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THE ANALYSIS OF SOME GEOGRAPHICAL CONCEPTS AND THEIR DEVELOPMENT IN THE LEARNING PROCESSES OF THE INDIVIDUAL MIND

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PREFACE

When I first approached Professor G.P. Meredith in 1964 and expressed my interest in adopting his methods of Topic Analysis for the investigation of geographical ideas I could not foresee what a rich harvest I was going to reap from association with him. For I am expressing my gratitude to him not only for directing the work leading to this thesis but for the wide inter-disciplinary educational experience of attending his seminars at the Epistemic Communications Research Unit at Leeds. I must also acknowledge my debt to my fellow students in those seminars from whom I have gained so much in discussion of ideas, and to Mr. A. Laing, my supervisor in the Department of Education.

On the practical side I must express my thanks first to the headmasters who allowed me to make use of their schools and interview their pupils, namely,

Mr. L. Simpson of Thornton School, and Mr. B. Sutcliffe, Geography master.

Mr. E.T.F. Griffiths of Hutton Junior High School.

Mr. J.W.F. Butler of Eccleshill North Junior School.
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CHAPTER I

INTRODUCTION

Some years ago the author carried out a piece of research for an M.Ed. degree on "concept Formation in Relation to the Study of Landforms among Training College Students". (Hannam, 1963. I.1.) The line of approach adopted was a study based on Inhelder and Piaget's work, "The Growth of Logical Thinking from Childhood to Adolescence", and under the direction of Dr. Lovell four of the physical science experiments from that work were used alongside a comparable experiment in reasoning in geographical fieldwork. Analysis of the students' thinking on this logical basis proved a useful tool for discriminating their relative ability to handle landscape information in the fieldwork context, but it opened up many more questions than it answered.

In the conclusion the following was written:

> "While it is not sufficient to analyse the subject matter of thought in order to understand the process of thinking, the nature of the subject matter is relevant. In this topic, the subject matter forms part of an organised body of knowledge (physical geography), built up by professional thinkers, and is extensive, complex and not easily defined. For a student learning about this, a double integration is taking place. Considering the material itself, in the earlier stages, individual ideas about landscape features are being identified, put

into classes, matched up or distinguished, for instance, the cross-section of a valley is recognised and classified as being the V shape of a young river valley, or the U shape of a glaciated valley. Gradually a body of information of increasing complexity may be built round these key ideas which form the nucleus of the concept, and because of this structure of the subject, already established by previous thinkers, it can be integrated into this common stock of knowledge, communicable to others because of an established vocabulary. For the individual, the integration of his own concept is also taking place, but this is not merely an additive process as cognitive experience, both verbal, pictorial and direct, accumulates, but involves a series of transformations as new information is assimilated."
(Hannam. I.2.)

The general conclusion arrived at from considering the evidence of students grappling with the problem of integrating their observational experience with structured information from the geographical discipline was that not enough time was normally devoted to the first observational task of matching up their existing ideas with landscape, and that therefore much exposition of theory fell on stony ground. This conclusion proved of personal value in guiding work with students but left unresolved a number of things. The first was that this all referred to a very limited type of population, so that inference of its relevance to school age populations, though obvious, had no backing of evidence. The second was that the logical analysis did not take into account sufficiently the nature of the information being dealt with and the various forms in which it was being received, i.e. by direct perceptual experience of landscape, through recall of earlier experience, and by social transmission of learned concepts in the classroom. The third was the need to locate some other system of analysis, which like the Piagetian type, facilitated the holding together of complex elements in a situation, but took into consideration the non-logical as well as the logical in a positive sense, and that dealt with the history of the information and the means of its communication to the individual.

The personal urge to do something constructive about this might have remained submerged under the pressure of work engendered by college expansion if it had not been re-enforced by the realisation that current developments in geographical teaching revealed an urgent need for this sort of background investigation. If these were only straws in the wind in 1965 when the present study was first planned, they have crystallised into a "new geography" by the present time (1969). But it is not so much the "new geography" by itself but the need to evaluate it in comparison with progress on more traditional lines that is the crucial matter. At one end of the spectrum lies the move towards the use of quantitative techniques, and the deliberate use of mathematical and conceptual abstract models to deal with the "information explosion" in geography. The reactions to this emerge in the results of a questionnaire enquiry by the relevant Standing Committee of the Geographical Association:

> "Such completely opposed reactions, so violently and vehemently at variance with each other, suggest a dichotomy in the subject and amongst its teaching practitioners which we would do well to take seriously...."
> ......"This negative fear (i.e. that the need for "numeracy" would put off prospective geographers) was often complemented by the positive argument that it was the "general awareness of the world" which attracted pupils and which was, indeed, the most valuable element at school, an argument expressed in terms that "real examples rather than models are of greater relevance at school level". Those expressing this attitude suggested that there was an element of incompatibility between "descriptive and interpretative geography" and "mathematical geography" rather than that the latter simply provided a means and a system of concepts by which the former could be carried out more effectively".
> (Gregory, 1969. I.3.)

The feeling for the importance of "real Geography", related to the strong traditional strand in geographical thought emphasizing the uniqueness of particular places, which is at the other end of the spectrum, is brought out here. This is not "old-fashioned" geography but has its own important contemporary progression in the increasing use of detailed sample studies of real people in real places. The campaign for the greater use of sample studies in place of too much regional generalisation gathered strength in the 1950's, and has had increasing influence in published textbooks in the 1960's.

Another even more "real geography" is evident in fieldwork. There has been a proliferation of textbooks giving examples of field studies and advice on methods and techniques; fieldwork has of course received much lipservice for several decades but despite the excellent work done in many schools there are still others where little is carried on. Geography's "conventional wisdom" sets against the Academic armchair geographer the True Geographer, "an energetic figure in anorak and rucksack" (Storm, 1966. I.4.) The problems of marrying the experience of the Geographer to the abstractions of the Academic are implicit in the conflict of ideas revealed by the questionnaire already referred to, and the caricatured figures point to the need for systematized analysis such as has been attempted here. In his article Storm writes of field studies that

> "they are essentially illustrative; translating purely mental concepts like 'moraine' or 'marginal farm' into visual experiences".
> (op. cit. I.5.)

Sometimes field study is essentially illustrative, of features or techniques, but this is to put it after the exposition of the concept, and it has already been stated above that the previous research project suggested that this might be putting the cart before the horse in some respects.

As Gregory hints in the last phrase of the quotation from his report on the questionnaire there should be no incompatibility between "real geography" and a "system of concepts". In fact there is a long tradition of the employment of a particular system of concepts in school geography, i.e. that of the regional organisation of geographical information. Along with this goes the concept of geography as essentially a synthesizing subjects and there is a fear that use of other concepts geared to analysis rather than to synthesis and often drawn in from other disciplines may result in fragmentation of the discipline of geography itself.

Looking for a schema which could serve to integrate the nature of the geographical discipline with the learning processes of the individual, the author recalled that in attempting to organise the first research project on the students' concepts she had made profitable use of the matrix presented by Professor Patrick Meredith in an article entitled "Mapping of Meanings", (Meredith, 1959. I.6.) and therefore turned to the development of his "Topic Analysis". Four basic elements of the problem of studying landforms were discriminated by this system:

1. The actual landforms on the earth's surface, e.g. cuesta, normal river valley, glaciated valley.
2. Perception of topological relations - slope facets, and breaks of slope.

3. The recall of earlier percepts, the present percept being incorporated in the concept, perhaps modifying it.
4. The use of schemata, from crude definitions to sophisticated terms, to represent the phenomena.

This is set out in the context of fieldwork and of physical geography but as the plans developed the scope was enlarged to include human geography and the specific fieldwork context was abandoned though it still remained highly relevant. At that time although Epistemic theory was clearly relevant to the further investigation of this interlocking of disciplinary learning, perception and conceptual growth, it was not clear at that time whether it would yield of itself an analytical system which could be applied, or whether it would point the way to the devising of such a system. However the development of Professor Meredith's Orthochoric and Mathetic analysis opened up far more possibilities than were envisaged at the start, and the system has been used in two ways:-

1. for <u>static</u> explication by display of various aspects of geographical concepts and their development in the discipline, and to show a comparable pattern for the development of the individual's schemata.
2. for <u>dynamic</u> analysis of the trains of thought of subjects (ranging from 7 to 39 years of age) who were required to make use of their concepts in imaginative building of a landscape of their own conception.

Finally, the dynamic analysis, having been first used <u>descriptively</u> in presenting the thought patterns of a randomly sampled population, has been considered to see whether it might serve prescriptively as a planning tool for teaching situations, or at least as a test for teaching plans to estimate their likely achievement of their objectives as far as their internal consistency is concerned.

As the work moved on to the practical phase of testing and analysis the problem arose that Professor Meredith's own ideas continued to develop, but that practical application demanded a finalisation of the form of the analysis. The possibilities of application of the Orthochoric system appeared very wide, however, and in any case selection would have to be made. Nothing of the essential framework has been lost in developing this particular application; the basic semantic aspects have remained firm, and it is hoped that it has been made clear when the geographical context and the particular type of test have affected the interpretation of the system. The notation and colour code used were finalised in 1968, therefore the colour code does not coincide with that introduced in 1969 for Orthochoric presentations, and the twenty-six capital letters have been used, but no small letters.

CHAPTER II

REVIEW OF SELECTED RESEARCH INTO GEOGRAPHICAL CONCEPTUAL LEARNING

Specific reference to concepts in titles of theses and articles is exceptional until 1959, although of course there is implicit reference to them in much research and experiment previous to that date. Indeed up to the present time American literature on geographical education makes specific mention of concepts to a much greater extent than does the British literature. This is partly a reflection of the different position of geography in the school curriculum: whereas here it has been a defined and recognised subject for decades, in the United States it has been submerged in Social Studies and in order to identify the geographical pattern in that matrix more attention has been paid to identifying concepts which here are taken for granted. At a higher academic level also American publications on the methodology and philosophy of the subject are more numerous and this greater habit of introspection in the discipline is reflected at the school teaching level.

British research has been reviewed twice in "Geography" in the last twenty years. The first review was by Scarfe in 1949. (Scarfe. II.1.) The general character of research up to that date is reflected in his categories; he divided the research into two classes of topics, (a) classroom techniques, and (b) specific geographical abilities and achievements, and children's attitudes and interests.

He comments,

> "The recent emphasis on research into the attitude of children towards geography is a reflection of the new approach to education which concerns itself more with children's thoughts and emotions than with providing facts to be learned and knowledge to be stored".
> (op.cit. II.2.)

The implicit conceptual element in the research is recognised as a thorny problem.

> "The matter selected for treatment in school has undergone progressive change during this century..... Because of these changes in our general concept of what should be the content and function of school geography, it has been very difficult for research workers at any period to be sure they were in fact testing the contemporary view of the subject".
> (op.cit. II.3.)

although he has offered a likely contemporary view himself,

> "The purpose of school geography now seems to focus largely on directing attention to the ways in which place influences the work and outlook of people"
> (op.cit. II.4.)

But in the next year Long in her thesis was suggesting a less Deterministic aspect of the point of view of children's interests,

> "how people respond to and utilise their environment"
> (Long,M. 1950, II.5.)

The research into the abilities required in geographical learning by Heywood (1938) (II.6.) and by Daniel (1936)(II.7.) on relational thinking came nearest to the question of the mental handling of concepts, but while they were suggestive with regard to the part played by verbal and spatial abilities in using verbal and map information in the contemporary school geography context, the factor analysis format limits their relevance to the present study.

The second review was undertaken by Long in 1964. (II.8.) She classifies research under five headings, (1) Techniques of teaching, (2) Comprehension and testing, (3) Interests and Attitudes, (4) International Understanding, (5) Historical. Matters relevant to conceptual thinking arise in some works in all these categories, though more specifically under (2), She comments,

> "As Scarfe noted in 1949, all too often, when psychological factors are being investigated, geography becomes a mere instrument for psychological research".
> (op.cit. II.9.)

This is perhaps partly a problem of thesis presentation, where time and energy must be expended in clarifying methods of procedure and analysis, but it highlights a problem of the effective communication of research results to the teacher. Since 1964, in some circles at least, the climate of geographical opinion has softened somewhat towards psychological investigation, especially of cognitive development. This is to anticipate, however, as current experiments in teaching method based on Bruner's ideas will be discussed more relevantly later on. The validity of the comment quoted above however is evident when reading some theses (the author's own M.Ed. thesis being no exception).

Attention will be focussed first of all on those theses containing the word "concept" in the title. Long lists four, Prior (1959), Vass (1960), Hogan (1962) and Hannam (1963).

Prior's study, "The Place of Maps in the Junior School, a study of the junior schoolchild's understanding of maps in relation to spatial concepts" (Prior, 1959. II,10) was based on Piaget and Inhelder's test of plan drawing. A model village lay-out was used and the children were required to draw a plan of this. They also had to locate a number of local features on a plan of their own school locality, and were asked to name towns on a map of England. Results were correlated with chronological and mental age; they were not conclusive except that little "success" (whatever that might mean) might be expected before the chronological and mental age of 10, when there was "readiness to understand and begin to interpret maps". Wallace, commenting on this study in a psychological context, says Prior

> "did not adopt the logical conclusion from this finding that the study of maps should be ommitted altogether in the junior school"
> (Wallace, 1965. II,11.)

Caution engendered by actual teaching experience led Prior <u>not</u> to adopt this logical conclusion. This thesis was looked at particularly carefully in view of the intention to use a model in this study as a basis for interviewing. This scrutiny suggested that in the particular task a dominant part was played by the recall of physical experience and the matching of the mental map of the locality with the local documentary map in one case, and in the other to recall map experience and to match it with the documentary map of Britain. With the model, there was involved the manupulative skill required to draw the representation of the model, a "spatial skill" requiring visual judgments. Categorisation in terms of spatial conception limited what was drawn out of these situations, just as logical categories limited Hannam's landform study. Therefore with regard to the village model there was no indication whether it was significant that the items to be represented were churches, villages, rivers, etc. As Wallace remarks, the group method of presentation also limits the data, reducing its "qualitative richness". This makes it less useful than had been hoped for comparison with the individual interview material gathered in the present study where quality of concept rather than skill in representation dominates interpretation of the results.

The study of Vass, (1960. II,12.) "<u>An Investigation into the Development of a Concept of Physical Geography</u>" suggests more direct relevance to quality of specifically geographical concepts. Its expressed purpose was to probe behind the superficial usage of common geographical terms. However there is little detailed analysis of what is implied by a "concept of physical geography", except for stating that "simple" concepts are not so simple and may have different meaning for the child as opposed to the adult. A number of concepts, some landforms, some vegetational and climatic, were selected, i.e.

mountains	glaciers
river basin	oceans
forest	relief
desert	volcanoes
climate	soils
plains	

He gives a more explicit analysis of the concept 'soil', referring to "an element of subjectivity" in what is included in the personal version, for instance in giving its depth, and he cites some other specifically geographical terms which would be involved in the full understanding of the concept. The group test given required the picking out of relevant terms in a list of words for each concept, which seems to confine the information gained to the word association content of the subjects' concepts. More interesting is the material from individual interviews requiring answers on short passages relevant to physical geography, but an attempt to analyse these in terms of Piaget's seventeen types of causal relation was abandonned, though they were graded on his own five-point scale for grasp of the principles involved. There is very little discussion of any relevance to the teaching of the subject.

These two, and the author's earlier study, come under Long's category (2) "Comprehension and Testing"; the fourth thesis, that of Hogan (1962. II,13.) is historical, "The Evolution of the Regional Concept and its influence on the teaching of geography in schools". This gives a thorough and comprehensive survey of the phases of development this concept, whose continuing influence has already been remarked on. She brings out the strong influence of Herbertson whose paper read in 1904 (Herbertson, 1904. II.14.) launched the "new geography" of his time; as a writer of textbooks he had enormous influence, but as Hogan says, the unfortunate crystallisation of his generalisations in these textbooks lent itself to rote learning, and textbooks still appear which are dominated by the stereotyped sequence, Position, Relief, Climate, Vegetation, etc. Although, as she points out, even in the inter-war years the growth of interest in smaller regions and the synthesis of human and physical interactions within them was already appearing, most schools were still using the stereotype sequence, though some were more enlightened, and a small proportion, mainly Modern Schools, were using a thematic approach and sample studies. The immediate postwar period saw a trend towards "social studies", but this dropped off because of its lack of coherence. The simultaneous trend towards field work brought with it a complementary trend towards more detailed work indoors, and there was a swing back towards regional geography in which the sample study was prominent. This Hogan sees as "teaching the geography of geographers" in school, i.e. "the study of small areas as particular examples of regional synthesis".

For contemporary considerations the interest of this survey lies in the fact that the present population of geography teachers will contain people whose own "regional concept" crystallised somewhere in this progression, depending on their age and their efforts or lack of effort, to become aware of and to absorb changing ideas in their profession, and this no doubt plays its part in the "reactions, so violently and vehemently at variance with each other" to the questionnaire referred to on p. 4 above. It presents an element of the framework in which individual conceptual development is taking place.

Other theses not having the word "concept" in the title do of course deal with concepts, explicitly or implicitly, and without analysis of conceptual thinking. The most relevant are now reviewed for the type of concepts which appear normally accepted as part and parcel of geographical learning.

The earliest of these to be considered here is that of J.L. Oliver (1948, II.15.). "An Investigation into the efficacy of outdoor work in improving the attainment of training college students in, and their attitude towards, the subject of geography." Despite his conclusion that "outdoor work in geography has a more immediate effect on conation than cognition", in the organisation of the study there is a careful and systematic identification of the concepts which the field trips might serve to enrich or to introduce to the students. Moreover there is a distinction of two classes of concept, or rather, as he gives it, a distinction between geographical concepts and geographical principles. The distinction appears to be based on the use of the concept in the immediate fieldwork context, and the generalised principle, e.g. the concept of "the port as the gateway to the world" (on a visit to the Port of London), as part of the general principle of the influence of site and situation. Processes of erosion and deposition, and limestone phenomena as concepts are distinguished from the principle of the physical causes of scenery. Sometimes the distinction is less easily expressed; "the idea of the community" appears listed as a concept, while parallel to it "the idea of the community in relation to tradition and planning" appears as a principle; it is evident however that the "concept" here implies its identification from evidence on the field trip and in associated work, while the "principle" represents the preservation and enrichment of the concept which should be stored by the individual for future use. Oliver concludes that "excursions should be planned to introduce concepts first and principles later". One suspects that he is really trying to express what Hannam was trying to express in concluding that observational experience of landscape should precede theoretical exposition of concepts of a higher order than those already attained. The main contribution of this study was seen by Oliver himself as the construction of the battery of tests, using words, maps and pictures, thus bringing the aspect of the documentary presentation of the concepts into the foreground.

Next we come to Long's thesis, "An investigation into the relationship between interest in and knowledge of school geography by means of a series of attitude tests", (1950, II.16) However much "knowledge" may be expressed in terms of "facts" and "principles", we may assume that we are in fact dealing with "concepts". In this study the general framework into which "knowledge" is put, (taking geography on a regional basis as being concerned with the synthesis of the relations of the three elements, Place, Man, Work), is divided up into five major concepts, i.e. Location, Description, Activities, Reasons, Relationships. The organisation of the tests themselves expressed these significantly through the use of the words, "what", "how", "where" and "why", distinguishing the relational thinking about the concepts embedded in the factual information provided. "Where", "What" and "How" appeared of more interest than "why" (which is interpreted as identifying relational thinking). This large scale study (of 4,000 children) suggested that there was a tendency for greater interest to follow from greater knowledge than vice versa. The particular lack of interest in topics presented abstractly, i.e. in climate and vegetation identifies a problem for which later Piagetian studies in logical thought might provide useful answers.

Because of their professional association as co-authors of a recent book (Long and Roberson. 1966. II.17.) on the teaching of the subject it is convenient to move on from Long's research to that of Roberson: (1961, II.18). "An Enquiry into the degree of understanding and appreciation of geography reached by children aged 14-15 years in the last years of attendance in school." This emphasised factual knowledge without analysis of constituent concepts, although he comments on the use of the term "concept" by American psychologists. Because of the amount of information he obtained from the teachers of these children, we can easily sample some commonly presented concepts of school geography, e.g. "tidal river", "crop-growing", "the North", "staple food", "scanty population", "reclaimed land", "transhumance", "routes", "capital city". These were selected from the sample examination questions which Roberson asked the teachers to produce. His interviews with children dealt with landform concepts and human activities through picture and sketchmap presentation. His conclusions from the interviews will be referred to later on when discussing responses in the present study.

An interesting piece of large-scale co-operative research was the investigation of children's reactions to geographical pictures carried out by the Training College Section of the Geographical Association (Long, 1953. II.19.). "Concepts" appear in this in so far as features of the landscape were identified by children in verbal terms which could identify the objects of their perception to the testers. It is particularly interesting because there is no specific verbal prompt except in the directions to study the pictures. The individual child's concept must be sufficiently clear to be employable in perception and communication of that perception. In her report in "Geography" on the earlier phase of the research, with 10-year olds, Long comments on the children's attention to detail, rather than seeing the picture as a whole and notes that

> "much detail of physical geography escapes the eye of the 10-year-old, either not seen, not recognised, not understood, not recorded, or not regarded as worthy of comment, e.g. less than 10% commented on apparently obvious features like bends in the river".
>
> (op.cit. II.20)

In the report of the second phase, she says that,

> "It would appear that as much as one-fifth of geographical significance escape the record - and probably the eye - of even the most observant sixteen-year-old,....."
> "It does not appear that the eye of the child sweeps, as does that of the geographer, to the 400-ft. platform of the Polperro picture, or to the raised beach of Sheldaig."
> (op. cit. II.21)

The Polperro picture also included a valley, deep and central to the picture, but only about a third of the 11-year-olds recorded it, and only about half the 16-year-olds.

> "They appear to record less readily, and therefore presumably to observe less readily, in these two pictures, physical features such as estuary, bay, valley or cliff; or it may be that they see these features, but may not be familiar with the geographical terms by which they might record them".
> (op. cit. II.22)

This study raises questions about the relationship between perception and conceptualization and the two-way traffic between them. This is not discussed in psychological terms, but lies behind the practical conclusion that the gathering of information from pictures should be guided, and is evident in the appreciation of the difference between what the trained eye of the geographer sees and what the child sees. While this is recognised by careful selection and annotation of pictures in the best recent textbooks, unfortunately some new books still contain photographs with poor reproduction of detail and accompanied by too much presumption that the child's eye and the geographer's automatically see the same thing.

The question may be carried further by considering the work of Rhys (1966. II.23) "The Development of Logical Thought in the Adolescent with reference to the Teaching of Geography in the Secondary School": the follow-on from the topic just dealt with is better seen in the title of the paper which he read to a meeting of the Colleges of Education Section of the Geographical Association in the autumn of 1966: "The Adolescent's Power to comprehend and analyse geographical data when presented in cartographic and pictorial form." Like Hannam's first study it was based on Inhelder and Piaget's "The Growth of Logical Thinking from Childhood to Adolescence". Rhys was dealing with the problem of the child being required to extend his imagination to the spatially remote. He was examining this against the background of the predominance of regional geography in teaching, focussing attention on detailed study of small units, i.e. the "sample study" approach already referred to. He points out that as Fairgrieve said, children "are required to create mental pictures of what has never been seen and never will be seen". (Fairgrieve, 1946. II.24) However well illustrated the sample study, the child has to undertake a formidable conceptual task if he is to visualise a remote environment, appreciate the regional cultural viewpoint, and mentally orientate himself as if he were living in that area. In his tests he used the usual media employed to convey information about remote places, verbal description, photographs, sketchmaps and statistical maps and diagrams. Besides the problems of picture interpretation already dealt with he deals with the problem of decoding map information before it can be used. The kind of qualitative information about the children's conceptual thinking in these exercises will be referred to below when there is relevant comparison to be made with material from the present study.

Because of geography's self-evident concern with space a number of investigations have been concerned with this but it is a complex matter; what kind of "spatial ability", are we considering? In terms of tests, this usually refers to documentary space. Dealing with this is of course relevant when working with maps and diagrams. Taylor (1959 II.25) found that factor analysis did not reveal association between the 'K' factor and attainment in geography. Consideration of his study suggests that it is indeed very difficult to isolate the purely spatial element in any geographical documentary task, because we cannot tap the internal verbal dialogue that may also be contributing alongside spatial perception. Clarke (1959. II.26) investigated the variability in visual perception which affects the use of maps and diagrams. This aspect of space, however, is probably more relevant to map-skill than to the kind of spatial relations problem which Rhys was concerned about. Satterley (1964. II.27) was likewise more concerned with skill and performance in his terms of reference. Blair (1964, II.28.), though concerned with documentary space in the sense that he was investigating ability to handle the representation of spatial relationships, is also concerned with the concepts of the places represented. He found that the children became confused about spatial relations once they had to go outside their personally constructed frame of reference. In placing towns, once beyond their personal frame of reference they had to use what he describes as a "socially transmitted external reference frame".

The same problem cropped up in Jahoda's (1963, II.29.) study of Glasgow primary school children, tracing their concepts relating the series of units, Glasgow - Scotland - Britain. He found they had difficulty with such concepts as "town" and "country". Both verbal formulation and spatial representation were used to obtain evidence of the concepts. He was searching specifically for the sense of national identification. In the verbal formulation he graded the children according to what he called their "G-stage" or geographical stage, to express their appreciation of the conception of a unit, Glasgow,-in-Scotland-in-Britain. Comparing the results with those of the spatial representation of the same relationship, he found a big leap forward to the final stage identified in both classifications; this might suggest again the question about the part played by verbalisation in the apprehension of space relations.

