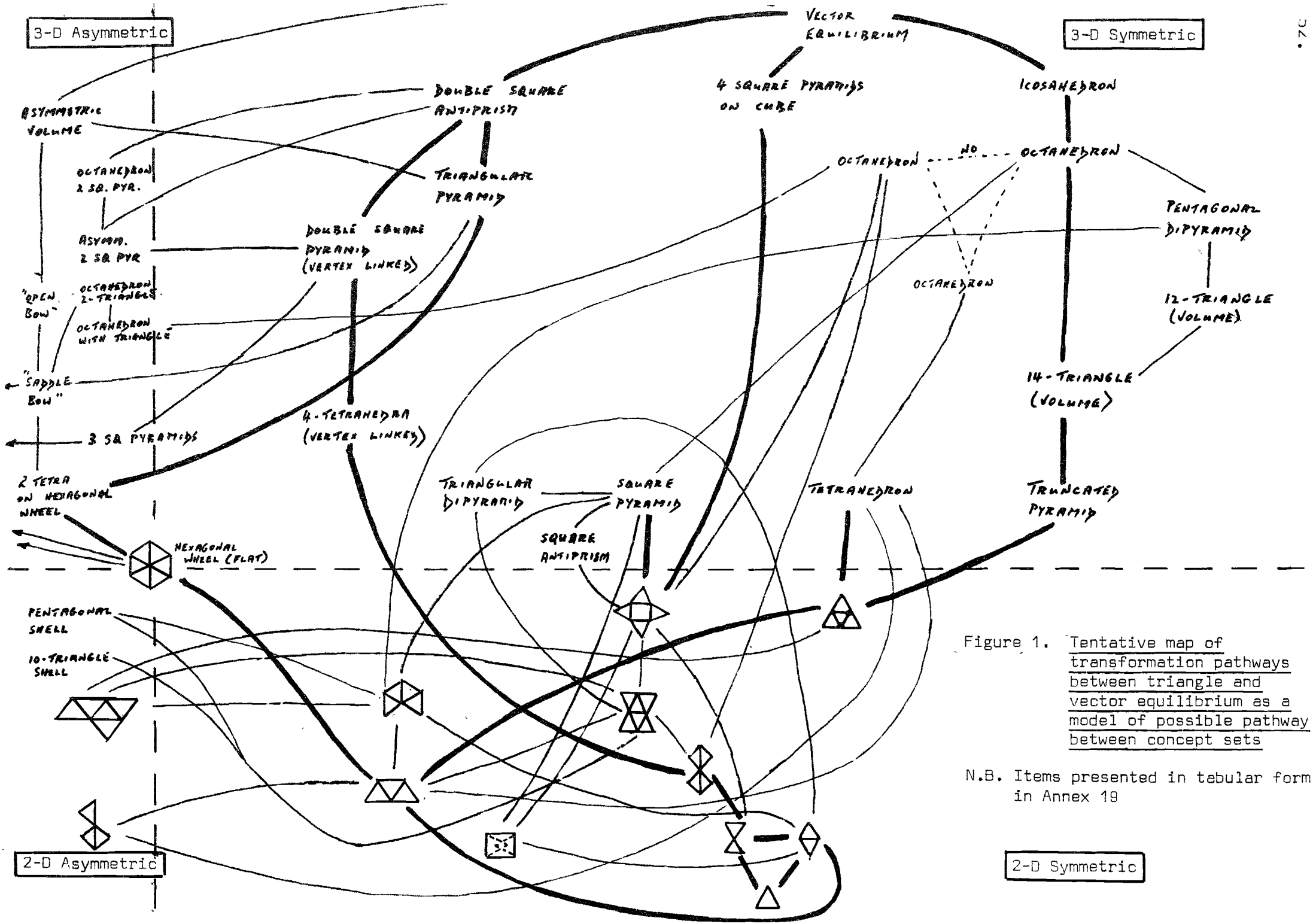

Figure 1. Tentative map of transformation pathways between triangle and vector equilibrium as a model of possible pathway between concept sets

N.B. Items presented in tabular form in Annex 19