Carnie (1963, II.30) dealt with the development of concepts of the nations of the world but was concerned more with the affective than the cognitive side. Coming to the apprehension of socio-spatial relations based on more immediate experience, this has come sufficiently to the fore to be the subject of a joint meeting of the geography, psychology and sociology sections of the British Association for the Advancement of Science at the Dundee meeting in 1968, under the umbrella title of "Mental Maps". Again the investigations reported emphasised affective attitudes to places and are inclined towards relevance to applied geography in planning rather than the elucidation of geographical concepts. (e.g. Lee, 1963, 1966, 1968. II.31) Lee's paper read at the meeting however dealt with the concept of an urban neighbourhood.* Is it a piece of area or a group of people? He spoke of a hierarchy of mental maps, from the body image, through house map, town map, country map, to world map, and of such maps as "templates" which people use. He also is aware of the problem of verbalisation - "one of the main difficulties seems to be to separate their ikonic (or direct visual experience) from the representation which has been coded into linguistic form". (Lee. II.32)

The examples of research quoted here (as well as prescriptive pedagogical literature which will be referred to in various contexts below) dealt with a variety of types of "ideas" which may be termed concepts and used varied methods of extracting evidence of those concepts, or at least evidence of conceptual thinking. Hogan's work on the development of the regional concept gives a general disciplinary framework of approach which dominates the majority of the geography teaching profession. Roberson's study gives direct evidence

*Not published at the time of writing. The reference is taken from personal notes made at the meeting.

of this and of the kind of verbalised concepts in which teachers are likely to embody some of the constituent elements of the framework. Long's study (1950) gave a rather more structured view of the children's knowledge, structured in terms of the elements of Place, Man, Work, being synthesized in regional study by considering "what", "how", "where" and "why" questions. Again set clearly against the regional framework Rhys throws light on the relational thinking which Long had identified as a relatively difficult element in school learning of geography, and this done in a framework external to the subject matter, i.e. the developmental Piagetian theory. Whatever limitations the logical emphasis may have, it provides an ordered method of extracting conceptual information, and individual testing raises the qualitative evidence to a higher degree. At the same time the media carrying the geographical information are distinguished, and the problem of decoding is recognised.

Separate from this strand which contains the co-ordinating disciplinary regional basis, we have those studies which emphasise some particular aspect of the communication of information or the perceptual/conceptual functioning of the individual. Vass, by implication rather than explicit intention, emphasised the verbal transmission of information. The Geographical Association's picture study and certain aspects of Rhys' work draw out the pictorial transmission. Prior, Taylor, Clarke, Blair, Satterley and some aspects of Rhys' work are emphasizing the element of documentary representation of spatial relations. Although Oliver's work is concerned with fieldwork, the type of testing actually links it with the verbal/pictorial/documentary elements. Hannam's fieldwork study is the nearest attempt to emphasize recalled visual (ikonic) experience. Finally there are those emphasizing socio-spatial relations (Blair, Jahoda, Carnie, Lee).

Where there is a framework external to geography and drawn from psychological discipline one must recognise the situation in terms of chronological date, and university influences as well as personal preferences and career situation of the researchers. Clearly there are two classes; in one, some specific interest, attitude or ability to which some external scaling can be applied has been distinguished in the geographical context, in the other development Piagetian theory has been used, whatever the particular emphasis in the geographical context. This assists comparison of sequential development shown in the studies of Prior, Hannam, Jahoda and Rhys despite other disparate elements.

For the teacher who asks questions about the teaching of geographical concepts there are far too many disparate elements which cannot be practically isolated in a teaching situation; continued analytic research into particular elements though necessary may produce a jungle of information not easy to relate to the whole situation. The function of Epistemics in relating the knowledge and the learner is to help to pigeonhole this information. It will be well to move outside the specific geographical context to examine the term "concept" more carefully and then to move back into it to examine the prescriptive academic frameworks of the discipline, mapping them into Epistemics.

Meredith, in introducing Epistemic theory says,

> "The long-term task is not merely to analyse the problems, but to design methodological instruments for carrying out practical researches into the problems of communication. These will be treated as problems of mapping. Given an original territory of factual phenomena how does this territory become mapped in the brain of the investigator? How does this map become transformed again into a language adapted to the needs of the ultimate recipient, the learner? Finally, how is this third map introjected into the latter's brain to form a pattern of knowledge?"
> (Meredith, 1966(a). II.33)

The first part of this thesis is largely concerned with the analysis of the problems inherent in the character of geographical information, the second part with the practical refining of the methodological instrument of Mathetic Analysis, (Meredith, 1966(c). II.34) on a testbed of geographical concepts. The third part attempts to assess how far this has contributed to "an adequately empirical taxonomy of learning-processes" (op. cit. II.35) in the geographical context.

CHAPTER III

EPISTEMIC THEORY AND THE ANALYSIS OF CONCEPTS

> "I hope I do justice to it, if I say that epistemics, as distinguished from epistemology, is about the manifold, lively and interconnected processes subsumed by knowing, in contradistinction to an obituary on already communicated knowledge.
> (Hogben, 1967. III.1.)

Meredith's theory of Topic Analysis begins to appear in his writing from 1946 onwards; as "Epistemics" it matured over the following twenty years, and the following exposition is drawn mainly from "Instruments of Communication" (1966(a). III.2.) and articles published in "Educational Sciences" (1966, 1967. III. 3,4.) further informed by documentary material and notes from seminars at the Epistemic Communication Research Unit at the University of Leeds. Though the sub-title of "Instruments of Communication", "An Essay on Scientific Writing", does not suggest relevance to conceptual thinking, in fact in its context of the problem of communication between scientists it is deeply concerned with the nature of the concepts being communicated. This appears early on,

> "Epistemics, starting always from experience, takes material bodies as the local basis for our sensations and hence for our conceptions. It cannot start from the 'sense-data' fashionable in philosophy, for these are likewise abstractions.

> Sense-data as such do not constitute our experience - they are derived from it, by introspective analysis or theoretical consideration. In our gross experience we are presented with bodies - our own bodies and the objects of our environment. Starting, then, from familiar bodies, we have to ask, how are the various sciences derived from this experience? Unless we can firmly and accurately relate science to common experience we cannot hope to arrive at methods of effective communication. For communication uses language and language has its meaning in experience."
>
> (Meredith, 1966(a). III.5.)

1. Defining a Concept.

Immediately we are embroiled in the problems of communication because of the "concept of a concept", which he presently defines, but before taking his definition let us review this situation. Wallace (1965) embarking on his review of research on concept growth found that verbal definitions were of little use in deciding whether particular studies fell within this field. He says,

> "Apart from their uniform lack of specificity, these definitions reveal a dichotomy between those which regard a concept as a guiding force, a dynamic process for scanning perceptual data in the light of past

> experience, and those in which a concept is a 'thing', a piece of mental furniture, a product of reification."
>
> (Wallace. 1965. III.6.)

He notes that the problem is complicated by references which might appear to be reifying concepts, but are simply 'naming' them in the interests of brevity, with dynamic assumptions in the context. Other complexities, and elucidation of the problems may be exemplified from the papers presented at a conference on Analyses of Concept Learning at the University of Wisconsin in 1965. (Klausmeier and Harris, 1966. III.7.) These provide a wealth of possible analyses of the process of concept learning and for the present context certain significant phrases have been selected. We will start with Lovell.

> "By concept we mean any term that can be recognised as a recurrent feature in an individual's thinking provided that the individual can go back over the mental actions from which the term was derived, and anchor it in his experience of firsthand reality. Thus, a piece of verbal behaviour, such as the use of a specific word, does not necessarily qualify it for the status of a concept".
>
> (Lovell, 1966. III.8.)

He then straddles the dichotomy remarked upon by Wallace, in distinguishing types of thought,

> "Now in logical thought, concepts behave very much as things do, for they have definitions, are treated as constant entities, and have their names manipulated. In dialectical thought, however, concepts act as foci of organisation in the continuous change of flow of thought."
> (Lovell, 1966. III.9.)

This was written with specific reference to <u>mathematical</u> concepts, but much research on concepts, especially on initial concept <u>formation</u>, has endeavoured to use <u>artificially devised</u> concepts, in order to eliminate previous learning experience, and this has built up a recognisable but limited "concept of a concept". Gagné distinguishes this, giving common properties of definitions,

> "(1) A concept is an inferred mental process.
> (2) The learning of a concept requires discrimination of stimulus objects (distinguishing "positive" and "negative" instances".)
> (3) The performance which shows that a concept has been learned consists in the learner being able to place an object in a class."
> (Gagné, 1966. III.10.)

(1) raises an important point, never to be lost sight of, i.e. the <u>inferred</u> nature of our conceptual research information, and (3) raises another important point, that we "infer"

the concept from performance (which may be verbal or non-verbal). Gagné's paper is concerned with the problem that if a concept is so defined, in a manner dictated by research method, how do we relate this to the 'concepts' of biology, or geography? While accepting that 'concept' is used in this way, he distinguishes the broader usage in disciplinary terms by using '<u>principle</u>' instead of 'concept'. In endeavouring to distinguish them, he refers to "concepts by definition", i.e. embodied by rules which have to be learned (principles), as opposed to "concepts by observation", the more basic type. He relàtes the latter also to the "conjunctive concepts" distinguished by Bruner, Goodnow and Austin (1956, III.11) and "concepts by definition" to their "disjunctive" and "relational" concepts, since a rule was needed to handle these latter types of concepts.

A philosopher's view of the question of types of concepts is provided by Harré; he startss by referring to them on entities,

> "Concepts are the vehicles of thought".
> (Harré, 1966. III.12.)

and goes on to distinguish two systems of classifying them, categorical and hierarchical. The latter system is relevant here, since he likewise distinguishes a first level used for describing observations (phenomenological) and a second level (physicalist) relating to a system of physical things of which the observations would be the effect or appearances, beyond this other levels would extend upwards to a termination in "the general conceptual system of that era". There is an extra-personal orientation here as opposed to the personal mental operations, but since we are concerned with an extra-personal system of disciplinary concepts as well as personal concepts this is a hierarchy to be kept in mind.

Kagan's paper opens with the proposition that

> "concepts are the fundamental agents of intellectual work" "Concepts are viewed as the distillate of sensory experience and the vital link between external inputs and overt behaviours"
>
> (Kagan, 1966. III.13.)

In discussing concept growth developmentally he refers to a "schema" as "the analogue of a concept and the cognitive representation of an external stimulus". Meredith gives very similar definitions in the terms "stored and organised residues of experience" for concept, and "plans of action determined by particular past experiences" for schemata. These definitions reflect another facet of the "concept of the concept" problem, i.e. the need to distinguish the extra-personal concept from whatever-it-is that is inferred as operating at a particular moment in thought.

To return to Harré's paper, he deals historically with the early connection of concepts with images, the linguistic philosophy's concentration on identifying the use of words, and the postlinguist "insight that language is not the only vehicle of thought", and the restoration of the image - or rather what he calls "its objective counterpart - model building". And with this Epistemics seeks to become a "vehicle of thought" for the "concept of a concept" (though we must continue with its linguistic expression before building the model).

> "A concept is something conceived, not an immutable form subsisting independently of man. The process of concept formation is a special type of learning. As such it depends on psycho-physical processes in the brain .... Even when the concept is well established it can suffer neglect or inhibition, and it can be revived by further re-inforcement or modified by new stimulation. These influences may come from "outside" through sensory processes which may be exteroceptive, interoceptive or proprioceptive, or from other "formations" in the brain itself..... A concept can interact not only with other concepts but also with other psycho-physical formations, such as images, skills, and word-schemes".
> (Meredith, 1966. III.14.)

Meredith refers to Claud Bernard's concept of the "internal environment", and suggests that concepts should be considered more in biological terms than in mechanical terms. This does not mean that we must abandon logical consideration of concepts, but it must be an <u>empirical logic</u>

> "whose axioms and procedures are distillations of experience, neither distant descendents of

> the subleties of Greek syntax nor disguised essences of modern arithmetic".
>
> (op. cit. III.15.)

Like Piaget he sees logic as useful in classifying the component operations of thought, but not as descriptive of entire thought processes.* While it is evident that he is dealing with the process of the continual adjustment of ideas which Piaget spoke of in terms of the adjustment of equilibrium by assimilation and accommodation, he is dealing with <u>the development of concepts in the learning processes of the individual mind</u> (to echo the wording of the title of this thesis) with an emphasis on the psycho-physical processing of information which produces a <u>different terminology</u> and <u>a different set of categories</u> from those used by Piaget.

2. <u>Developing the Categories of Epistemics</u>.

> "Categorization is a necessity of all organised thinking. Psychologically a category is simply an established habit of identification, an aspect of the brain's economy in replacing the multiplicity of stimuli by the oligarchy of categories. Once established they rule our thought and impose structure on our percepts. It should be obvious that their number, their

---

* Compare W.Mays' comment on Piaget: "Piaget's approach is that it gives us for the first time, a method of testing experimentally, many of the concepts and principles which philosophers and logicians have been discussing on a purely normative level for centuries; and which consequently have been regarded as sacrosanct and closed to empirical investigation".

(Mays, 1954. III. 16.)

> forms and their differences all reflect the limitations of our brains and our sensory equipment".
> (Meredith, 1966(a). III.17.)

That every concept, however "objective", however "logical", has had an initial dependence on human judgments is implicit in the whole fabric of Epistemic theory. Some "established habits of identification" are more widely established than others, and more thoroughly proven than others. A great deal of "Instruments of Communication" is taken up with the search for the Epistemic categories:

> " A single psycho-physiological hypothesis is adopted: each category is regarded as representing a distinct brain-state at the moment of collision with a selected in-flow of stimulation".
> (op. cit. III.18)

Since "Instruments of Communication" was published these categories have been further refined, therefore while the build-up of the structure of the categories can be traced here, final definitions have been derived from later sources.

Since the term "information" will be used so frequently, it is important to distinguish that we are dealing with "semantic information", not the stripped down "bit" of information theory. Semantic information retains meaning. Meredith quotes Maloney,

> "Semantic information treats the conservation of meaning in terms of the structural relations of code elements with the consequence that

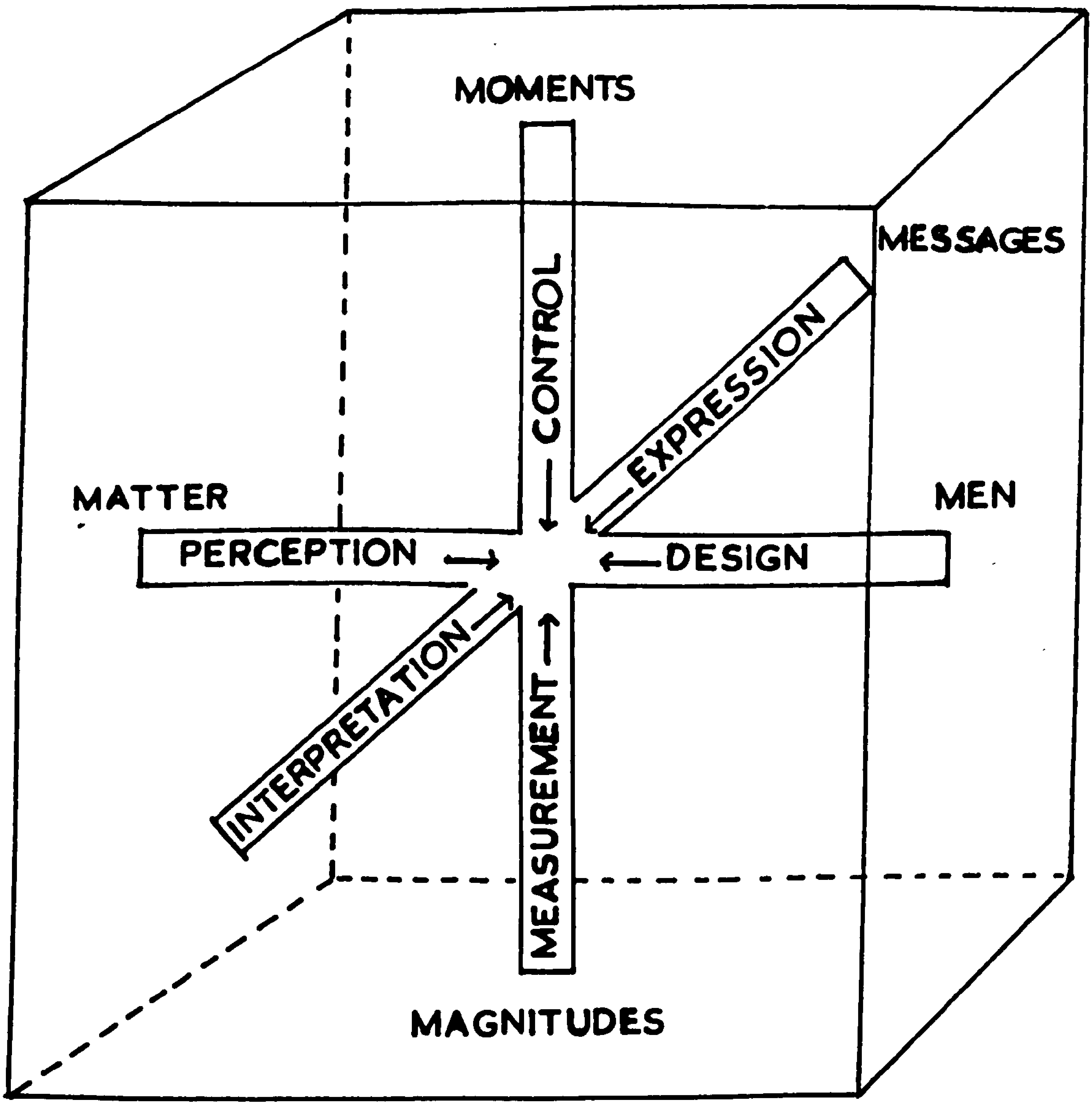


Figure III 1. The Episodic Block of Events.

> dimensionality must be preserved"....."The term "information" is suggested to stand with "matter" and "energy" to form the third basic category of constituents of the external world, specializing into signal, semantic, inductive, pragmatic and other forms of information in particular contexts".
> (Maloney, 1962. III.19.)

He goes on to say that neither the concept of the schema, nor Hebb's cell assembly, though leading in the right direction, are sufficient to deal with the complexity of information and communication, knowledge and men. He gives what he considers the basic terms,

> "There are the materials of work and the moments of interaction between these materials. There are instruments of observation (which may be simply eyes, ears, etc.), and the measures and meanings which these deliver to the percipient. This information is communicated by messages between men."
> (Meredith, 1966(a). III.20.)

He then constructs an "episodic block of events", a cube surrounded by the field of events, with emphasis on the three axes (Figure III.1. is an amalgam of his Figures 5.2 and 5.3, 1966(a). III.21.). In viewing this diagram it is important to (1) focus on the 3 lines of the axes and their opposing poles, and then (2) shift the focus to the cube form and view the labelling Matter/Men, Moments/Magnitudes, Messages/Meaning as referring to the areas representing the six sides of the cube. Although the use of opposites echoes the concept of the Semantic Differential (Osgood et al 1957), the constructed frame of reference of "Epistemic Space" has a much wider significance than that of Osgood's 'Semantic space', as will appear below. Beginning thus to build his semantic matrix he refers to the following basic definitions for such a structure,

> "1. A semantic matrix is display of referential elements.
>
> 2. A referential element is a material sign conveying a meaning to a human respondent.
>
> 3. A display is an arrangment of elements in a spatial framework according to some ordering principle.
>
> 4. Semantic matrices develop functional properties in so far as their elements are assigned characteristic functions.
>
> 5. The syntactic function of a sign is a rule of usage whereby the sign enters into characteristic relations with other signs to establish a matrical structure of signs.
>
> 6. The matrical structure of a semantic matrix enables it to enter into inter-matrical relations with other semantic matrices".
>
> (1966(a). III.22)

Although Epistemics is essentially relativist, nevertheless to stablise this "spectrum of information" a fixed centre is needed, and this is taken as man's own body, the centre of his experience. He quotes Cassirer on this conceptions of the co-ordinates by which language relates to spatial observation,

> "The 'differentiation of locations in space' starts from the positions of the speaker .....
> ... Once he has formed a distinct representation of his own body, once he has apprehended it as a self-enclosed and intrinsically articulated organism, it becomes, as it were, a model according to which he constructs the world as a whole. In this perception of his body, he possesses an original set of co-ordinates, to which in the course of development he continually returns and refers...."
>
> (Cassirer, 1953. III.23.)

Thus the personal element is recognised in all "cultural episodes", and the important linguistic analysis is allied inevitably with the orientation of the user of language.

> "In the problem of categorization we have the meeting point of syntax, semantics, philosophy, psychology and logic".
>
> (Meredith, 1966(a). III.24.)

Man's observation is "language-contaminated", but in trying to establish "a really valid system of categories in any empirical sense of the word "valid", we cannot ignore psycho-physics, and the "natural syntax" of the nervous system (c.f. Sherrington's "Integrative Action of the Nervous System" 1961).

The sequential order of prose cannot reflect these complex relations; the three dimensional "Cultural Cube" of the Semantic Matrix can do better, but between them we are dependent on two-dimensional geometric display. At least in this we are freed from the compulsory order of prose and in documentary space can maneuovre better amongst the space-time relations of an episode, its observation, its reporting and its analysis. Documentary space can thus be used to represent the "epistemic space"

> "i.e. a region of definable phenomenal transformation which can be analysed in the categories of epistemic syntax".
> (Meredith, 1966(a). III.25)

The Tetralectic

The primary matrix incorporates four of the six elements of the "episodic block of events" shown in Fig.III.1.

PRAGMATICS "MESSAGES" social conventions IV R	SEMANTICS "MOMENTS" phenomenal sources J I
III P "MEN" PSYCHO-PHYSICS individual programs	Q II "MAGNITUDES" SYNTACTICS instrumental outputs

Fig. III.2. The primary elements of Epistemics are here identified with their interpretations for the "Tetralectic of Communication".
(Meredith, 1966(a). III.26)

The "cultural cube" as the basis of an Epistemic Thesaurus appears here as a skeleton whose final clothing in "an assembly of verbal indicators" of categories was not undertaken in "Instruments of Communication" and it would serve little purpose to review the categoreal schemes which preceded the eight syntactic categories which were finally hammered out. These eight "modes of attention" in the "Chora" or "dynamic space of every creature's homeostatic processes" are to be generated in terms of a triple choice of axes which are finally expressed thus:

> "1. We attend to our present experience, "E", or to our undercurrent of memory, "U".
>
> 2. We attend to a selected focal point "Y" in the total field, or we scan the whole ambient margin, "A" or the information field.
>
> 3. We attend to the inflow "I" of variation or to the outflow "O" in the total two-way variation in the relationship."

(Meredith 1966(a). III.27.)

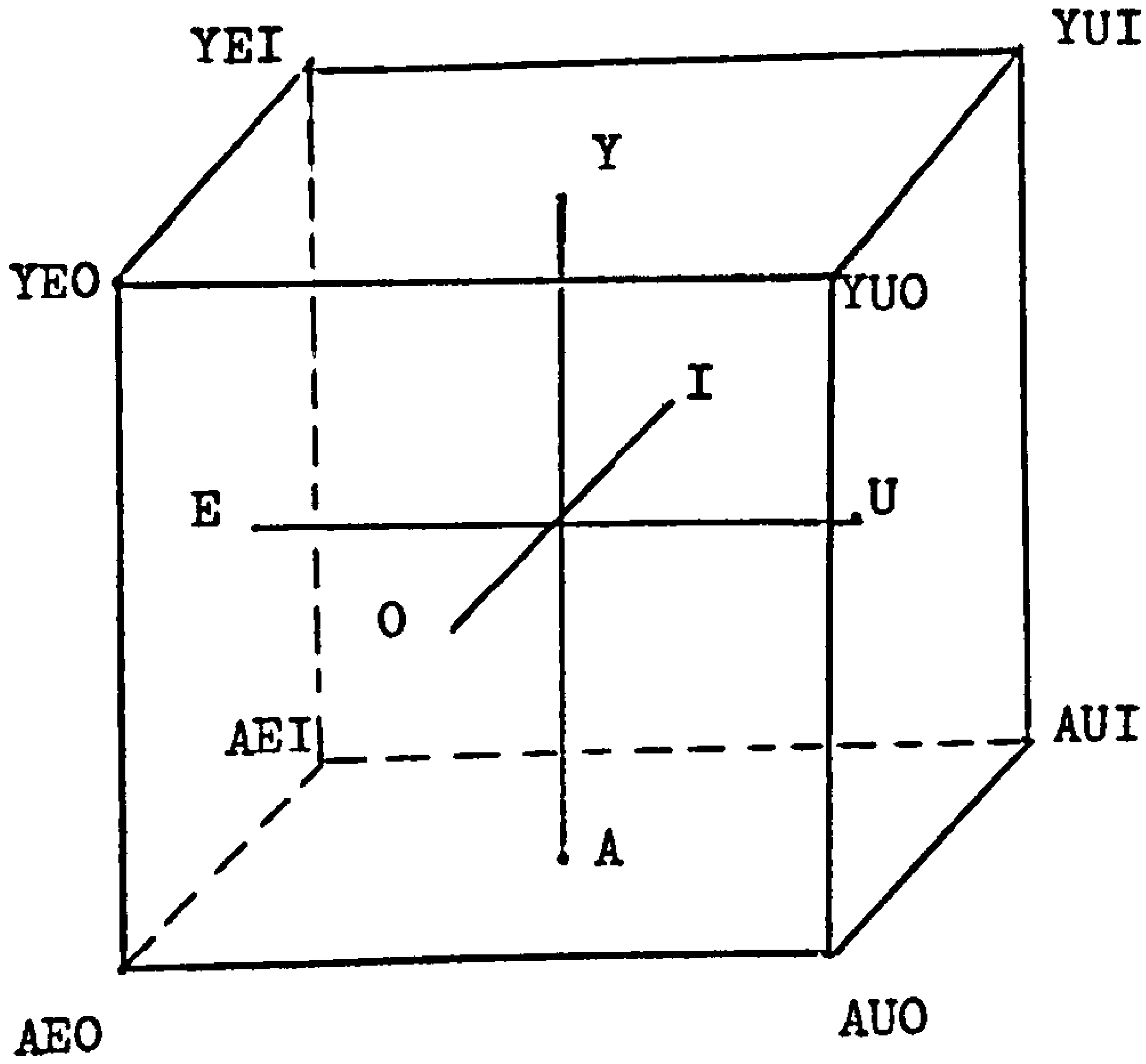


Fig. III.3. The Epistemic Cube

Despite the different verbal indicators there is a basic affinity with the embryonic cube of Fig. III.1. (p.37.). The same alternate focussing on lines of axes and areas of faces is necessary for EU, OI, YA.

Each face of the Cube can then give us a "Tetralectic" of four categories. By considering all possible relations between the surfaces, points and lines of the Cube we have an Orthochoric Structure which retains the dimensions in the "semantic information" (c.f. Maloney, quoted above on P. 36.)

3. The Expression of the Categories in Orthochoric Notation

This Semantic Matrix is going to provide pigeonholes for semantic information,

> "The framework for the Epistemic Thesaurus is our "Cultural Cube". It is a mapping space in six dimensions and stands or falls by its adequacy and convenience, not by any claims to immutability".
>
> (Meredith, 1966(a). III.28.)

We have to employ general verbal indicators for the categories. Later on we shall be compiling our geographical thesaurus fitted into these pigeonholes for the purpose of this investigation. Because it has proved useful for comparative purposes later on, some of the verbal indicators employed in this exposition have been taken from Meredith's article on "Ultra-Behaviourism and Mathematical Education" (1967. III.29) in which he is commenting on some comments of Lancelot Hogben on Epistemics. Others come from material produced at the Epistemic Communications Research Unit.

Let us start by re-stating the three axes, with which we will associate the six faces of the Cube in their pairs at rightangles to the axes.

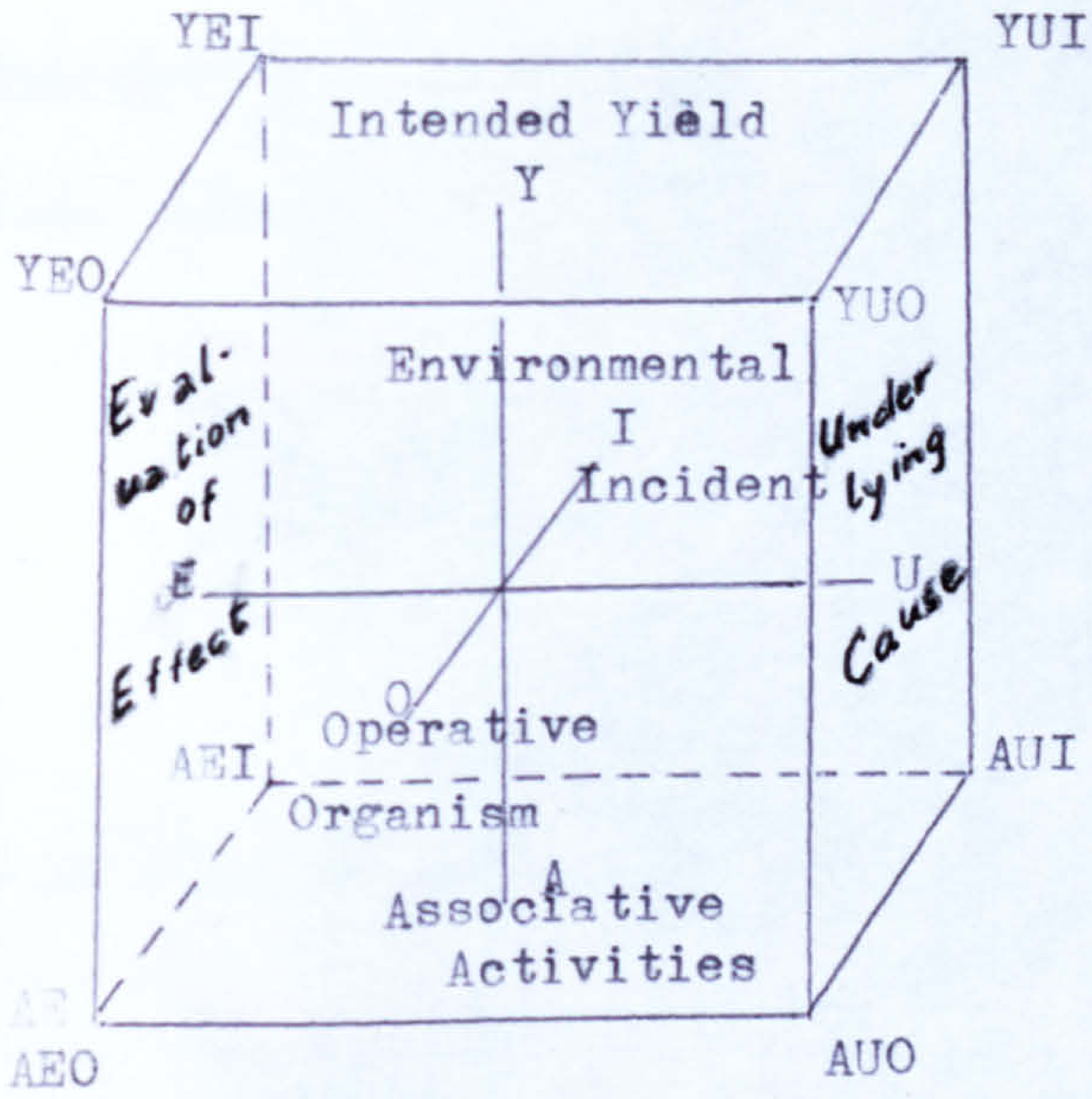
1. UE = Cause - Effect Axis (symbolised by α)
   This connects causally-productive events with evidentially-reflective events. It may be regarded as the axis of Physical Control and of physical time.

2. IO = Environment - Organism Axis (symbolised by β)
   This connects environmental incidents with operations

<u>of the organism</u>. It may be regarded as the axis of <u>Individual</u> or <u>Biological Control</u>, and of the organism's own time.

3. <u>AY = Activity - Yield Axis</u> (symbolised by γ) This connects associative, aggregative, distributive events to selective, directive, focal events i.e. <u>Extensive</u> - <u>Intensive</u>. It may be regarded as the axis of <u>Social Control</u>, and of the social time of a communication.

The time distinctions may be brought out by an example: a communicated massage might be delivered at noon (α); the recipient might not immediatèly re-act to its meaning, and so would meaningfully receive it five minutes later (β); the social time of the measage related to a meeting at 10 a.m. which the recipient of the message had forgotten was to be held on that day, and the sender of that message had assumed that it would be delivered at 9 a.m., not at noon (γ - an Intended Yield which had not materialised).

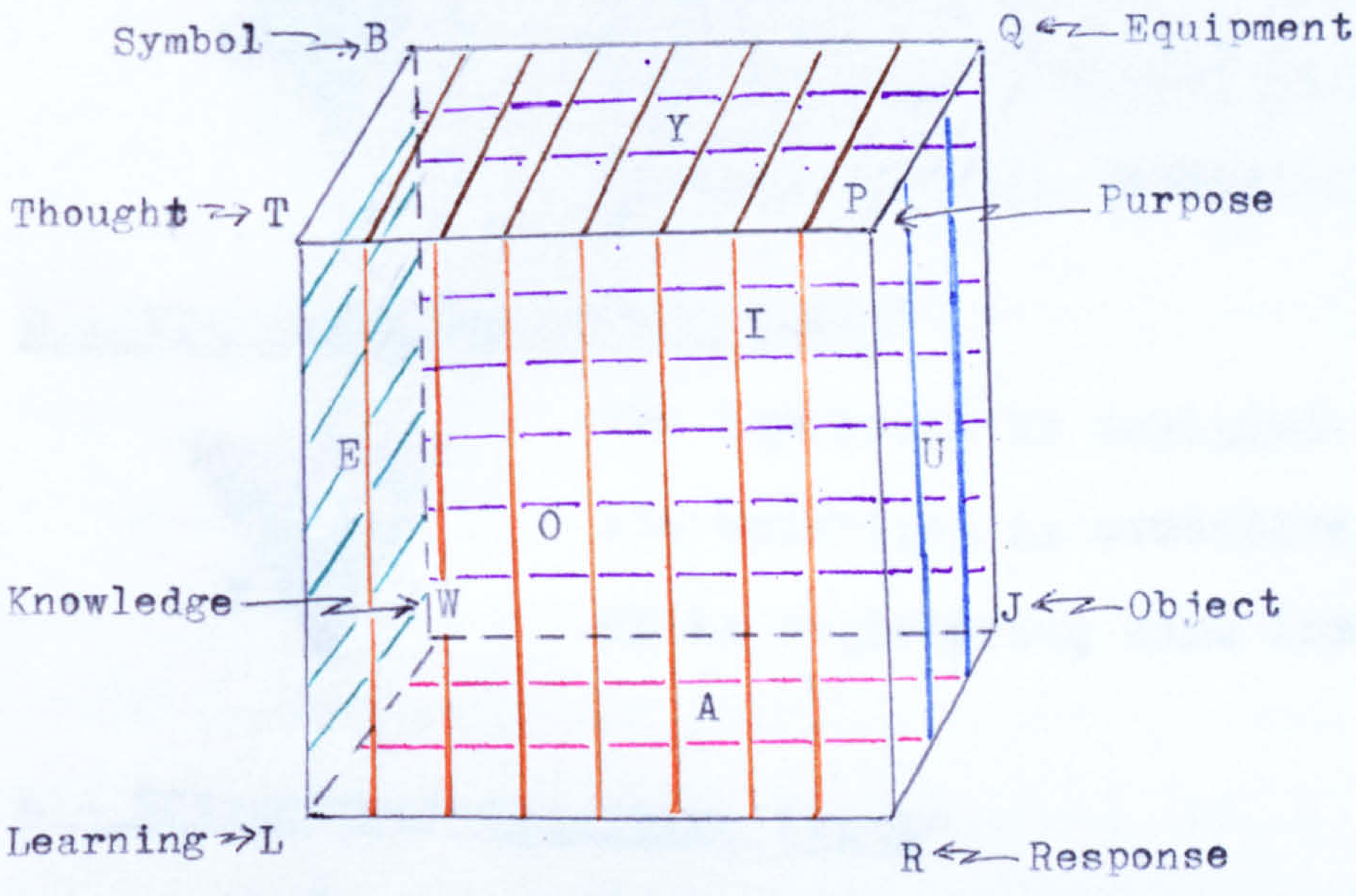


Associated Colour Code

Y	Brown	A	Red
O	Orange	I	Violet
E	Green	U	Blue

Fig. III.4. Orthochoric Surfaces

The three axes and a specific association of surfaces unite at each corner identifying a category of events.



These are the simplest set of verbal indicators.

Fig.III.5. Constants of the Cube

N.B. Selection of letters may be regarded as arbitrary: some had alliterative associations originally.

Neighbourhoods of the Syntactic Constants

T - "Theoretical Formulation Event"*

In this syntactic mode Thought is motivated, having some positive Intended Yield for which the Organism is Evaluating Experience.

P - "Procedural Decision Event"

The Organism is pursuing an objective, deciding on some operation which will be a causative process.

B - "Symbolic Behavioural Event"

The reference-bearing mode; symbolism carries the evaluated experience, the incident, the intended yield; alternatively it also selects, focussing attention.

Q - "Instrumental Action Event"

The Equipment is designed for some Yield; its operation is causative of some Incident, or is registering some incident.

L - "Structural Cognitive Event"

In Learning, the Organism is co-ordinating Associations and Experience.

---

* Verbal Indicators from Meredith (1967)
The expanded phrases used are designed to connect the meanings associated with the 3 surfaces of the Cube which join at this corner point.

R - "Responsive Behaviour Event"

The Organism is oriented towards absorbing something from the physical world which is transformed by active Associations in the response (visual, auditory, tactile, kinaesthetic)

W - "Knowledge Retrieval Event"

There is Association of Environmental Incidents and Evaluation of their Effects in the Cultural Store of Knowledge, categorized Witness of the past in cumulative ideas.

J - "Objective Source Event"

The Environmental Incident seen in some Causal field, and also in some Associational field.

It will be evident that T, P, L, and R, surrounding the Organic surface O, are directed from the brain (refer back to Fig. III.5. p. 46.) whereas W, J, B, Q, surrounding the Incidental surface I "are determined by available environmental assemblies of information, vocabulary, instruments and objects". (Meredith, 1966(c). III.30) P, Q, R, J, are "causally productive" and have U in common: T, B, L, W, have E in common and are "evidentially reflective". Finally, we have the selective, directive T, B, P, Q group around Y, facing the associative L, R, W, J., around the A surface (Figs. III. 6, 7, 8.).

P
Procedural Decision

Q
Instrumental Action

U
<u>Causal Surface</u>
"Underlying Cause"
(causally productive events)

Responsive Behaviour
R

Objective Source
J

PHYSICAL CONTROL

and

TIMING

$\propto$

B
Symbolic Behavioural

T
Theoretical Formulation

E
<u>Experiential Surface</u>
"Evaluation of Effect"
(evidentially reflective events)

Knowledge Retrieval
W

Structural Cognitive
L

Fig. III.6. Surfacial Relations (alpha)

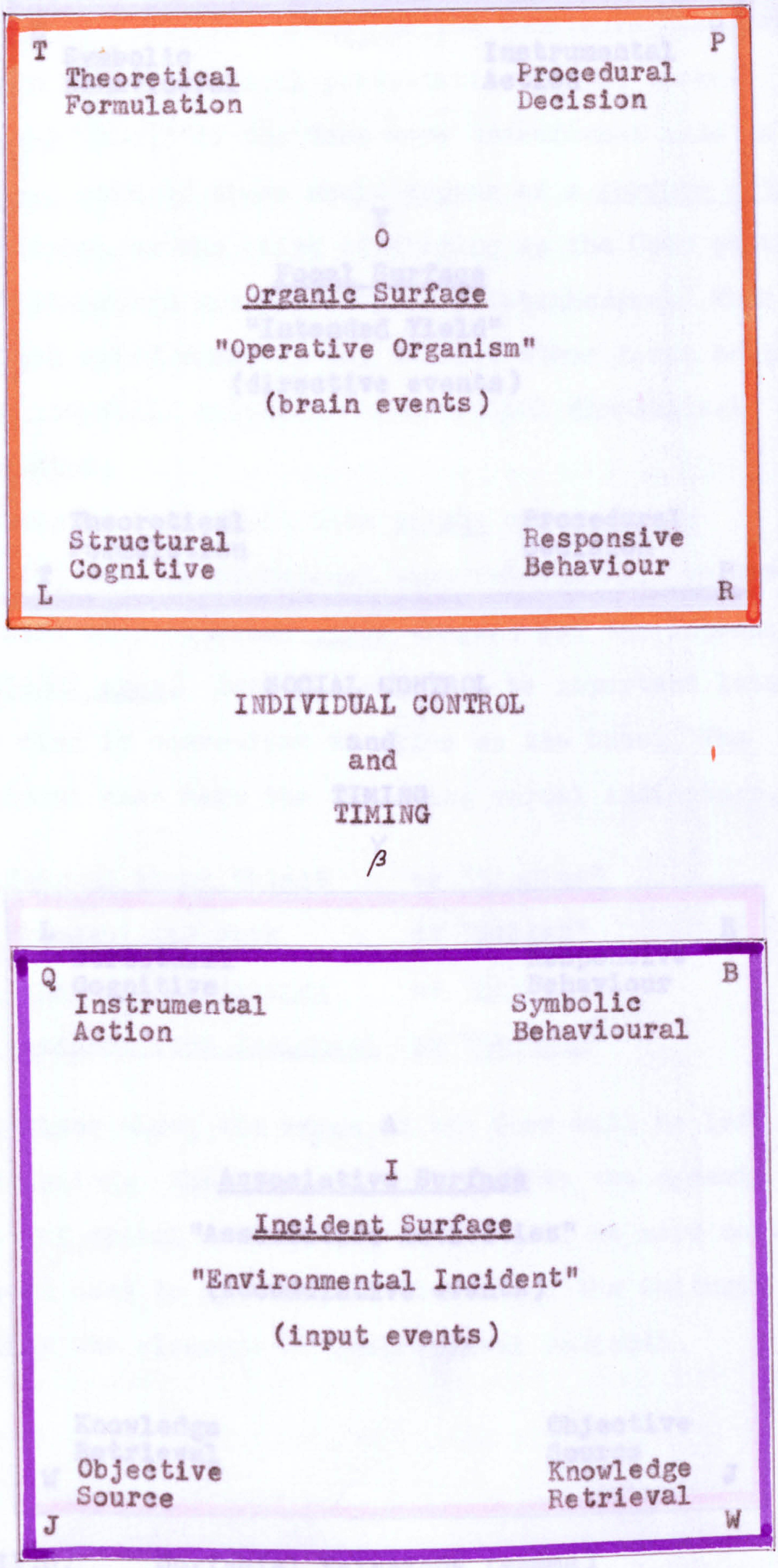


Fig. III.7. Surfacial Relations (beta)

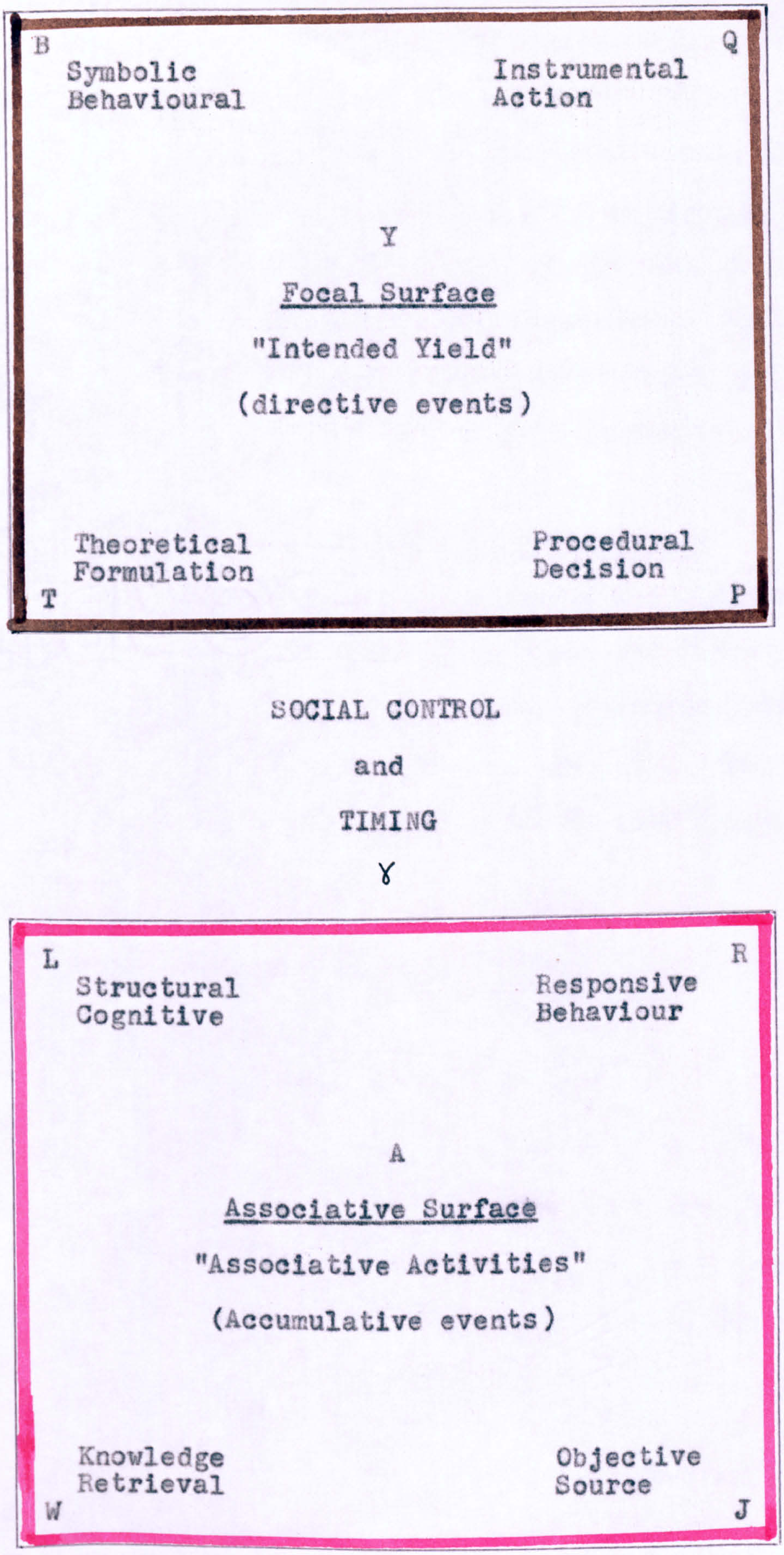


Fig. III.8. Surfacial Relations (gamma)

Each of these "neighbourhoods" of the Constants has been shown as a two-dimensional presentation of the three-dimensional Cube. If the Cube were transformed into an Octahedron, each of these would appear as a surface octant. Alternatively, we can think of slicing up the Cube so that each neighbourhood was isolated as a tetrahedron. Thus the Behavioural solid Geometry can utilise other forms besides the Cube and still maintain the essential dimensional relationships.

So far we have dealt with points and surfaces externally, and the orthogonal axes internally; we have yet to deal with external lines (edges) and the internal Oppositional axes. Both are going to be important later when we find it convenient to slice up the Cube. The Oppositional axes have the following verbal indicators,

T - J Thought about Object or "Minding"
P - W Proposal for Work or "Making"
B - R Bearing or Reference or "Meaning"
L - Q Learning from Equipment or "Mapping"

The relations along the edges of the Cube will be left for the time being; they are more relevant to the dynamic analysis of mental operations, and it will be more convenient to proceed next to use the static form of the Cultural Cube to display the elements of geographical concepts.

CHAPTER IV

EPISTEMIC ANALYSIS OF GEOGRAPHICAL CONCEPTS

Geography is concerned with mapping terrestrial space into documentary space. We might regard orthochoric procedure as an analogous procedure for mapping knowledge/thought relations into documentary space. Relevant geographical terminology and orthochoric terminology therefore tend to be cognate. Ackerman discussing Geography as a science, says,

> "There is no doubt that there is such a thing as "thinking geographically". To structure his mind in terms of spatial distributions and their correlations is a most important tool for anyone following our discipline"...
>
> (Ackerman, 1963. IV.1.)

> "The basic organizing concept of geography has three dimensions. They are extent, density and succession".
>
> (op.cit. IV.2.)

The word "dimension" has to be regarded carefully, since we may be using it analogously as here, while in the following statement also about Geography it is being used literally, when de Jong says,

> "The material things investigated by geography have three dimensions, but geography lays stress on the two dimensions that determine the surface. This surface extension is clearly expressed by

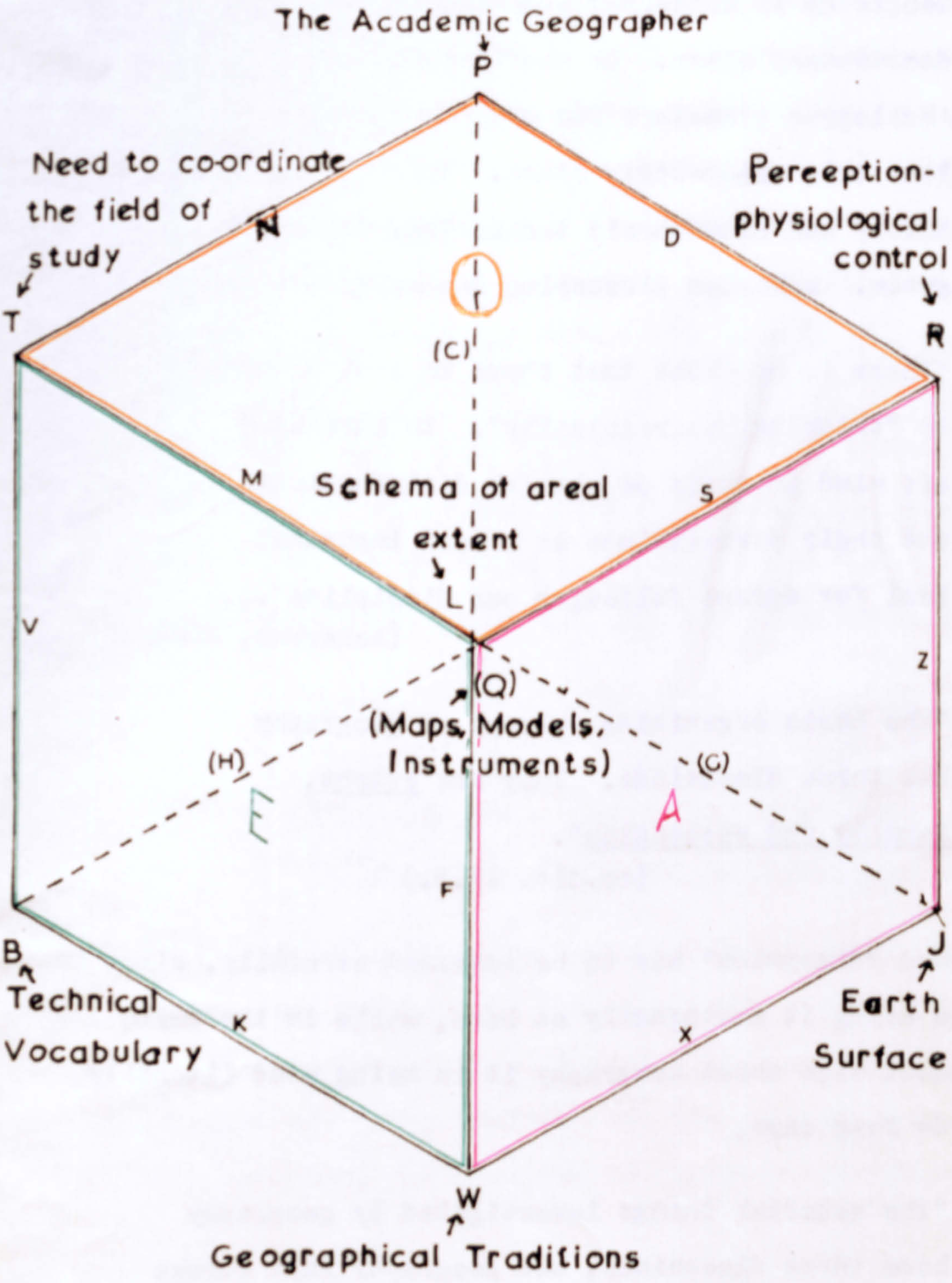


Figure IV.1. The Geographer and the Concept of Areal Extent
(Q is hidden by L in this projection)

> the notion chorological, which has about the same content as the concepts areal and regional".
> (de Jong, 1962. IV.3.)

> "Our conception of earth space,.... an earthly complex of material and immaterial things which is further determined by its absolute and its relative location on the terrestrial globe".
> (op.cit. IV.4.)

To look at the structuring of the geographer's mind, it will be appropriate to look at the Epistemic dimensions of geography projected on to "Structural Cognitive" (L) mode of attention. Instead of showing only the Neighbourhood, the whole Cube is shown in Figure IV.1., appearing two-dimensionally as a hexagon. Letters which will indicate the dynamic vector relations along the edges of the Cube have been shown; their significance will begin to emerge during the analysis. The projection is at right-angles to the "Mapping" Oppositional axis LQ, so we may invert it to consider the "Instrumental Action" mode as well.

The common element in the statements quoted above has been that of extent. How is the Operative Organism, the Geographer (P), going to co-ordinate (T) the field of study? Physiological control (R) limits what he can directly perceive of the Earth's Surface (J). Has he got some Technical Vocabulary (B)? Let us try Geographical Tradition (W). This is the oldest problem in geography and we can go back to the Roman geographer Claudius Ptolemy, or less far, to Kant, for a triadic schema (L), mediating between (W) and (R). There is the Topographic scale of study, which deals with an extent of the earth's surface which can be seen, then the <u>Chorological</u> scale, for which it is not possible to see the unit area. And thirdly there is the <u>Global</u> scale, the whole earth. Advance in technology, of course, has altered the possibilities of "seeing" since man might now see the Chorological from a high-flying plane and the Global from a space craft, but from neither would the detail which can be seen in the Topographical scope be available without intervening instruments (Q).

This Triadic schema of extent is very much of a rule of thumb; where does the geographer's extent start? He is concerned with the macroscopic, not the microscopic. Preston James says,

> "the answer to the questions concerning the minimum size units which we consider to be relevant for geographic study must be found in the fact of the physical dimensions of man himself, not in the objective reality of nature.....
> Man himself is the instrument of observation....
> What he thinks of as the smallest indivisible unit is determined not by the facts of area differentiation, but by man's average height and the average distance between his eyes."
> (James, 1952. IV.5.)

Can the Geographer construct any "instrument" to deal with this problem, which can translate the scale-of-extent schema? Yes, he can, by using successive logarithmic subdivision of the earth's surface to construct an index, the G-scale -

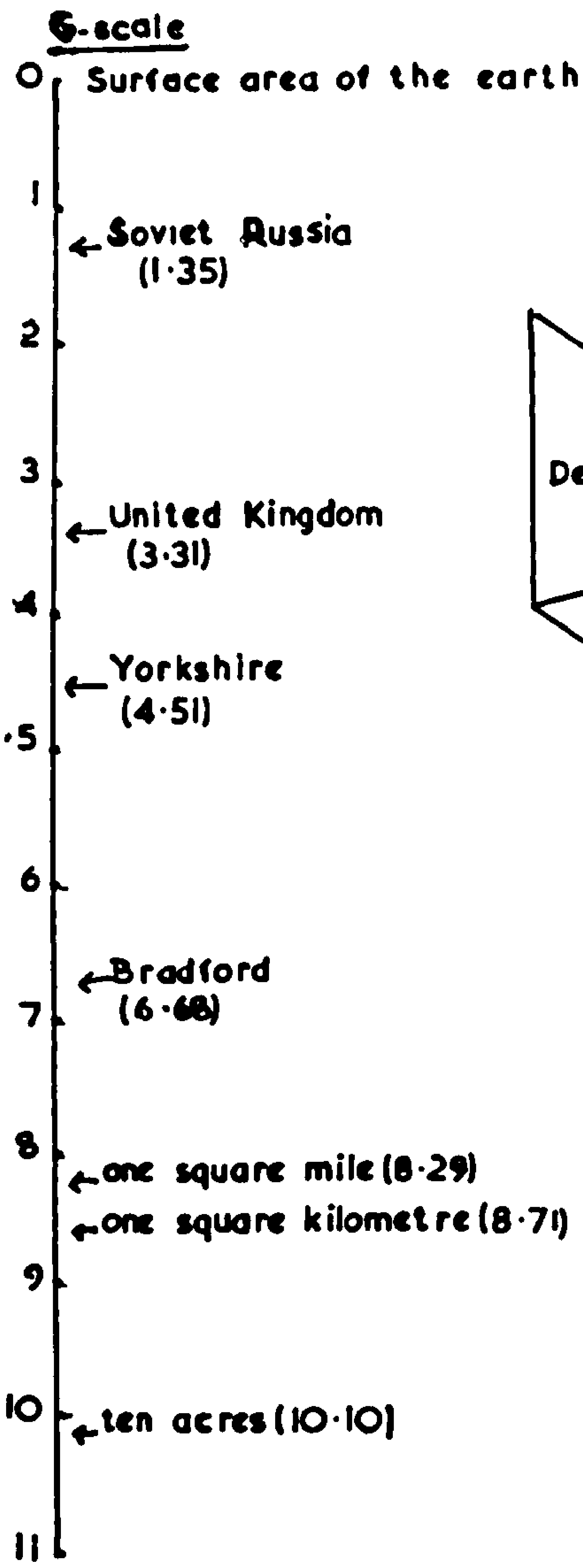


Figure.IV.2. Examples on the G scale. (after Haggett)

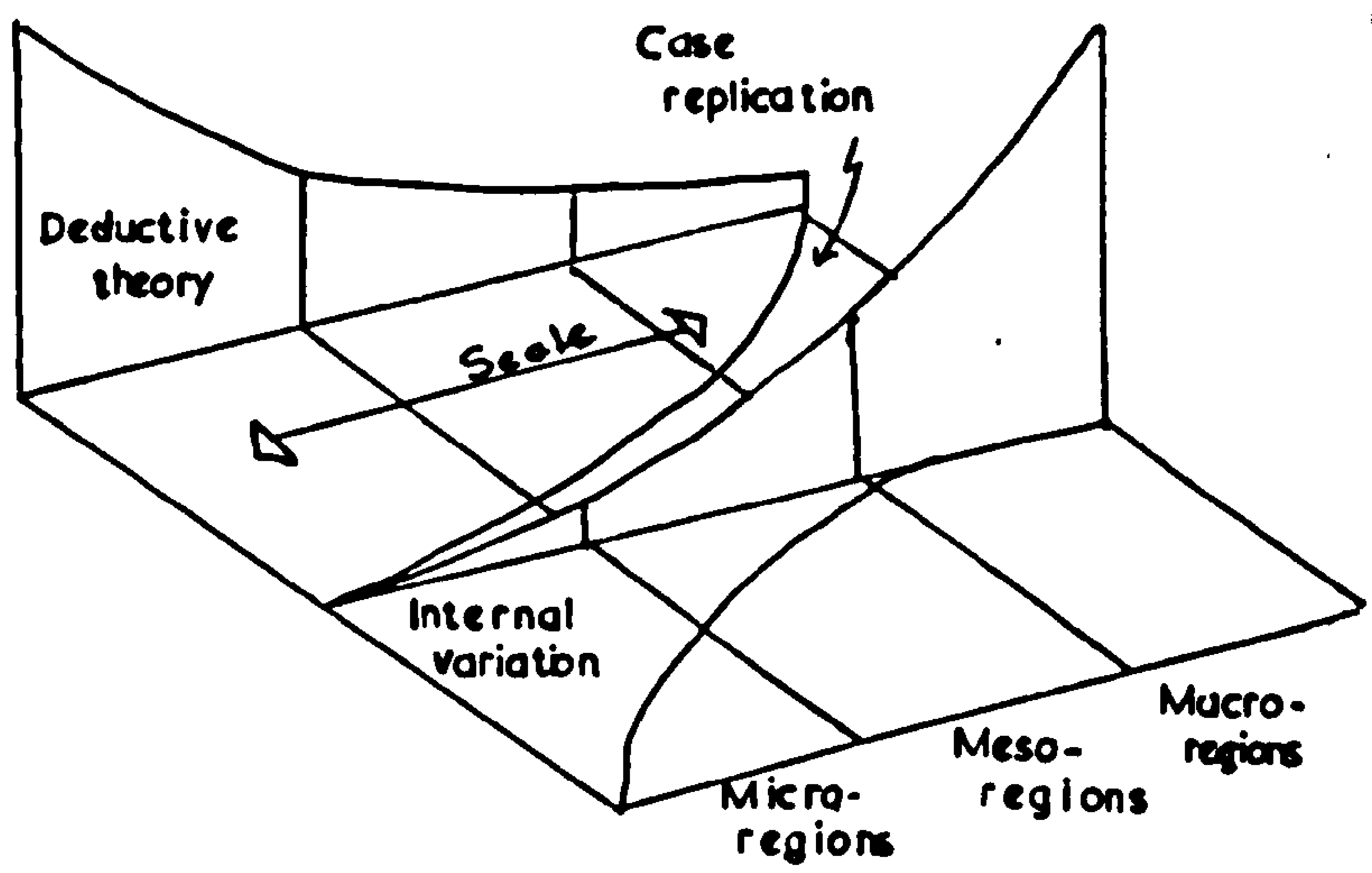


Figure IV.3. Implications of regional scale for teaching models (after Chorley) - a view of the extent schema and method.

a matkematical instrument expressed in the formula G - log (G_a/R_a) where G_a is the area of the earth's surface (1.968×10^8 square miles) and R_a is the area of a regional subdivision. (Chorley & Haggett, 1965. IV.6.) By creating a continuum-schema in place of a triadic schema the extent-concept is altered in character. This we might call a "socialised concept" or "cultural concept", since our idea of terrestrial-space-as-a-whole has to be built up through social communication. The use of atlas and globe tend to build up a socialised concept of extent in which there is a sharp break between the Topographical and the Chorological/ Global. Although Man-in-Astronomical-Space is outside geography's terms of reference, it seems likely that the sympathetic awareness of Man-outside-Terrestrial-Space created by televising of space travel will introduce an effective element into the socialised concept which will be available for building into the structure of the personal schema.

The dynamic relation (or vector) L - F - W has in essence been described above; these vectors are not easy to fit with simple verbal indicators; for one thing there is a two-way trafficalong them; they indicate processes; F is parallel with the β individual axis and represents interaction between a concept identified in the common stock of knowledge and the personal variant of that concept. The Neighbourhood of L may be filled out in character by introducing these vectors which meet in L. L-S-R, the interchange on the α (physical) axis between structure of ideas and meaningful formulated thought, on the γ (social, intentional)

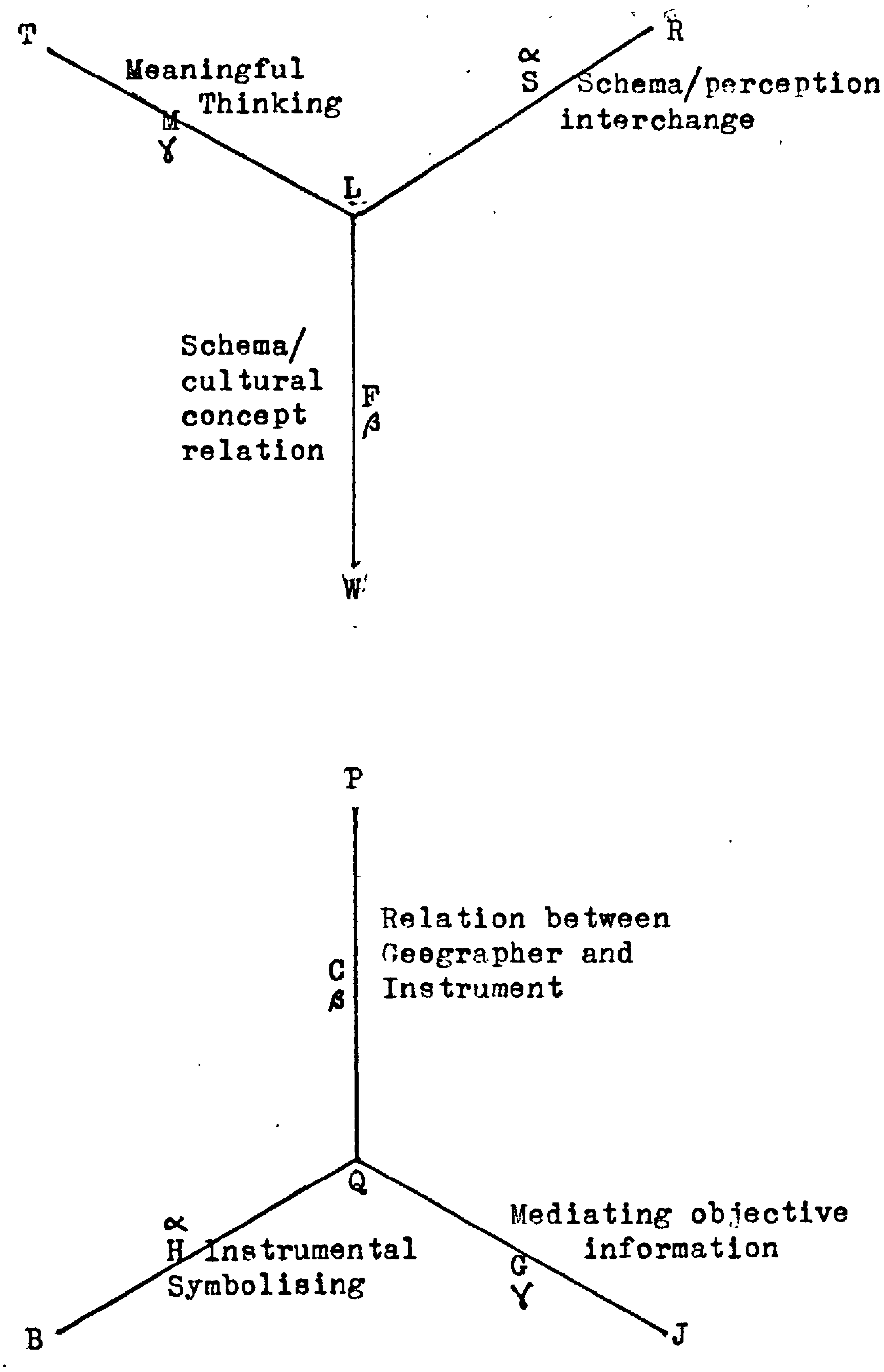


Fig. IV.4. Neighbourhoods of L and Q.

axis, complete the possibilities, the potential mental operations in which L may be involved. (see Fig.IV. 1. p.54.)

In noting that the Geographer P can construct an instrument Q we have already designated the nature of P-C-Q (and the Geographer is influenced by the instrument); the β reaction between organism and environmental event). The instrument in question in this context is linked in Q-H-B to symbolism in the technical vocabulary (α axis), and is mediating information about the earth's surface in Q-G-J on the social intentional γ axis. Thus the neighbourhood of Q, the Instrumental Action Event is filled out. It takes a lot of tedious words to spell this out, but in the Orthochoric matrix the relations are maintained whatever the context. (Figure IV. 4.p. 59)

The "Mapping" axis was presented at the start of this exposition because of the common ground with Orthochoric presentation, but since Geography is made by geographers, P - the "Procedural Decision Event" paired with W - "Knowledge Retrieval Event" is attended to next, projected along the "Making" axis PW (Figure IV.5.p.61) To retrieve knowledge about Geography it is inevitable that we must refer to the most thorough recorder of its growth, R. Hartshorne ("The Nature of Geography" (1939), "Perspective on the Nature of Geography" (1959).*

His second book is more economical in the expression

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* His books bring to English-speaking geographers the flavour of the systematic methodological discussions of the German school of geographers.

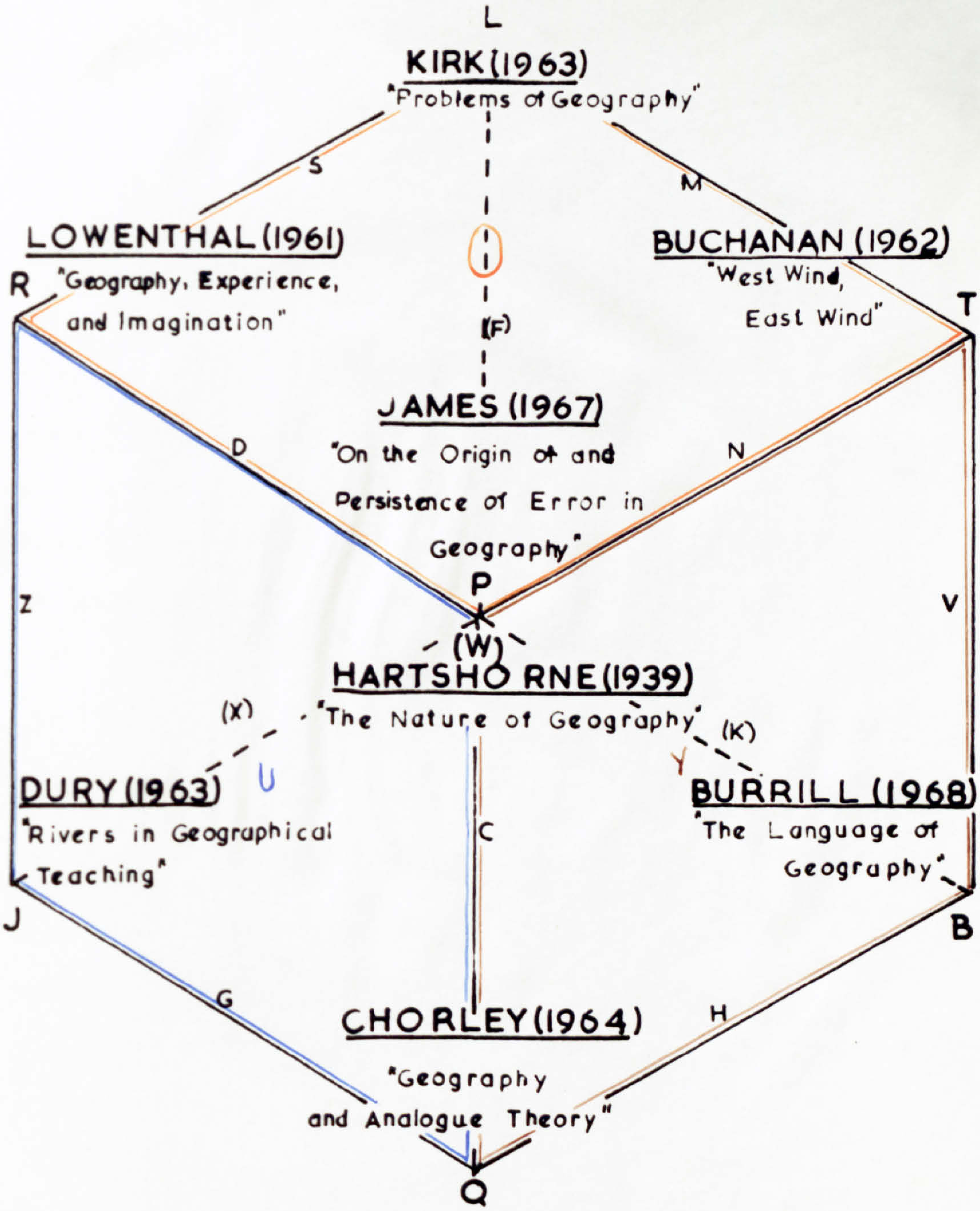


Figure IV 5 The Geographer makes his discipline.

The accumulation of geographical thought is represented by Hartshorne's book (and his later volume, "Perspective on the Nature of Geography (1959). The other seven modes of attention are represented by articles written in the 1960's.

of basic principles,

> "In geography.... the interest is focussed from the start on the existing integrations of diverse phenomena which, by their existence, determine the variable character of area. It begins, that is, with things as they are actually arranged and interrelated in reality, even as the layman may observe them.... the geographer must use some systematic and purposeful methods of selection".
>
> (Hartshorne, 1959. IV.7.)

Concepts, however are more fully discussed in the earlier book; he writes of the

> "concepts of common sense... adaptable to scientific thought. Ocean, lake, river, mountain, plain, city, port, farm, crops, - for all of these the ordinary meaning, as used in common speech, can be sharply defined for scientific use ...... A second large group of generic concepts has been brought into geography from the systematic sciences.... Finally, geographers themselves have developed various systems of types into which they may classify the features which they study".
>
> (Hartshorne, 1946. IV.8.)

Later he enlarges on the use of generic concepts as providing a "shorthand method of description", and emphasises that functional systems of classification are more use in geography than those based on the genetic aspects of phenomena.

Hartshorne painstakingly dissects the progress by which geographers have organised their discipline, building on the work of their forerunners. Preston James (1967) emphasises the pitfalls in this progress,

> "Some kinds of error arise because of the problems of dealing with phenomena in the three-dimensional zone forming earth-space. The broad curvature of the earth, the sheer diversity of earth space, and the patterns of change through time all form pitfalls for the geographer, who is, thereby, liable to error in his descriptive analyses. The problems of placing percepts (things perceived) against concepts (mental abstractions) make for difficulties in analysing the three dimensional spatial zone in which geographers work."
>
> (James, 1967. IV.9.)

He illustrates the problem mentioned in the last sentence above,

> "Note how the observers of landforms once saw only cataclysms or floods, where, since Hutton and Playfair, they see the results of processes going on ..... How many peneplains were identified after Davis had presented the concept!

> And where peneplains were once identified we now see clearly the formation of pediplains".
> (op. cit. IV.10.)

and he touches on the essential epistemic viewpoint in saying,

> ".....geographers must learn to observe carefully in the field even if only to understand the mental process involved in the initial transfer of what is directly observed to the symbol that represents it. If we let the symbol become reality it is because we have dropped headfirst into this trap."
> (op. cit. IV.11.)

Since it would appear from this that the geographer may decide what he sees, we may traverse from P via D to R and consider what Lowenthal has to say in the selected article. This is subtitled "Towards a Geographical Epistemology". But as it seems to be about "knowing" rather than about "knowledge" it also has the Epistemic outlook. This particularly marked when he deals with the limitation of perception by the nature of the central nervous system, both in terms of time (number of images seen per second) and space,

> "As with time, so with space, we perceive one of many possible structures, more hyperbolic than Euclidean. The six cardinal directions are not equivalent for us: up and down, front and back, left and right have particular values

> because we happen to be a special kind of bilaterally, symmetrically, terrestrial animal".
> (Lowenthal, 1961. IV.12.)

He points out that both the shared world view of society and the private personal view are transient, changing as the society and the individual histories develop, but ,

> "The personal "terra cognita" is however in many ways unlike the shared realm of knowledge. It is far more localised and restricted in space and time."
> (op.cit. IV.13.)

To turn from the general to the particular, he illustrates by quotation from R.M. Chisholm the intricate interaction of perception and conception in observation,

> "What you now claim to see is, not that the mountain is Monadnock, but merely that it has a shape like a wave and that there is a cabin near the top. And this "perceptual statement" is coupled with a statement of independent information (Monadnock is shaped like a wave and there is a cabin near the top, no other mountain like that is within miles of here) - information acquired prior to the present perception".
> (Chisholm, 1957. IV.14.)

Considering "Responsive Behaviour Events", we cannot avoid involvement in "Symbolic Behavioural Events" and this suggests viewing the Cube projected on to the "Meaning" oppositional BR; since we are still examining the evidence provided by the geographers we have pigeon-holed on Fig. IV.5. only a skeleton is shown in Fig. IV.6. to remind us of the orientation.

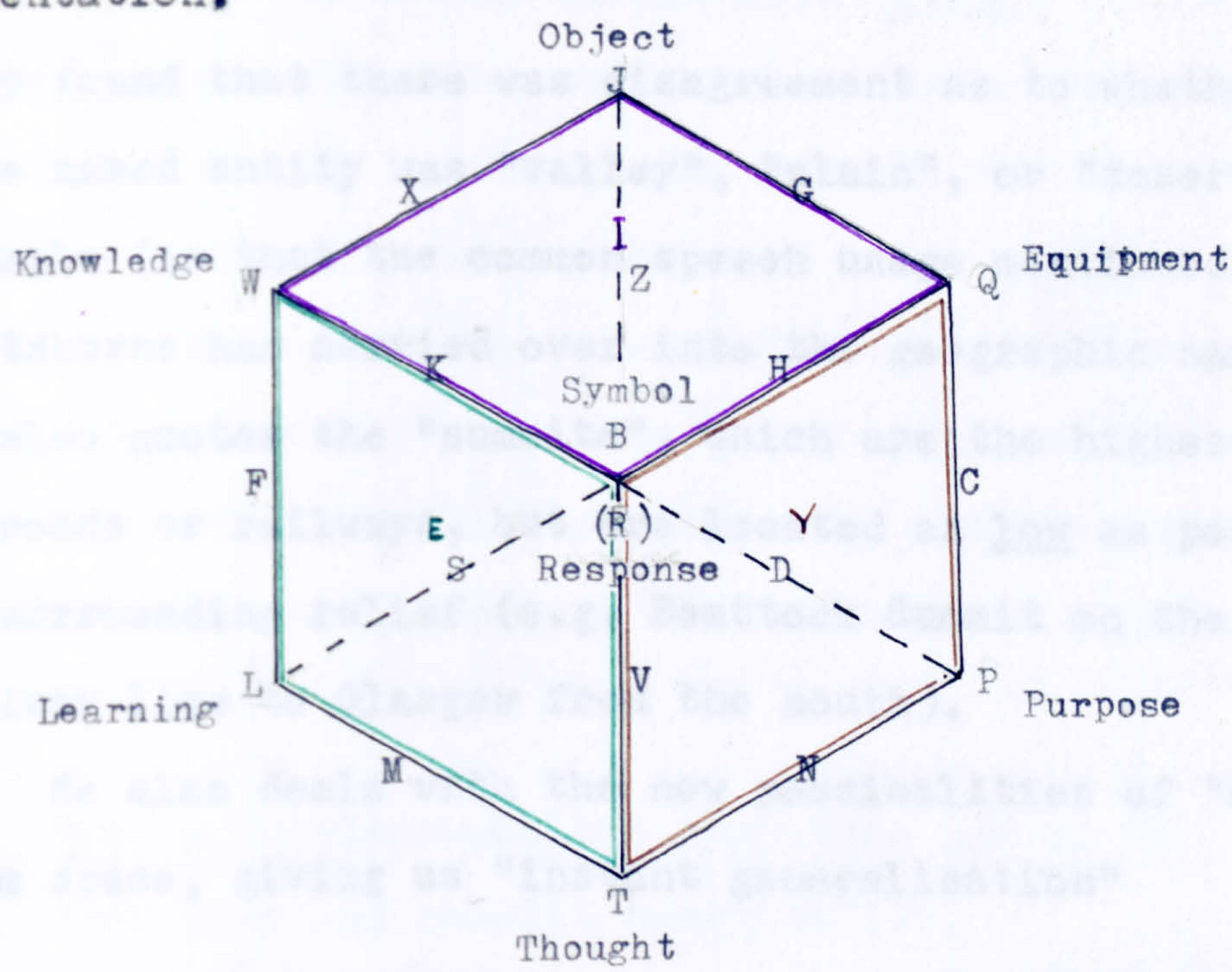


Fig. IV.6. "Meaning"

Burrill (1968) had been concerned with the attempt to identify precisely geographic names. He summarises the situation in the abstract of his article,

> "Great semantic variation in geographic terms is masked by (1) contextual carrying of meaning in communication and (2) highly individual formulation of central meaning and range of concepts that are rarely challenged."
>
> (Burrill, 1968. IV.15.)

he gives details of this kind of thing,

> ".... we encountered many cases that we later

> recognised as examples of mental set with reference to the meanings of common ordinary geographic terms such as valley, plain, desert, gorge, swamp, archipelago and creek."
> (op.cit. IV.16.)

They found that there was disagreement as to whether the same named entity was "valley", "plain", or "desert", for example (so that the common speech usage mentioned by Hartshorne has carried over into the geographic naming). He also quotes the "summits", which are the highest points on roads or railways, but are located as <u>low</u> as possible in surrounding relief (e.g. Beattock Summit on the main railway line to Glasgow from the south).

He also deals with the new possibilities of "seeing" from space, giving us "instant generalisation"

> "This is communication in a new medium... with images composed like half-tones of familiar bits producing, at scales or with resolutions that do not permit identifying the bits, patterns we have never really seen before even if we suspected they were there."
> (op.cit. IV.17.)

In connection with this he refers to the use of computers and automatic scanners to identify arrangements, and points out the superiority of the human organism as a pattern recogniser.

In considering this we would do well to transfer our attention from the BR axis to the <u>vector</u> <u>B-H-Q</u>, which has already been identified as "instrumental symbolising", and to the further <u>vector Q-G-J</u>, both in the neighbourhood of <u>Q</u>. For Burrill is dealing with different instrumental modes of communicating information. Remote sensing from space is transmitting phenomenal information (<u>Q-G-J</u>) without <u>symbolising</u>: otherwise this sort of information can only by transmitted by breaking down what is really a space-time continuum into discrete symbolised bits (<u>Q-H-B</u>). So though Man-in-Astronomical-Space was referred to earlier as an affective element (P. 58 above), on closer examination of the effect of new technological media for communicating areal differentiation, it appears that there is a cognitive element. Burrill says,

> "One's knowledge-belief structure has to be torn down and rebuilt continually".
> (op.cit. IV.18.)

and geography is "a part of our individual and

> collective total structures of knowledge-plus-belief. Perhaps with some new language tools, some new order of things, and some new releases from old mental sets, we can even communicate about it." (i.e. as a continuum).
> (op.cit. IV.19.)

This would seem to be looking forward into the twenty-first century; meanwhile in the twentieth, <u>conceptual</u> models are being specifically recognised as important instruments transmitting phenomenal information in highly organised packets. (This software frequently requires the hardware of the computer for effective use, but not always, at least in more elementary learning situations as contrasted with research). Chorley puts it thus,

> "the problem is translated into more familiar or convenient terms such that a useful model involves a more simplified accessible, observable, controllable, rapidly developing, or easily formulated phenomenon from which conclusions can be deduced, which in turn, can be reapplied to the original system or real world".
> (Chorley, 1964. IV.20)

In this <u>translation</u> we are back with the <u>Mapping</u> axis <u>QL</u>, but this time focussed on the instrumental end of it, as Chorley is considering the Anologue Model as a tool for the geographer,

> "A model becomes a theory about the real world only when a segment of the real world has been successfully mapped into it".
> (op.cit. IV.21)

As James (op.cit.1967) has pointed out, some models long used by geographers, have resulted in the persistence of error when they have been retained uncritically overlong. "The symbol has become reality", and if we look carefully at <u>J</u>, our <u>phenomenal referent</u> we may find that "a segment of the real world" <u>cannot</u> be successfully mapped into it. Dury (1963) takes a look at an instance of this in the selected article. The inaccuracies of examination candidates reflect the particular problem of learning about rivers.

> "A check on more than a dozen textbooks reveals more error than accuracy in statements about deltas, stream velocity, and channel patterns.... teachers may feel that they are trapped in a closed system of misinformation... a whole fictional corpus of belief exists about the qualities and behaviour of rivers."
>
> (Dury, 1963. IV.22)

In this case the very excellence of the Davisian concept of the cycle of erosion, involving the maturing of landscape as river dissect an uplifted landscape has been its downfall. Well suited to carrying on the chorological scale (P.56 above) the ideas of landscape evolution, it carries with it a simplified model of young, mature and old age river features which on the topographical scale are not only rarely found in their ideal form, but which are not really valid as a system based on empirical observations.*

This mythical river is evidently part of the Cultural Store of ideas represented by *W*, so let us look at the conjunction of the neighbourhoods of *W* and *J*.

*Also dealt with in Chapter V below.

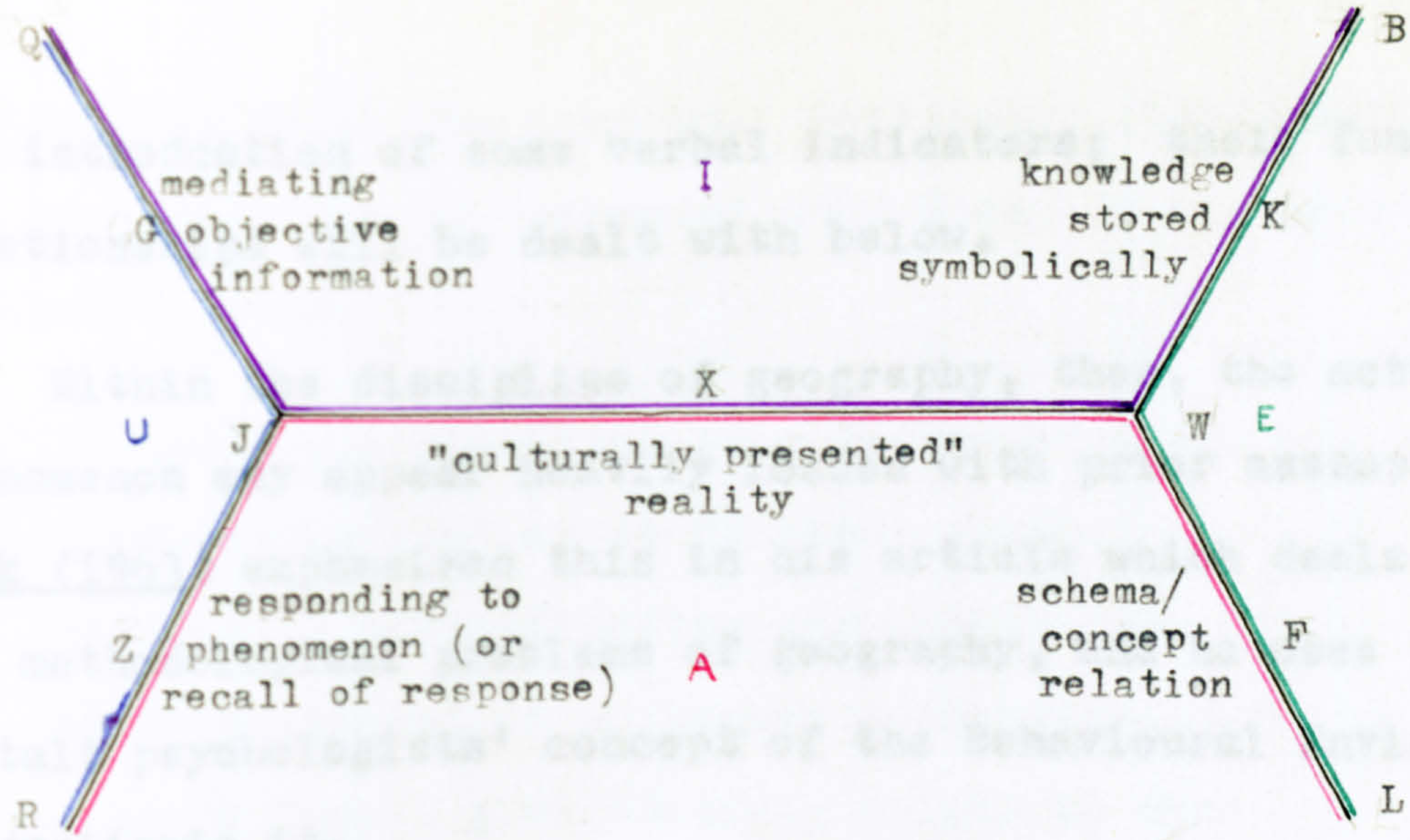


Fig. IV.7.

This enables us to view the character of some more of the vectors represented by the edges of the Cube. There are three such relationships not yet specifically presented. If we emphasize the connection between the Symbol and the Response to the phenomenal referent, we can present them.

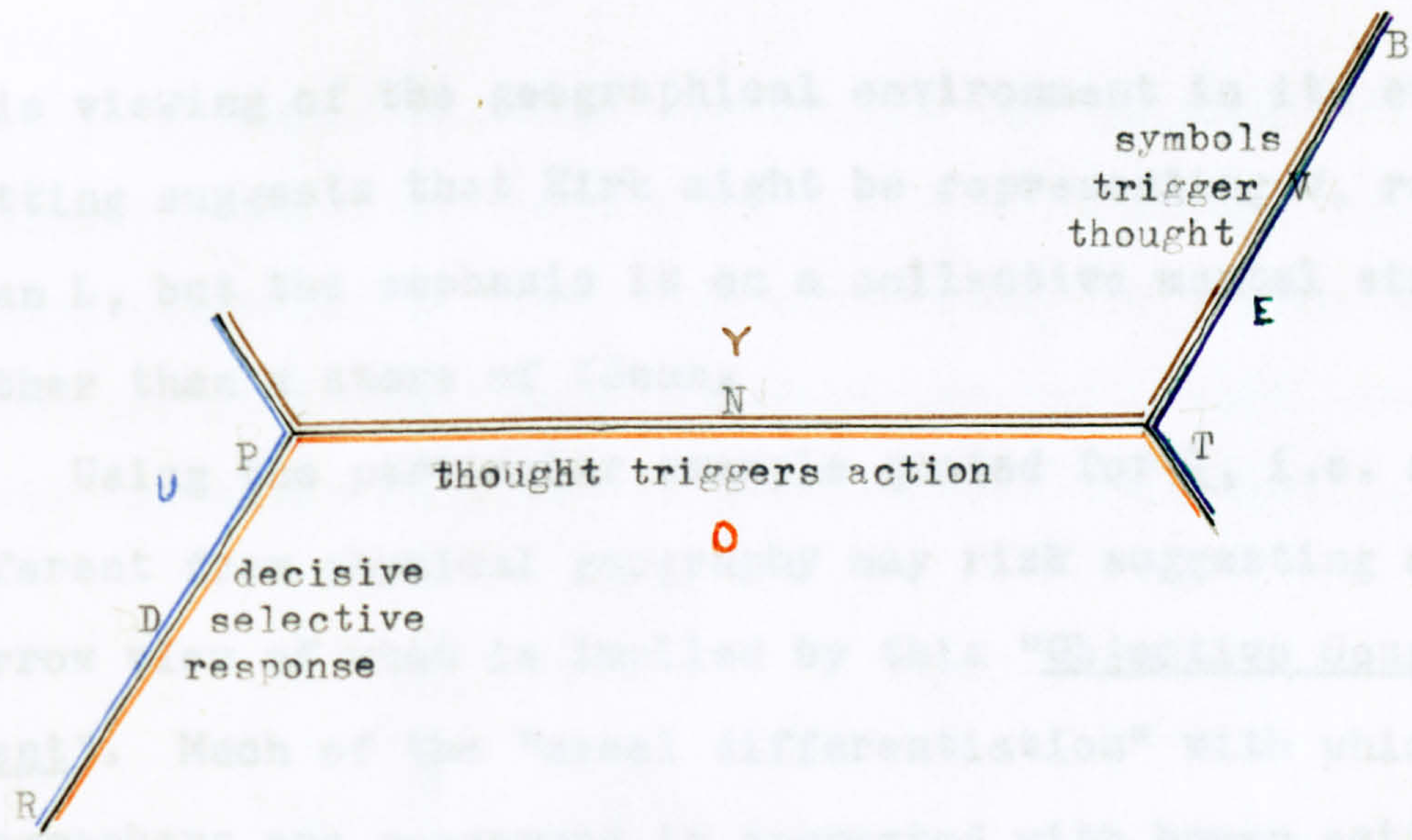


Fig. IV.8.

Thus symbolic expression, i.e. "a young valley" prepares the response; we may well see what we expect to see. However to present vectors thus is simply to isolate them for introduction of some verbal indicators; their functional relationships will be dealt with below.

Within the discipline of geography, then, the actual phenomenon may appear heavily loaded with prior assumptions. Kirk (1963) emphasizes this in his article which deals with the methodological problems of geography, and he uses the Gestalt psychologists' concept of the Behavioural Environment to explicate it.

> "Facts which exist in the Phenomenal Environment but do not enter the Behavioural Environment of a society have no relevance to rational, spatial behaviour and consequently do not enter into the problems of the Geographical Environment".
> (Kirk, 1963. IV.23)

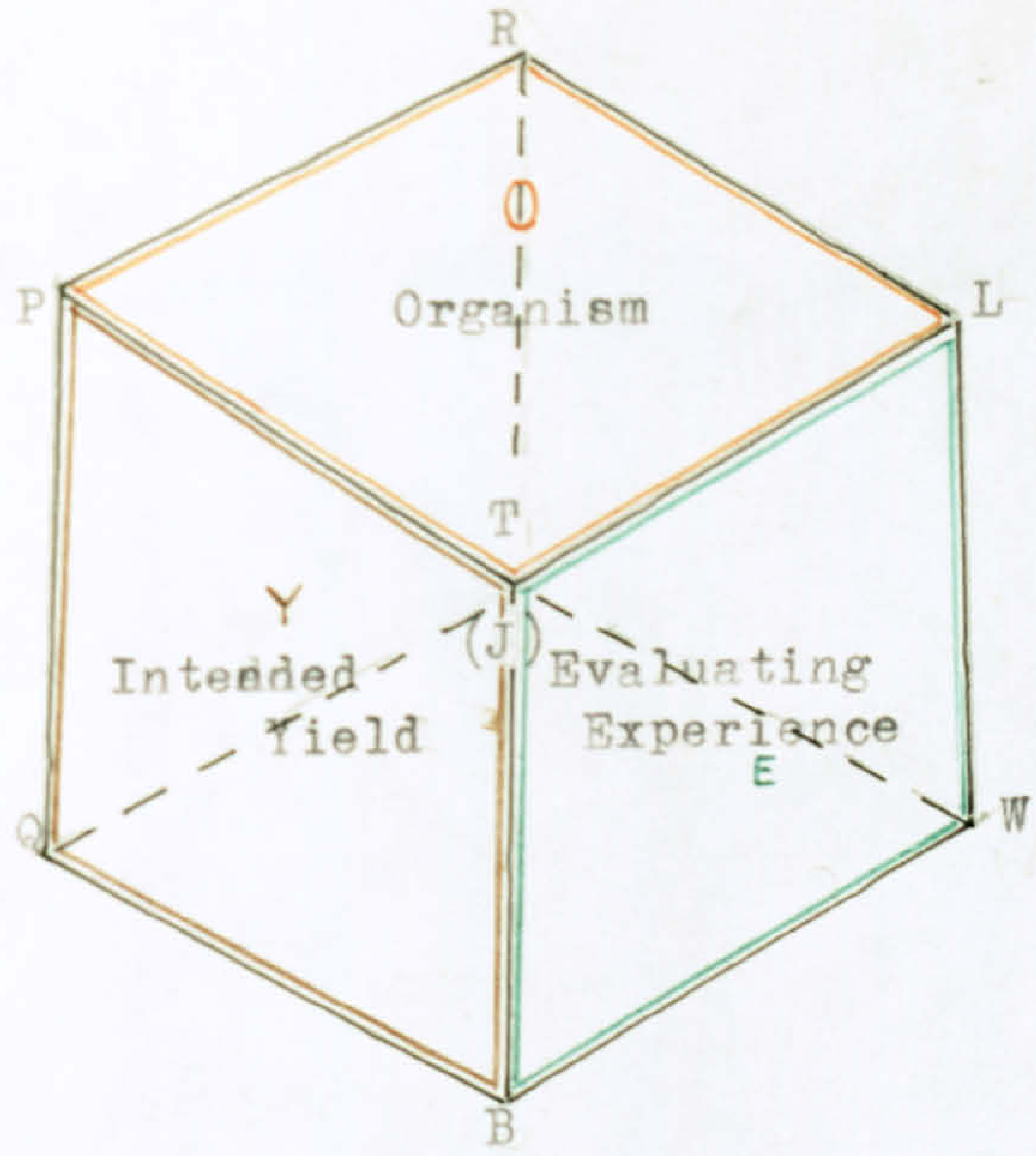
This viewing of the geographical environment in its cultural setting suggests that Kirk might be representing W, rather than L, but the emphasis is on a collective mental structure rather than a store of ideas.

Using the particular example quoted for J, i.e. a referent from physical geography may risk suggesting a narrow view of what is implied by this "Objective Source Event". Much of the "areal differentiation" with which geographers are concerned is connected with human activity. "Theoretical formulation events" are concerned with "Minding" (TJ) both physical and human events. While cognitive "Models" are plainly important, the value-judgments of the Behavioural

Environment cannot be ignored. Buchanan's (1962) article has been selected to represent this facet of the geographer, because he says,

> "A geography conceived as a "study of areal differentiation" or as "a study of the discovery, identification and explanation of earth patterns" is no longer satisfying, for such a study cannot give adequate weight to the accelerating, expanding, and planned transformation of the environment by man. Above all, it provides a completely inadequate basis for the interpretation and understanding of the geography of those socialist and planned societies.... which today contain one-third of humanity."
> (Buchanan, 1962. IV.24)

What is attended to, what appears as the geographer's responsibilities in society is going to influence his conceptual models. More than that even, for in the Soviet Union physical and human geography are kept apart because their synthesis is alien to Marxist political theory.



The skeleton Cube showing orientation on the <u>Minding</u> oppositional axis sums up the Motivated Geographer.

Fig. IV. 9.

Finally we may take a look at the Geographer as the Organism centrally placed with regard to the Environmental Incidents to which he attends, by projecting on to the surface O, in Figure IV.10. p. 75.

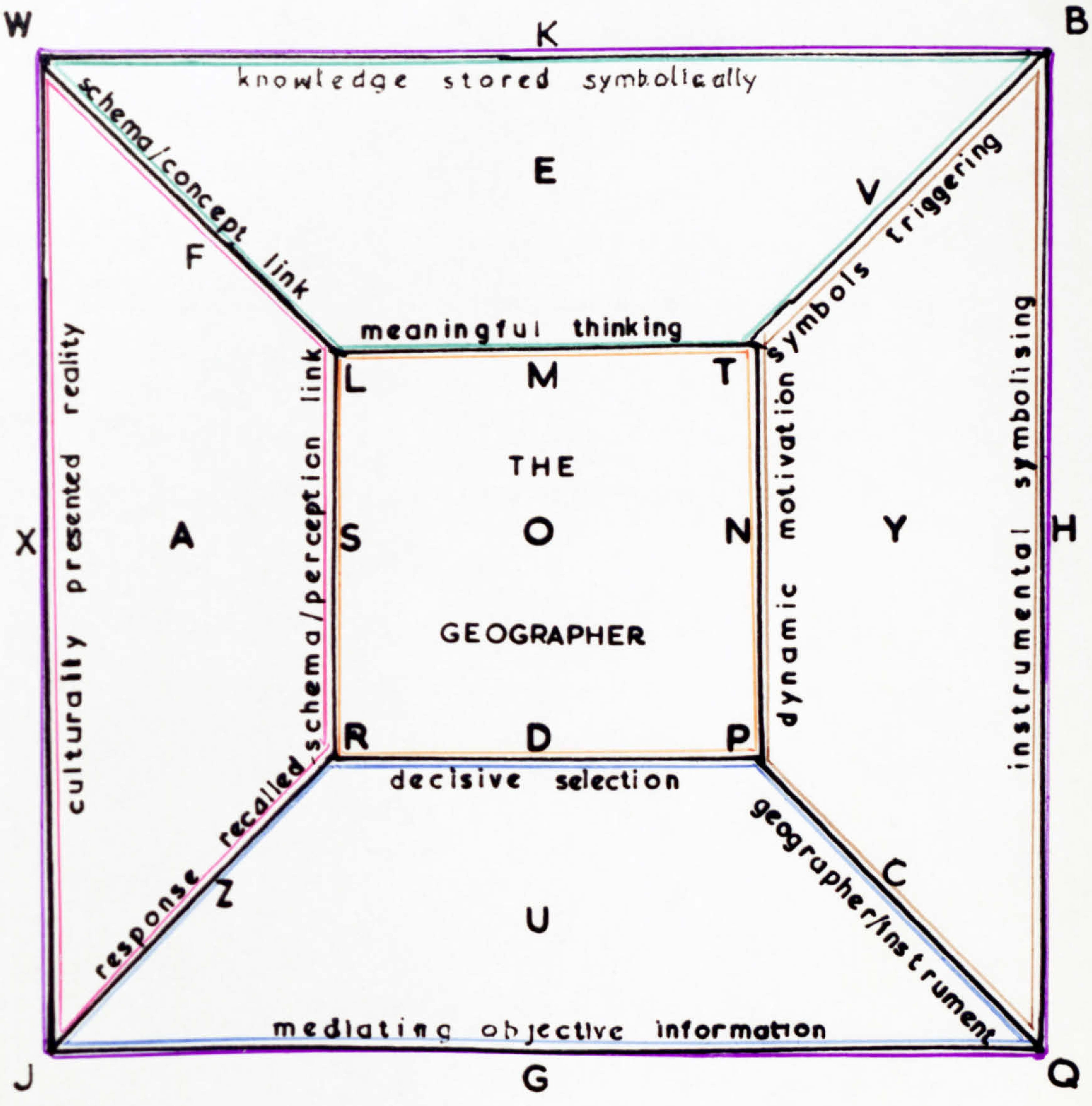


Figure IV.10. The Geographer looks at his environment.

CHAPTER V

SELECTION OF CONCEPTS FOR THE PURPOSES OF THIS STUDY

Returning to the basic reference of this study from the previous excursion into the minds of academic geographers, it is the direct contact with the external referent of landscape with which we are particularly concerned, and the recall of experience, i.e. dominance of the "Minding" (TJ) Oppositional. Let us start from experience therefore in considering types of concepts.

Going out into an urban landscape, we walk along a road and see detached and semi-detached houses of varying design, and we say, "this is a post-war residential area of the town", or, alternately, we walk along a street and see small terraced houses, and say, "this is a mid-nineteenth century working class area of the town". The perceived details of the houses have been sorted out by classifying their assembled attributes, and putting the houses in classes, but this in only part of the categorization of our observations, enabling us to arrive at the statements above. We have also a notion of "an area of the town"; the "town" is a more complex concept than a "house", but "an area of the town" implies that we are describing our observations in relation to an implicit mental map of the town. This is a localised example of the geographer's basic concept of "Areal differentiation".

This might be considered basically topological, but it becomes more complex if we refer back to Ackerman's summary of the dimensions of geographical thinking, for it has three aspects,

a) the concept of area, of <u>extent</u>

b) the concept of the distribution of the <u>density</u> of housing.

c) the concept of the <u>succession</u> of building periods in the town.

The identification of these "areas of the town" itself takes place within the sphere of a concept of "Urban Geography" - coupled perhaps with another major concept, "The regional geography of the West Riding of Yorkshire". Now we started this example at the very bottom of the G-scale (p. 56 above), and we have skimmed through a hierarchy within the subject, at the same time moving up the G-scale at least to county area. If we are going to have some manageable material we are going to need some phenomenal concept which can carry a load of <u>organisational</u> concepts. The tabulation cited below provides a useful example of major concepts with which we may find ourselves involved.

1. <u>Global ism</u>: the earth as a sphere
relationship to the solar system
scale
grid.

2. <u>Diversity</u>: pattern
(Variation) areal differentiation
regionalisation - (phenomenal
(functional

3. <u>Spatial Location</u>: position
(Areal)
site
situation

4. <u>Interrelatedness</u>: areal association

spatial interaction - (circulation
(trade
(migration
(diffusion
(interdependence

5. <u>Change</u>: sequent occupance

process (physical
(biological
(social

6. <u>Cultural Regions</u>: "way of life"
(Steinhauser, 1967. V.1.)

This particular tabulation is influenced by its context, i.e. American geographic education, but nevertheless provides a useful array of organisational concepts for general application.

The concept of a geographical feature which is to serve to carry the general conceptual load reflects in its selection the personal geographical schemata of the author and the geographical environment in which she works. This concept is, <u>VALLEY</u>. The development of the outlook of geography teaching in Britain has already been referred to in Ch. II above. The latest developments, i.e. the use of quantitative methods and of models, have appeared in the epistemic "translations" of geographical concepts because of their affinity with psychological model-building, but this is all <u>P-C-Q</u>, instrumental control emphasis. <u>W-F-L</u> - the socialised concepts, which have been stored longer in the traditions of the discipline and in the minds of teachers and pupils now emerge in selection.

The elements may be summarised thus:

1. The earlier research work with students on their use of concepts related to a valley situation, although this was incidental rather than intentional.
2. The author's own geographical studies provided particular expertise on valley situations. (Hannam, 1954. V.2.)
3. Bradford and the surrounding area of the West Riding of Yorkshire provide a physical context in which valley situations are inescapable.
4. The valley lends itself to the naive conception of a unit which is "natural" and within which human activity has developed; and this can be found clearly and concisely expressed in geographical literature.

Two other concepts, PATTERN OF SETTLEMENT and LOCATION have also been selected as major components involved with VALLEY in the form of the investigation, and providing three types of concept:

1. 'Physical', i.e. VALLEY

it is identifiable as J, i.e. "an event in the physical environment". It can be pointed out on the earth's surface and can enter into direct perceptual experience events in vision, and if sufficiently marked in slope character is appreciated kinaesthetically in everyday movement.

2. 'Human' i.e. PATTERN OF SETTLEMENT

it is identifiable as LJ, the diagonal of the Cube surface A (Associational), since it signifies a schema for viewing selected phenomena. It is something which can be pointed out from a convenient hilltop or from a helicopter, and can be seen best on a map. It is not, like valley, an everyday term used in common language. It involves the "principle" of "areal differentiation", i.e. a recognisable part of the discipline of geography. (Gagné 1966 op. cit., in distinguishing disciplinary "principles" from "concepts", says that he is using "principle" for what Berlyne calls a "transformational" concept).

3. A "Principle" or Transformational Concept - LOCATION it is identifiable as L - a schema - but rather as the neighbourhood of L, not simply the point. Taken specifically geographically, it implies position in terrestrial space, i.e. on the earth's surface (or in relation to a location on the surface, as of an ore body below the surface, or a meteorological "warm front" above). Given as No. 3 in Steinhauser's six major concepts tabulated above (p. 77-8), in operation it is strongly connected with No. 2 (Diversity) and No. 4. (Interrelatedness)and is always relational.

The Concept of VALLEY

Hartshorne wrote,

> "While landforms appear to be one of the most readily observable phenomena, they are at the same time one of the most extraordinarily complex. The configuration of the land is arranged in countless features, none sharply delimited from another, and all varying in size and in the three dimensions of shape. Further, these landforms features vary in texture of surface materials

and in structure of underground materials.
Finally, the location of the diverse features
in relation to each other, the areal distribution
of different kinds of landforms, constitutes a
complicated pattern of significance in geography".
(Hartshorne, 1959. V.3.)

In view of such complexity the task of investigating such a concept as "valley" would appear to be formidable. But we have already seen in Chapter II that in geographical education such concepts are presented to and have to be employed by the pupils. To look for L, the personal schema is the task of the investigation, but meanwhile, can we take something from W to represent the socialised concept? Using hindsight after interviewing subjects, it is evident that there is something in the nature of a "model valley" which is being employed. Since the development of geographological ideas has been written up at least to the time of the emergence of the critical version of the socialised concept, (Chorley et al, 1964. V.4.) we are able to see how the collective body of past observers gradually arrived at some organisation of their impressions of the complexity of landforms.*

It will be far enough to go back briefly to the sixteenth century to note that Leonardo da Vinci with his artist-engineer's eye looked clearly at what was before him and saw the significance of river erosion and the character

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* Despite the view of Hartshorne that generic rather than genetic concepts are important to the geographer, in this case the genetic concept is prominent.

of landscape evolution. But few of the observers of landscape, not only in the sixteenth century, but indeed up to the mid-nineteenth century, saw what seems so obvious to present-day geographers. One of the greatest problems was religious - the story of the Creation of the world in six days - even if the six days were taken as figurative. The concept of the Flood led to explanations in terms of the action of ocean currents in forming valleys. The existence of widespread gravel deposits, now recognised as fluvio-glacial, encouraged this tendency. The Church's decision that the date of the Creation was 4004 B.C. provided a worse problem, for how could rivers, or ocean currents, have eroded large valleys in the time available? Catastrophic splitting open of chasms had to be conceived. When the former extent of Glaciation was hypothesized the idea had to do battle with the marine and fluvial enthusiasts.

European geographers and geologists were faced with a complexity of detail in their native landscapes which became matched by complexity of theories. Increasing accuracy of the measurement of the material carried by rivers, and experience of rivers in tropical climates, however in the mid-nineteenth century led to an increasing appreciation of their importance in landscape sculpture. But the achievement of more order in the chaos of ideas was closely associated with advances in the geographical knowledge of the western parts of the United States. A significant point in the story was the navigation of the Colorado Grand Canyon by J.W. Powell in 1869.

"Here in tremendous magnification were the answers to the doubts that had been troubling European geologists for a century".
(Chorley et al, 1964. V.5.)

The simplicity of rock structure and the exceedingly rapid river erosion in an arid area made clear the forms that elsewhere were masked in confusing complexity. Powell saw the gradual rise of the level of the land as the key to the landforms and produced the concept of the base level to which the rivers were cutting down. His assistant Gilbert added to this the Concept of "Grade" (the ideal long-profile of the river-bed). Both of these concepts were taken up and bound into the major systematizing concept of the "cycle of erosion" propounded by W.M. Davis, the creator of coherence in the concept of landform development.

Davis, who became Professor of Physical Geology at Harvard, not only produced a coherent, compelling ideal landscape model, he also happened to live at a time when communication of ideas through scientific journals was becoming more efficient. Also the lively anthropomorphic language in which he described the cycle - through youth (active rivers cutting down their valleys, to maturity, to old age (denudation to base level) - helped to fix the concept in the mind and to make it an important vehicle for geographical education;

"Once established, an original river advances through its long life, manifesting certain

> peculiarities of youth, maturity, and old age, by which its successive stages of growth may be recognised without much difficulty".
>
> (Davis, 1889. V.6.)

In speaking of <u>river</u> stages, he is inevitably speaking of the <u>valley</u> stage characteristics associated with them. Davis himself makes clear, however that only in some instances will the model fit well with reality,

> "It is only during maturity and for a time before and afterwards that the three divisions of a river commonly recognised appear most distinctly; the torrent portion being the still young headwater branches, growing by gnawing backwards at their sources; the valley portion proper; where longer time of work has enabled the valley to obtain a greater depth and width: and the lower flood-plain portion, where the temporary deposition of the excess of load is made until the activity of middle life is past".
>
> (Davis, 1889. V.7.)

1889 may seem a long way back to go within the geographical tradition, but the concept of the valley stages is still with us, and though battered by criticism* at the academic level it still remains a strong element in school textbooks

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* The nature of this criticism is reviewed in an article by R.J. Chorley 'A Re-evaluation of the Geomorphic System' of W.M. Davis, Ch. 2. in 'Frontiers in Geog. Teaching' ed. Chorley and Haggett (1965). See also Dury (1966) 'The Concept of Grade' in Essays in Geomorphology. (ed. Dury)

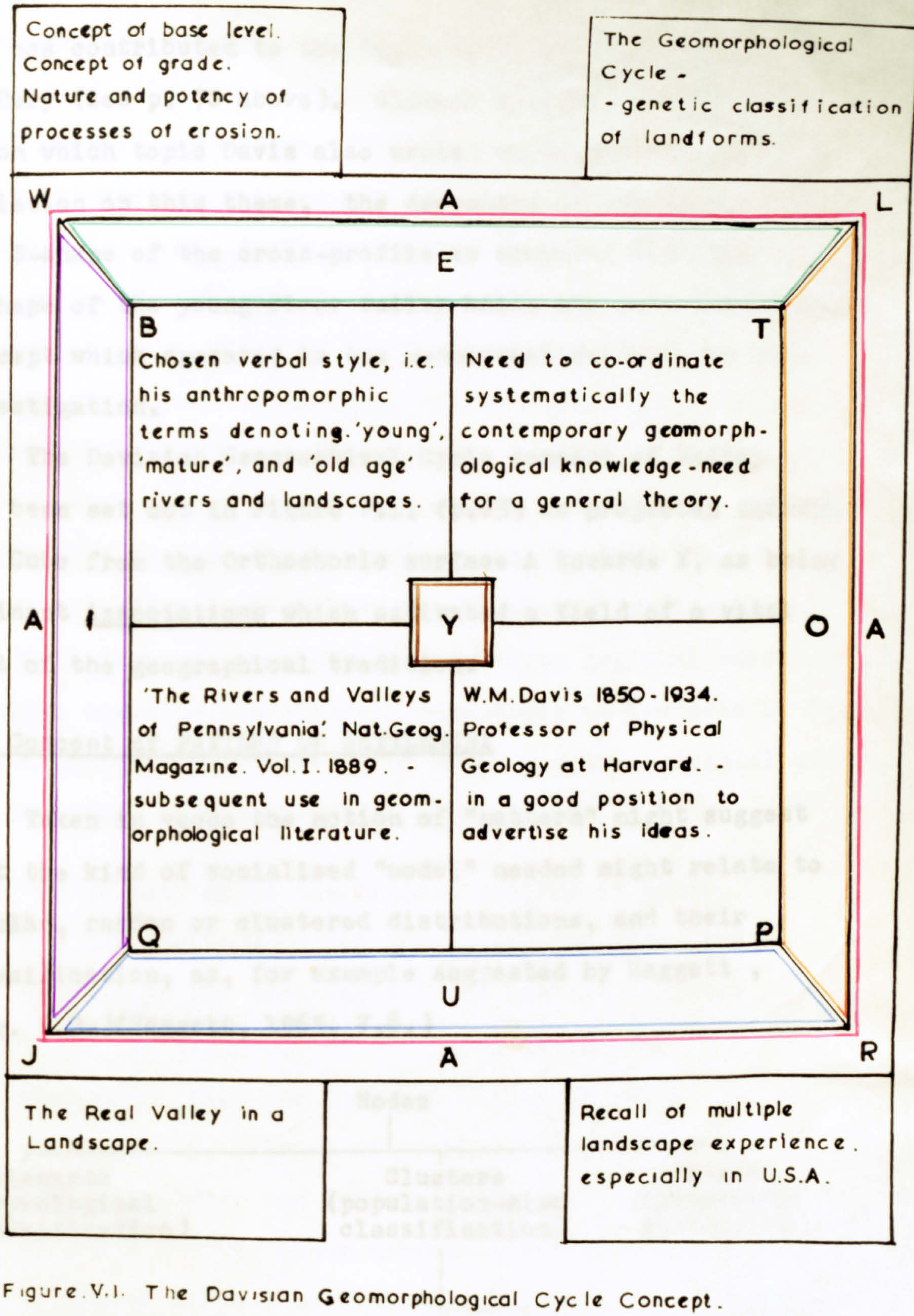

Figure.V.1. The Davisian Geomorphological Cycle Concept.

(it has contributed to the "mythical river" complained of by Dury (see p. 70 above). Glacial modification of valleys (upon which topic Davis also wrote) appears as the main variation on this theme, the deepening of the valley and the U-shape of the cross-profile as compared with the V-shape of the young river valley being the most fundamental concept which appeared in the conceptual evidence in this investigation.

The Davisian Geographical Cycle concept of Valley has been set out in Figure V.1. (p.85) as projected through the Cube from the Orthochoric surface A towards Y, as being dominant Associations which activated a Yield of a vital part of the geographical tradition.

The Concept of PATTERN OF SETTLEMENT

Taken in vacuo the notion of "pattern" might suggest that the kind of socialised "model" needed might relate to regulàr, random or clustered distributions, and their Classification, as, for example suggested by Haggett , (Fig. V.2.)(Haggett, 1965. V.8.)

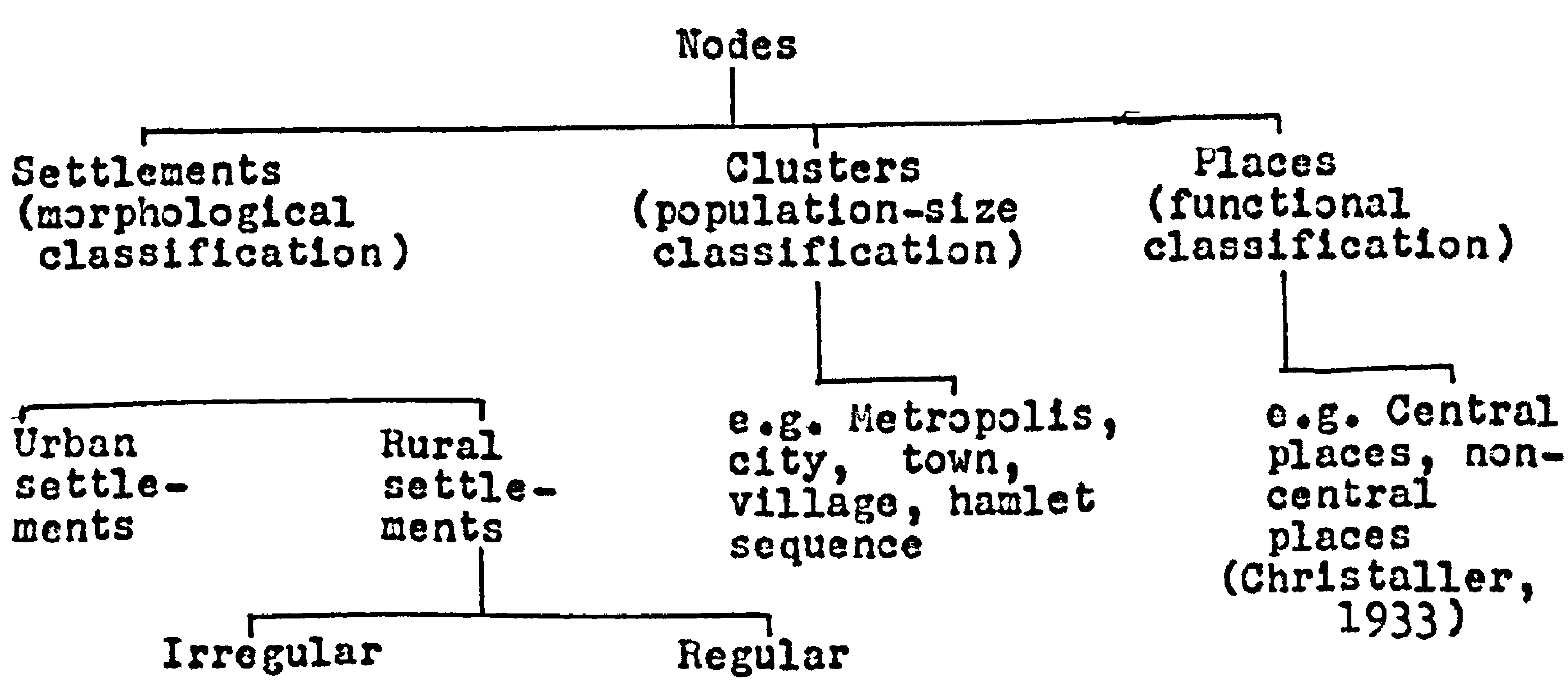

Fig. V.2.

While this is very relevant, in this context the pattern is associated with a particular landform pattern, so we also need a model of "pattern-of-settlement-in-a-valley". For the close interaction between man and his environment and its presentation in a lively compelling manner we might look back to the French school of geographers, and the "personality" of regions (e.g. Vidal de la Blanche (1922),* but for our particular purpose of an ideal valley settlement Patrick Geddes (1954-1932), provided us with the "Valley section". Geddes, like Davis, was an integrator, a seeker for coherence, though this time in the biological-sociological field. Though himself a biologist he contributed significantly to the discipline of geography in developing regional survey methods, based on the general conceptions of Frederic Le Play. He was convinced that the river basin was the essential unit for the study of Place-Work-Folk relations,

> "At or just above the highest springs of water are the workings of the quarry and the mine, the uplands of the forester and the hunter: a little lower the highlands of the herdsman and the shepherd: then the pastoral hill-sides with their crofts, patches of arable land and sparse hamlets, before the descent to the more prosperous villages and the minor market, situated where highlands merge into lowlands. Between those centres, each at the foot of a glen with its

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* Vidal de La Blanche. Principes de la geographic humaine. Haggett (op. cit. P.3.) speaks of the "heritage of Biographical regional studies".

tributary stream, stretch the broad farmlands centred in their market towns: and a day's march farther down the meandering river we reach its junction with other tributaries from other valleys. Here we find the large country town: and finally, where the winding river broadens into the tidal estuary, stands the great manufacturing city, with its port which is in some degree a market of the world, and beyond this, on the coast, are the smaller fishing havens. This descent, from source to sea, epitomized the underlying realities which, with all their variations and exceptions, are the most abiding influences upon the character, possibilities and limits of all human societies".

(Beaver, 1962. V.9.)

Beaver says,

"Whether our students have ever heard of Le Play and Geddes or not, unless they are dyed-in-the-wool geomorphological specialists, the greater part of the field work they do will be moulded in essence on Place-Work-Folk, as adapted and enriched by professional geographers during the last forty years."

(Beaver, 1962. V.10.)

In view of the kind of settlement/valley personal concepts which were brought to light in this investigation, Geddes' settlement/valley concept as expressed in the quotation from Mairet provides an important referent (Geddes' LJ association having been transformed into W-X-J - socialised-concept-mediating- environment - as Beaver says in the quotation above). Although appearing as a general "model", the Valley section, like the physical valley of the Geographical cycle, has roots in the landscape experience of its creator and his selection therefrom. The "valley section is shown in Fig.V.3 on the same Orthochoric projection as that used for the Geographical Cycle (Fig. V.1. p. 85.)

The Concept of LOCATION

Because the concept of Location is a pervasive element in all geographical thought and because of the great variety of its expression in the personal concepts investigated, there is no socialised conceptual source which can be identified as significant background. The Valley section of Geddes of course carries within it a strong locational element in relation to placing of certain human activities within the valley framework and in this sense may be regarded as illustrative of the Location concept also. Given in descriptive terms, however the concept is blurred. For evaluation of individual concepts Haggett (1965, op. cit. Chorley and Haggett 1967) can provide more background. Without going into academic analysis irrelevant to the level

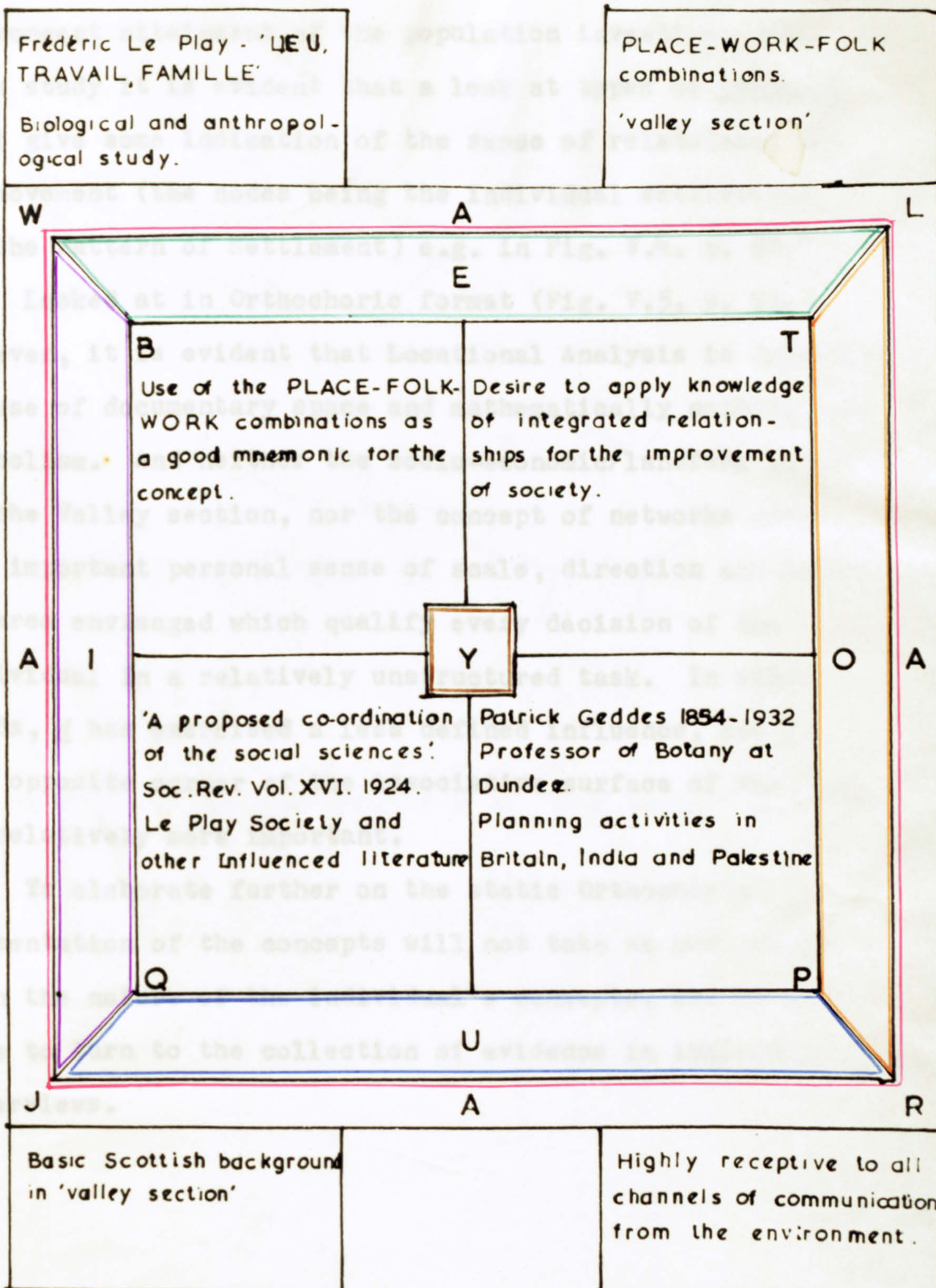

Figure. V.3. Geddes' PLACE-WORK-FOLK in the 'valley section' Concept.

of concept attainment of the population investigated in this study it is evident that a look at types of <u>networks</u> will give some indication of the sense of relatedness and of movement (the nodes being the individual settlements of the Pattern of Settlement) e.g. in Fig. V.4. p. 92.[x]

Looked at in Orthochoric format (Fig. V.5. p. 93.), however, it is evident that Locational Analysis is dependent on use of documentary space and mathematically sophisticated symbolism. And neither the socio-economic/landform relations of the Valley section, nor the concept of networks cover the important personal sense of scale, direction and extent of area envisaged which qualify every decision of the individual in a relatively unstructured task. In other words, <u>W</u> has exercised a less defined influence, and <u>R</u>, the opposite corner of the Associative surface of the Cube is relatively more important.

To elaborate further on the static Orthochoric presentation of the concepts will not take us much further with the nature of the individual's concepts, and it is time to turn to the collection of evidence in individual interviews.

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[x] Chorley R.J. and Haggett, P. (ed.) Models in Geography. Methuen. London 1967. Fig. 15.10. p. 625.
Simulated road and rail networks given in the same chapter illustrate similar concepts.

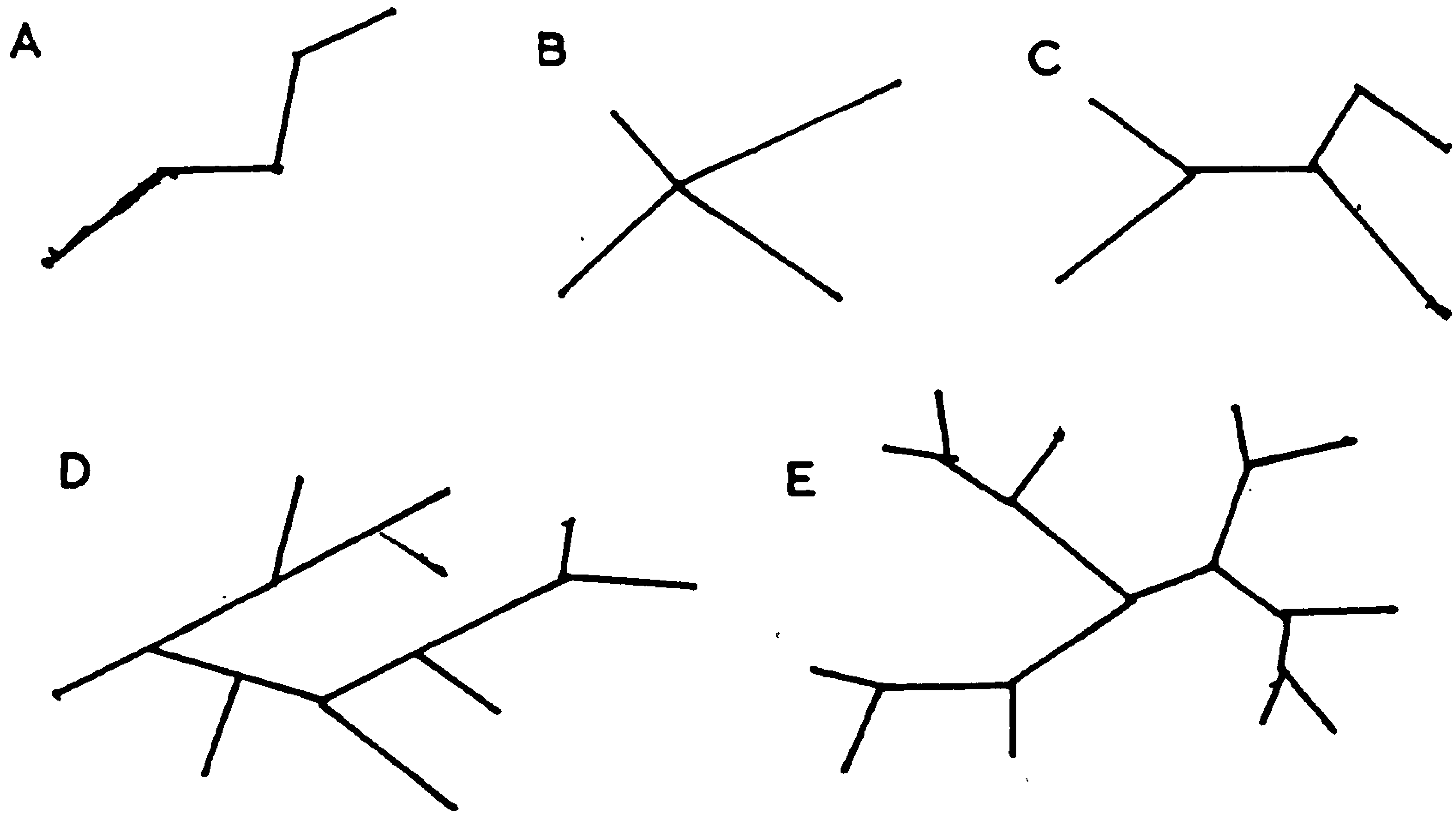

Figure V.4. Alternative geometrical forms of 'tree' topologies (Source, Ore 1963)

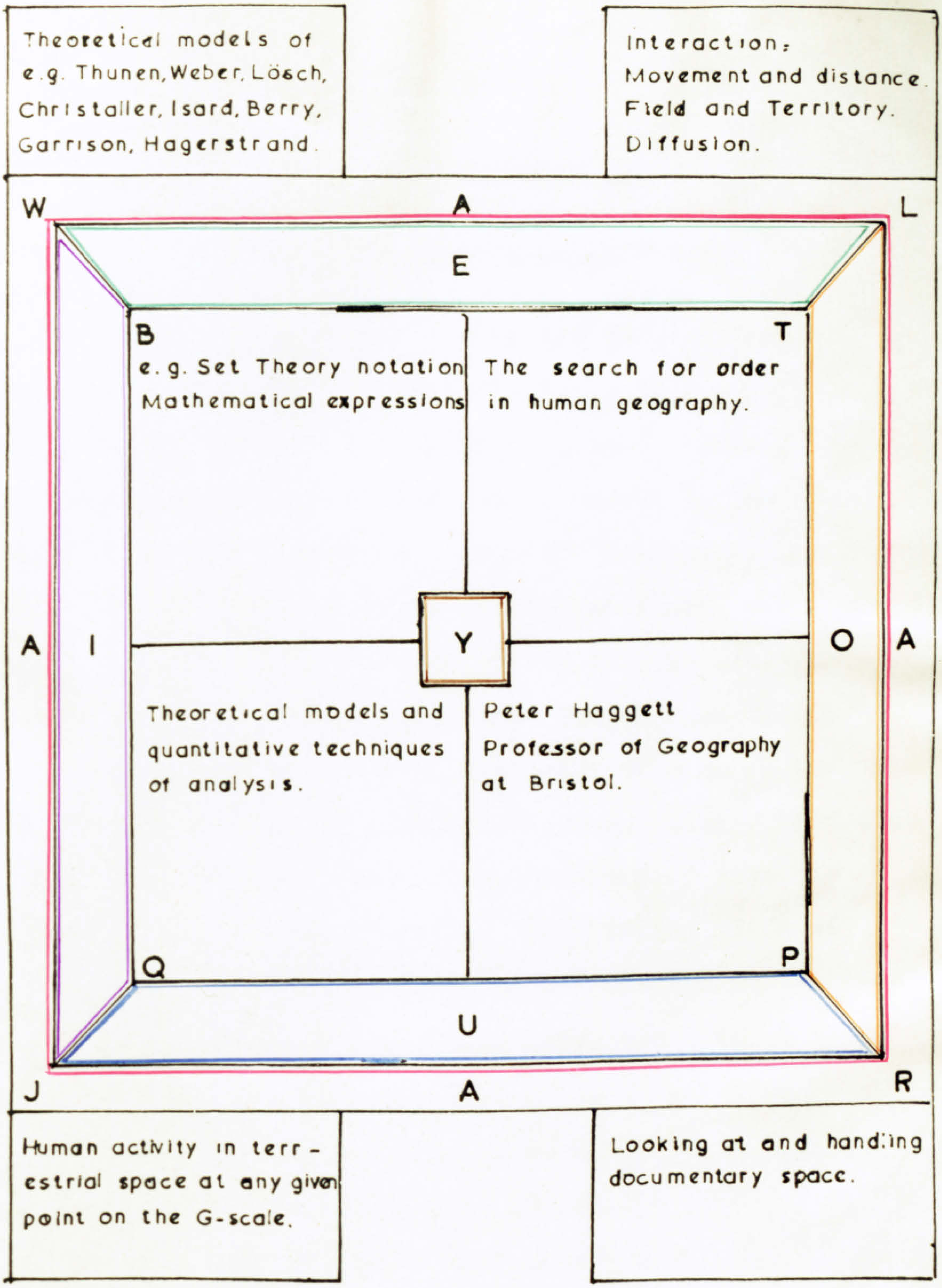

Figure V.5. Locational Analysis Concept.

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CHAPTER VI

THE INVESTIGATION OF INDIVIDUAL SCHEMATA RELATING TO THE SELECTED CONCEPTS

It was desired to sample a wide age range of subjects, from primary school age to adult students, if possible, and this aim in itself posed a problem of method. Purely verbal interviewing would only extract such elements of the schemata as could be expressed verbally. Picture interpretation though it can be revealing, is a skill in its own right, and with a wide age range the limitations of the younger children (cf. Long, 1953, op. cit.) would make comparisons difficult. Map reading again might lead to dominance of a skill and would be useless with the younger children. Direct landscape interpretation involves insuperable problems of time and organisation of individual visits. Even in the study of students' landform concepts in which a landscape was visited, for individual interview a sandtray model was used as an intermediary for landscape recall.

Some situation was required which would be as neutral as possible in its Q-element, i.e. equipment; the previous use of the sand tray suggested this as a useful tool; slightly damp, loose sand does not suggest any given form and it provides another means of expression of land form other than verbal or diagramatic. It could be used for any age group. So could moddelling clay, but this takes longer to handle, and eventually was used only for drawing patterns with a wooden tool. With these two media it could be expected that the individual could make non-verbal representation of his VALLEY concept.

For the associations of human activity and its patterns, however, some kind of 'given' landscape was desirable as a standard starting point as least. So a very simple polystyrene valley model was constructed. It showed a valley deeply incised into a plateau, with one tributary entering it, and opening out somwhat at its lower end. A river and tributary were indicated, but there was no other elaboration. No colour was used lest this should be too suggestive of anything beyond surface form (only in one case did the white plaster finish suggest snow cover to a subject). It was quite a crude model originally intended as a try-out, and a second larger model with more detail and less definition of a specifically highland environment was made. Also for a pilot test, some triangular markers were made of cardboard, and strips of tape of various lengths were cut to use for roads.

A small group of children of ages ranging from seven to fourteen years were interviewed at a private school which was chosen because of the extent of age range easily tapped. The simple model was used, and the sand tray, but not the modelling clay. The trial suggested that this type of interview pattern was going to provide the material needed, and certain points emerged.

1. It would be possible to start at the lower end of the Junior school; it had previously been doubted whether it would be worth while to extend the age range so far down.

2. The simple model had many possibilities and would probably be more suitable than the large more elaborate one.

3. The simplicity of the triangular markers was an advantage; they could stand for one house, a village, or a town, and there was no need for anything more elaborate; the younger children had no difficulty with such a simple symbol.

4. There was a marked reference to personally experienced landscape, implicit or explicit.

5. In a fifteen minute interview considerable ground could be covered; beyond this, in fact, there might be a danger of going on to ask questions which were too directive in character.

6. The younger children were not likely to be able to model a valley, but they could use the given model.

7. Using a tape recorder and prepared basic diagrams to record details of modelling in sand and placing of markers on the model a sufficient record for subsequent analysis could be made.

A preliminary format for analysis was also tried out, but not yet formalised,,as it was only after comparing judgments made on a much larger number of interviews and much reviewing of them that a basis of confidence in decisions was reached.

Selection of the Interviewed Population

It must be emphasized that the analysis of concepts and the nature of concept variation was at issue, and the development of the concepts, not their relationship to any specific inferred abilities or specific circumstances of educational situation of the individual. Variation amongst the population was sought rather than any kind of standardisation. There was a minimally structured interview which was intended to undergo a great deal of Epistemic processing out of which might emerge some significant patterns, rather than the placing of individuals on a scale, although it was possible that some relationship to the Piagetian stages might appear.

Thus while a chronological age range was covered, on the human side, on the environmental side there was a very important element, at least for the school population, which governed selection of groups. To ensure that it was possible to identify the J-element, i.e. recalled direct landscape experience, it was necessary to select schools in a marked valley situation; then it would be possible to hope to distinguish the implicit as well as explicit reference to the background experience of everyday living. This was far more vital than any other possible criteria on the educational side for the selction of schools.

Bradford is a city which has incorporated many hamlets and villages which were sited on the spurs and slopes above the streams which flow down to join Bradford Beck. These "villages" are still identifiable and important in the city's social geography. Modern housing estates are also on the slopes, and the valley bottoms are either industrial or (farther from the centre) open spaces. Schools are therefore perched on the valley slopes, but where the surrounding area is densely built up, or where there are gentle plateaus on the interfluves, the valley need not be obvious in the circulation of people in their everyday affairs. Care was taken therefore to choose schools where the valley was more likely to be appreciated.

With the youngest age group, the Junior school children, it seemed unlikly that they would be aware of the major landforms, so a situation was looked for where there was a stream at the bottom of a distinct valley, and where they were likely to go and play. This situation was satisfied at Eccleshill North Junior School which is situated in a housing estate which lies on a sloping plateau above Fagley Beck. This is outside the basin of Bradford Beck: in fact the city boundary runs along the beck, the far side being "green belt" - a hillside too steep for building in parts of it in any case. The beck is incised within a larger valley, so that there is a narrow inner valley below the estate. This inner valley is full of minor geographical features, so that the estate children, although belonging to an area which might be regarded as disadvantageous socially and culturally in the city's pattern, were rich in semi-natural environment (the odd decaying car in the woods not being sufficient to spoil the situation).

To find a Junior High School (11 to 13 years) was not so easy; it was not essential to have a valley bottom so accessible, but they tended to be sited in the older built-up areas or else where there were flatter plateau sites. It was decided to use Hutton Junior High School, which is also on the slopes above Fagley Beck, but on the upper slopes on the fringe of the old hilltop village of Eccleshill. It

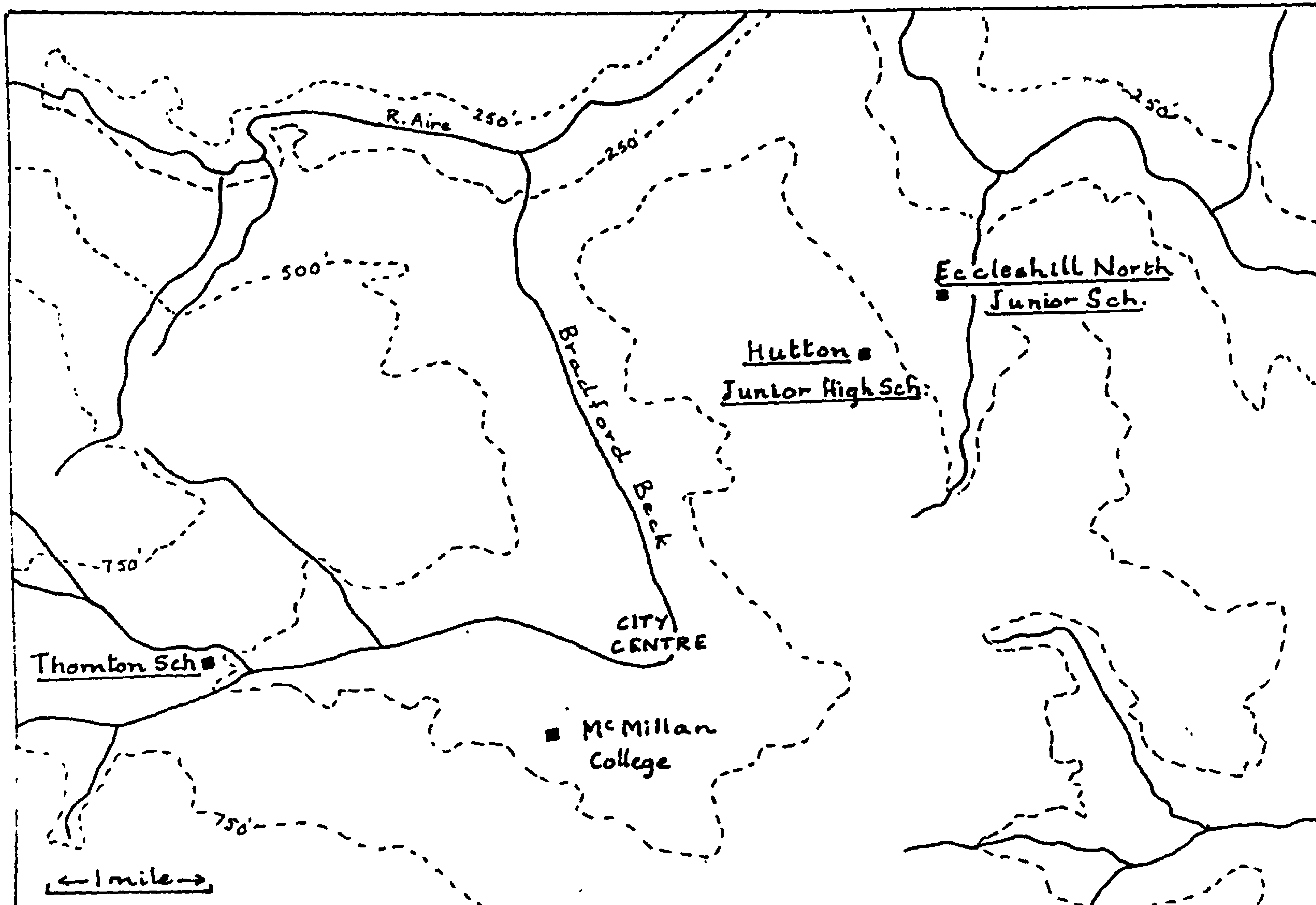


Figure VI. 1. Positions of Bradford Schools used looks right across the valley and is built on a very steep slope, but some of the children live on the plateau area above. However it seemed reasonably suitable and did have the advantage of having a catchment area which included that of the Junior School being used.

For the thirteen-plus school population there was no doubt of where the best valley situation was to be found, i.e. at Thornton Grammar School, which looks down on to Upper Bradford dale, on the western side of the city, where Clayton Beck (the upper part of Bradford Beck) is still flowing in an open landscape of rural aspect, the villages of Thornton and Clayton being separated by the empty steep-sided lower slopes of the valley.

The lower forms of this school are less selective than the upper forms, but in any case the fifth and sixth formers interviewed were self-selective in having chosen geography as an examination subject. In the Junior and Junior High School the subjects were picked by random numbers from the complete school roll, only taking care to have equal numbers of boys and girls in each age group. At Thornton School they were picked randomly from middle stream forms (a compromise with a more difficult situation in which to arrange interviews). Sixth form numbers were too small for random picking to make sense, and instead they were selected to include both some who were highly motivated in the sense of aiming at university entrance, and those to whom geography was just another subject they happen to be taking (estimate of their teacher).

So much for the school population; there remained the student population of the author's own college, which of course had a more diverse background of landscape experience - and of school experience. The first year students, with which the author was not acquainted (being on study leave) were used, picked randomly to some extent, but ensuring equal numbers of men and women and also of local and non-local origins. The "mature students", so classed for this purpose as over the age of thirty, were all interviewed, as it was felt that having all spent a considerable time working in a variety of jobs since leaving school, they would form an interesting adult group. The students were interviewed when they had been at college for about half a term, long enough for them to settle down, but not long enough for them to be markedly indoctrinated by the college geography course. It has to be recognised, however, that they were probably more motivated to search into their own concepts than the school population.

Using individual interviewing, and taking into account the detailed analytic processing which every interview record would undergo, numbers from each age group were kept low. The subjects were regarded as individual cases, not necessarily "typical", but overall of course there is an age progression within broad bands.

The numbers were as follows:

Mature Students (30-39 yrs.)	7
Normal Age Students (18-20 yrs.)...	9
Grammar School (4 of each age group except for Lower VI - only 1)	17
Junior High School (6 of each age group)	12
Junior School (4 from each age group)	16
	61

The Grammar School subjects were interviewed first, starting with Form III and working upwards to the VIth form, as far as possible, but as interviewing had to be fitted in to the lunch hour, subjects were taken from various forms as they could be fitted in. With the younger age groups in the Junior High and Junior Schools, the progression of interviewing was downwards in age. The same form of interview was maintained to the end of the Junior High School, but in the Junior School some adaptation was necessary, e.g. as expression of the valley concept began to fail, discussion was continued in terms of hills and streams, and instead of using Aloplast modelling clay for showing a valley pattern it was used to illustrate stream details. At the other end of the scale, the students were also shown the larger model to allow them to expand their ideas further.

The final Form of the Interview Situation

When a subject came into the interview room all apparatus was covered up.

Introduction Good morning, X, come and sit down.
I am going to ask you about some things connected with geography. It is not a test, I just want to find out what sort of ideas you have about some things which you can see for yourself as well as learning them in class or from books. (slight adaptations according to age groups)

1. Verbal Definition

We are going to concentrate on things to do with valleys, so first of all, tell me quite simply what a valley is.
(supplementary questions) any more associations come to mind?

any particular associations with people?

any particular place in mind?

2. <u>Modelling in Sand</u>

A small sand tray was offered for demonstration of the valley as defined in (1). If guidance was asked for, the reply was, "this is your choice of valley" (this sometimes arose with the more knowledgeable who had a number of types of valley in their personal concept, though occasionally it might have been playing for time while the problem was approached: to the younger children sand was familiar, but some of the older school pupils were somewhat embarrassed by it as a medium of expression).

If verbal comment did not arise spontaneously it was elicited by questions such as,

"tell me about your valley"

"is this the whole valley?"

"would other parts be the same or different?"

"how might the valley come to be like this?"

or specific questions - what it is? what happens here? - where the sand model was not clear. It was important to avoid leading questions based on the interviewer's own assumptions about extensions of the valley as shown, e.g. does it continue <u>down</u> (or up)? thereby suggesting relationship to a longer valley in a particular direction.

Junior School children who did not respond to the concept "Valley" were asked to model a "hill", a concept which appeared earlier.

3. <u>Modelling in 'Aloplast'</u>

To try to establish how far the valley was thought of in an extended landscape a small 'dome' of modelling clay was offered - If this represents an area of hilly country descending in all directions, what sort of pattern of valleys might there be? It could be anything up forty or fifty miles across.

Though offered as a "pattern of valleys" this was likely to appear as a pattern of rivers, especially as they were asked to draw lines with a modelling tool rather than scoop out valley forms. As a simple form it was suggestive, i.e. of a pattern of radial drainage, which could result from studying the form and thinking about the likely behaviour of flowing water, or could result from learning the "socialised concept". It was predictable that some would say "as in the Lake District" (as standard textbook example): what was less predictable were some of the curious patterns produced even high up the age range.

At the lower end of the Junior High School (i.e. 11 years) it was evident that the lower limit of an idea of "pattern of valley" had been reached, so in the Junior school instead of a dome a flat surface of clay was used on which the children were invited to show details of their stream, drawing with a pointed tool.

3. Presented Model of a Valley Form (see Fig.VI.11 p. 106.)

This simple form has already been described on p. 89. above. It was interpreted as a wide range of environments ranging from the Alps through the Pennines to the Lincoln Wolds and the local environment of Fagley Beck. The most common locality identified was Wharfedale. It raises the question as to whether there was any area implicit in its

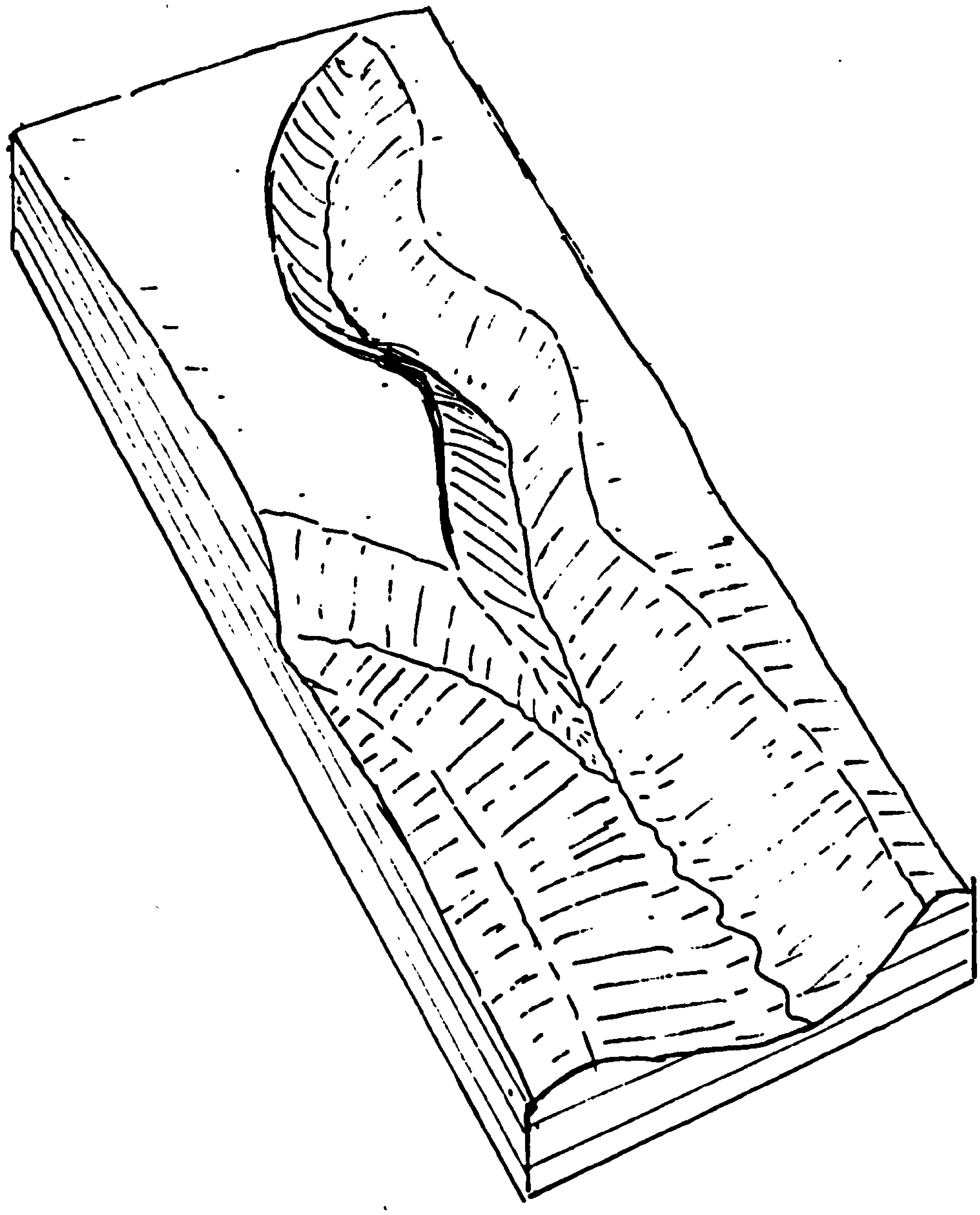


Figure VI.2. Sketch of polystyrene valley model.

original construction; it was designed for a population which would be familiar with Pennine valleys, but in view of the author's own most intimate experiences of valleys might well have been influenced by recall of the Welsh border country valleys. In some cases however it was evident that so much was being read into it by the subject's schemata that the details of its form were almost irrelevant.

The subject was first asked if the model fitted their idea of a valley. Then the questions was put;
Where might people choose to live?
or for the more sophisticated subjects;
What sites might have been occupied?

The small triangular markers, as already mentioned above, were used to represent houses, villages and towns (and with the youngest children, sometimes just a person, probably). There were six markers, and they were encouraged to use at least three if they were hesitant (the Junior High School children were determined to use all that was provided).

When the Settlement Pattern was established, reasons for the siting were asked for if they had not been given in spontaneous comment, either as running commentary or after placing the markers. Then they were asked about possible roads so that people could get about, and strips of tape (insulating tape, slightly rough and tacky was used so that it would rest on the sloping surface without slipping too much) were offered. Again comment was asked for if not given, especially, "where is this going?" when it seemed possible that a road leading beyond the valley into an extended landscape might be envisaged. If the possible extension seemed accidental (e.g. a piece of tape that was too long for the purpose), the questions was put as neutrally as possible, "tell me about this road?" to try to avoid offering the extended concept which had not arisen spontaneously. Another element in the concept which had to be approached delicately was the concept of crossing the river; sometimes a bridge might be mentioned but if not was one being assumed, or was the river as an obstacle being ignored?

Lastly, a further elaboration of the whole valley concept was invited by questions such as,

What about the slopes between your settlements and roads?

What might they look like?

What sort of vegetation or land use might you find?

Some information of this type might have appeared already in earlier comments, especially with the older subjects. Not only did it give evidence of associated human activities, but also revealed the scale of their thinking in terms of areal extent and the degree of consistency of view for the whole valley. Finally, if it was not already clear that an area had been recalled they were asked again, "Have you any particular place in mind?"

College students were also offered the second model, which showed a more open landscape with gentler slopes and more tributaries entering the main river, as well as a distinct emergency of the river on to a plain or major wide valley flow. River terraces were incorporated, and gentler shelving areas which might have been identified for settlement sites (and indeed were). As they saw it when their schemata were already marshalled by studying the first model, those with a rich and complex valley concept were able to cover the landscape in very rapid scanning comment.

Recording

The interviews were taped-recorded, modelling activities being recorded by the interviewer by drawing on prepared basic diagrams. The majority of interviews took fifteen minutes, occasionally twenty minutes either because the subject was very slow in responding or at the other extreme particularly loquacious (or in the case of the students, examining the second model). Transcription was done on the same day if possible, or on the following day: the transcription was then typed out divided into segments which appeared likely to serve the need for specific division in analysis. In fact this did not work out in many cases where the thought operations were complex, but the divisions provided a useful reference system. Two types of analysis were carried out, (1) to identify the elements of the geographical ideas, i.e. to assess the quality of L - the schemata, and (2) to identify the progress and nature of the subject's conceptual thinking with the aid of Epistemic criteria and "mapping".

CHAPTER VII

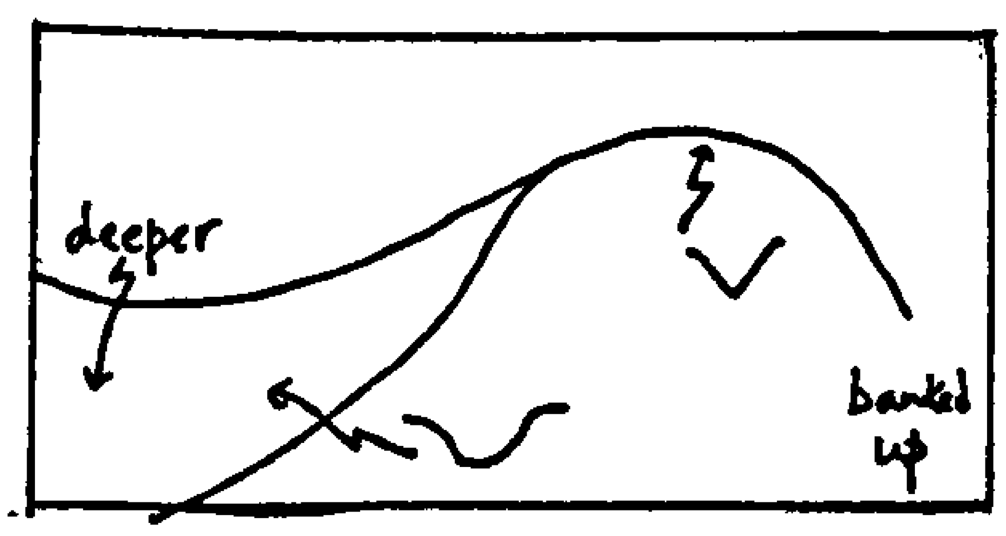
GEOGRAPHICAL ANALYSIS OF QUALITY OF CONCEPTS

In presenting this evidence it will be easiest to start by illustrating in diagram form the types of modelling variation, to which verbalisations can then be related.

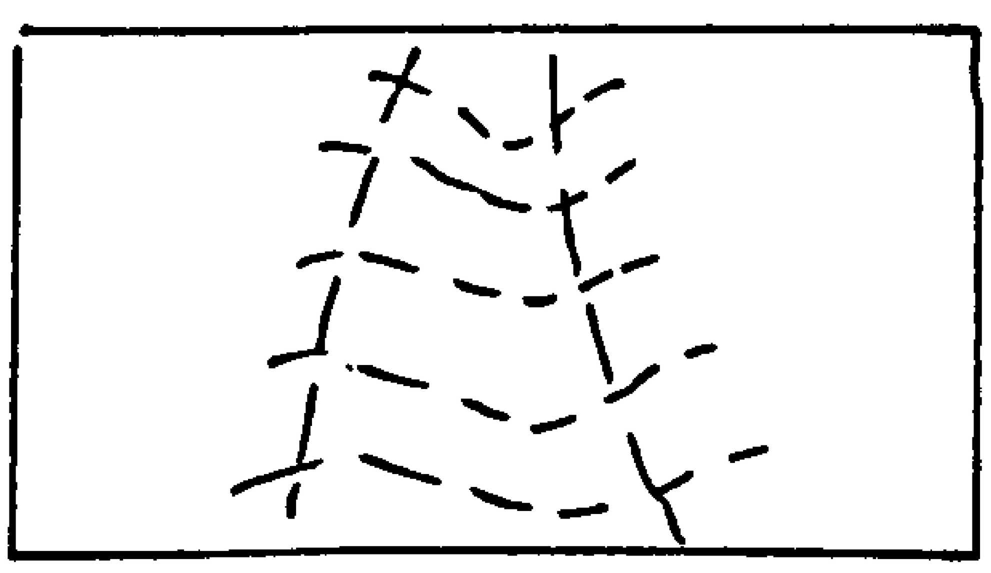
1. The VALLEY concept, i.e. the landform itself*

In the form itself, three particular elements appeared as basically important, (a) the extent to which the length of the valley, descending from mountain to plain, was shown: (b) If a short section was shown, was this recognised as a part only? (c) Was there continuity of valleyside-hillslope form or were there separate hills shown?

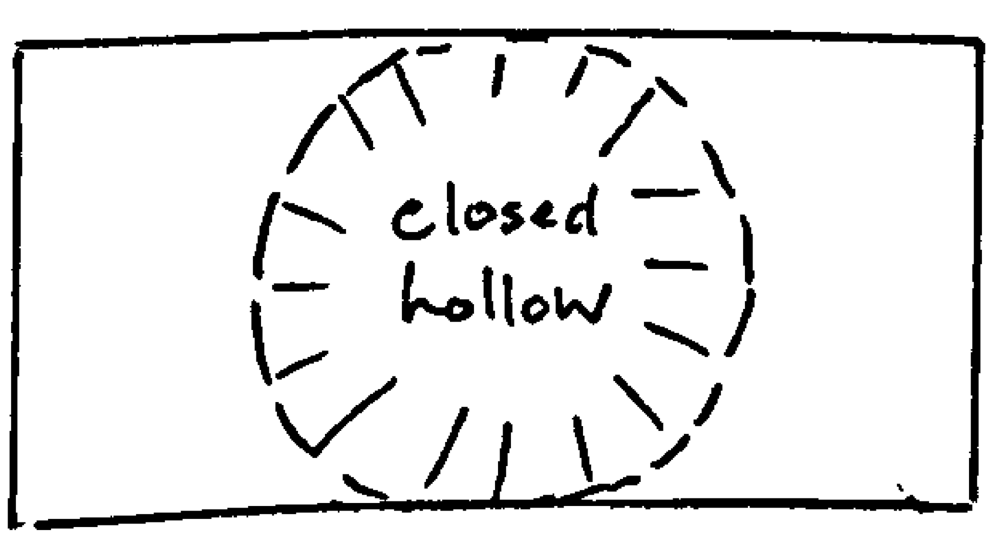
Examples of the progression are illustrated below.



(a) Good presentation of long profile, descending, with broadening cross section, and curving. No. 34 (14.11 yrs)



(b) Clear presentation of simple cross section, accompanied by clear verbal statement that this is the mature section, and that the lower section would wide out. No. 48 (18 yrs)

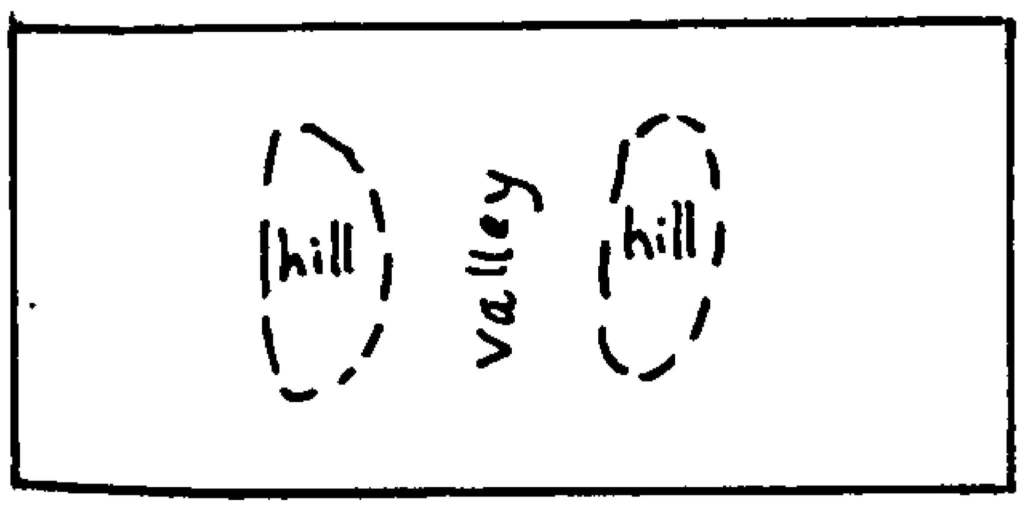


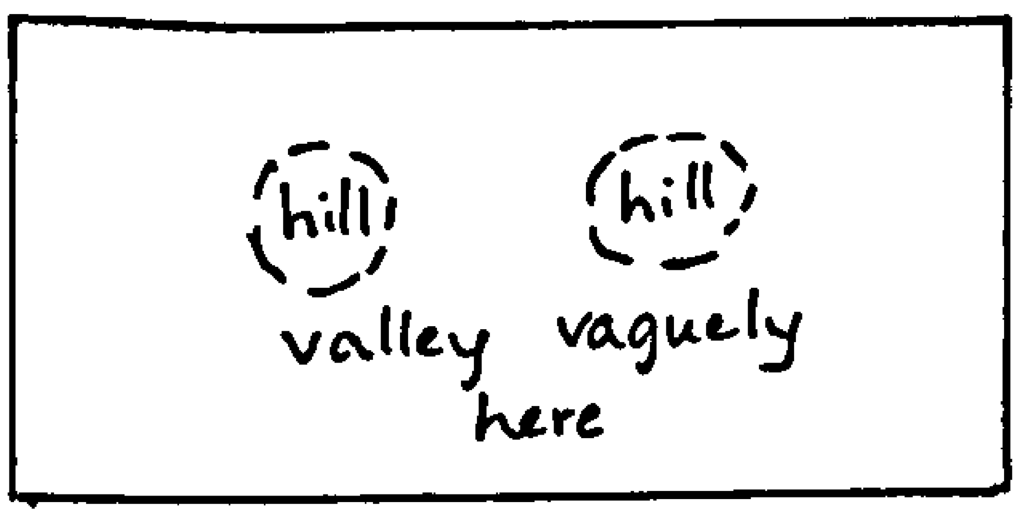
(c) A hollow, accompanied by verbalisation which mentions "hills all round", and later, "caverned out of a hill", no concept of long profile No.35 (14.11yrs)

*See pp. 79-86 above for the socialised concept

Irrelevance of age is evident. In the case of (c) there was no question merely of poor modelling; the "given model" was declared different from her own idea of a valley. One should note, however, that she was able to make use of the given model to express other concepts. The random selection happens to have provided extreme examples at this particular age.

From twelve years old downwards (d) the concave-convex form leading from valley bottom to hill top began to be lost. More and more often there were two (e) mounds for hills and a space between, though some were still producing the hollow form. Both No. 19 (d) and No. 20 (e) subjects were 11.7.





That this is not simply a modelling characteristic is borne out by the verbal definitions which emphasized "between two hills", with few words for what was between. The two subjects illustrated in (d) and (e) said respectively, "sort of ditch between two hills", and "sort of .... in between mountains" (gesture supplying the form) .... a big drop". Contrast even No. 35's comment (c), where the physical concept was very limited - "usually there's hills all round, usually in the middle you go down to it and usually it's a little village that's there". From other evidence, it is lack of adequate <u>river</u> concept that limits (c).

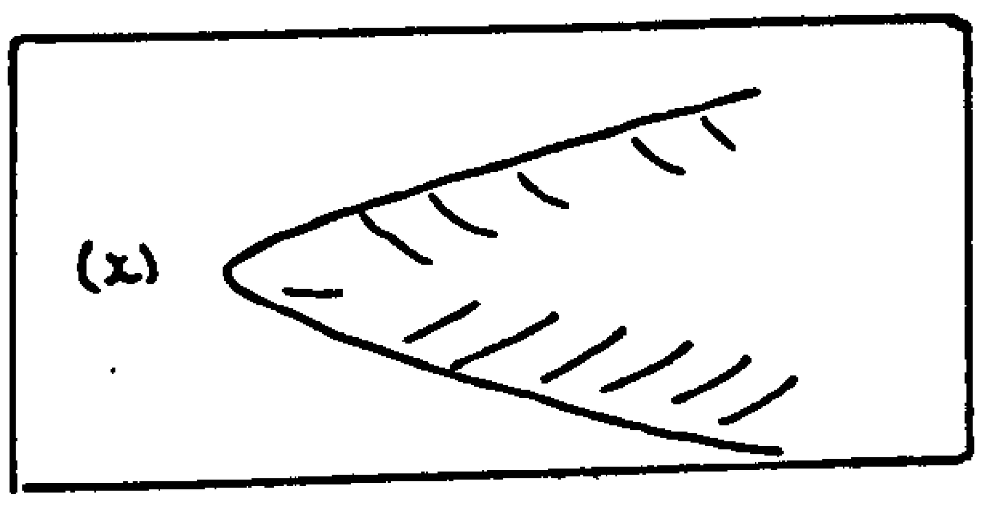
At the other end of the scale No. 48 (b) - student - says,

"syncline - it's the V - shape between two mountains, caused sometimes by a downfold, sometimes by erosion, eroded by river, sometimes by glacier".

This is amplified by descriptive detail.

(f) No. 14. (f) at 10.5 yrs. has only one hill - "it's a ... a big hill and it's got a few houses on, and it's like a plain, it's got green grass on ... a few pastures, ... it slopes down".

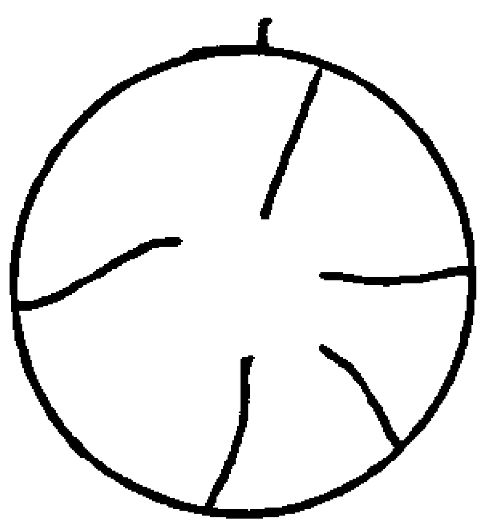
Evidently it is the valley side which is identified, just as "hill" may be identified as a hill side. This should not be read as suggesting that a ten-year old could not conceive of a valley between two hills; nine-year olds did so, but not any of the random selection of eight or seven year olds.



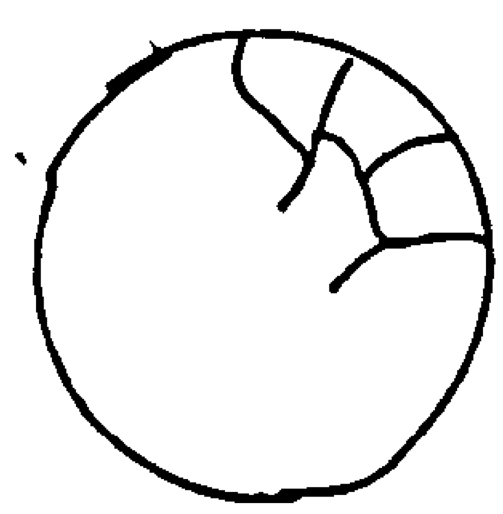
(g) No. 32. (14.0) has been illustrated because it reveals a particular sort of error in the incorporation of learned textbook concept. His definition includes, "They are always a V shape", then after modelling it, he said, "It's going into a rough V shape, here at the bottom", and when asked if it was the whole valley, said "it is a whole one coming from here (x), opening out into the big V". This arises from contour map study, and the dominance of the two-dimensional V shape of contours on the horizontal plane of the paper, instead of the vertical V shape of the valley cross section. The horizontal V-shape appeared again in the use of the Aloplast dome. He is aware of the vertical V, but the phrase "V shape", which is a part of the socialised concept is linked with the horizontal V in his schema. This illustrates one of the conceptual hazards of contour map study, where documentary space must be translated into terrestrial space.

The modelling clay dome was provided as seeming to offer the most neutral type of generalised slope form.

(a) Radial drainage showing tributaries was the most advanced concept type shown e.g. No. 44 (a) a VIth former (17.9). A running commentary revealed a vivid imagining of the pattern developing.

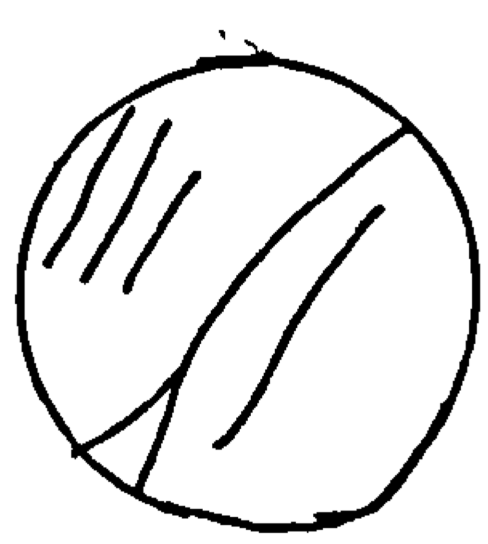


(b) Simple radial drainage as in (b) No. 41 (16.6) was not usually accompanied by much verbal elaboration. Sometimes the elaboration involved 'faulty' concepts, e.g. in (c)



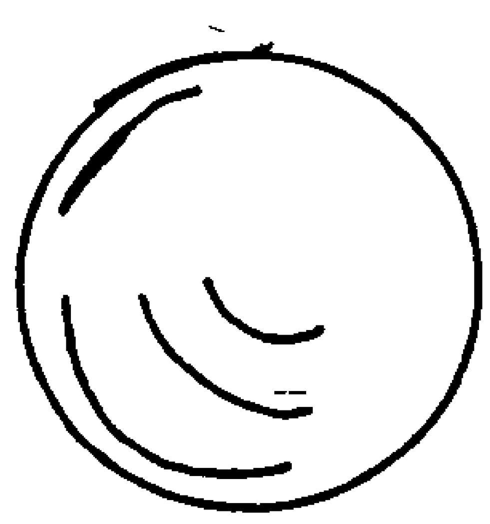
(c) This VIth former No. 42 (17.5) said,

"the drainage would be radial, rivers coming out from the centre, as in the Lake District... could become dendritic if some of these joined up."



(d)

This again reveals the conceptual hazards of documentary space: the dendritic pattern has not been related to slope and dynamic development of river pattern, although this VIth form student has knowledge of valley details informed by local fieldwork which add up to a fairly sophisticated valley schema.



(e)

The verbalisations of this "debased radial concept" distinguish it from another rather similar pattern where distributaries were also shown, but identified as such in a delta at the bottom of the slope.

Drainage running across the top (d) was shown by some Junior High School children; this example No. 24 is at 12.6 yrs. Another variation characteristic of the declining concept was contouring drainage (e) No. 21 (11.9). Although the radial pattern is lost, the idea of streams running round the hill seems logical enough, only set in a landscape of smaller extent. And with regard to the valleys which run across the dome (d), this might have relation to a river cutting through a range of hills. There was very little accompanying verbalisation at this stage, and the lack of response led to the omission of the dome in the Junior School interviews; some very odd patterns had appeared amongst the 11-year-olds. One twelve-year-old, having said, "round the sides", then drew a house; she had previously modelled separate hills, and when asked about the valley between, made a separate hollow in another part of the sand tray; it was all more characteristic of the Junior School interviews (she was in the lowest ability stream in the school). The broad relationships between the evidence of the valley concept and the age range is shown in Fig. VIII.1. p. 115.

2. Settlement and Road pattern concept, involving Location*

To handle the analysis of the settlement siting, a division of the territory was made, as in Fig. VII.2.

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* See pp. 86-89 above for the "socialised" concept.

Generalised analysis of Concept Development

Land form

AGE GROUP	MODELLING nonverbal handling of material (clay or sand)	LONG PROFILE Dominant and relevant reference	CROSS PROFILE Dominant and relevant reference	PROCESS Formation and features	VOCABULARY adequacy of technical or common lng.
30+					
18-20					
17+		Generally dominant		stages & slopes	
16+			V/U shape references		use of technical terms
15+	Radial pattern			increasing reference	
14+		lack of awareness appearing but some references			common language
13+	pattern declining		Dominant	sporadic reference	
12+	slope continuity declining		increasing dominance of positive Hill concept, loss of valley form		limitations of language
11+	valley concept uncertain			none	
10+					Minority able to define 'valley'
9+	lack of concept of form	no reference			
8+					
7+					

Fig. VII .1.

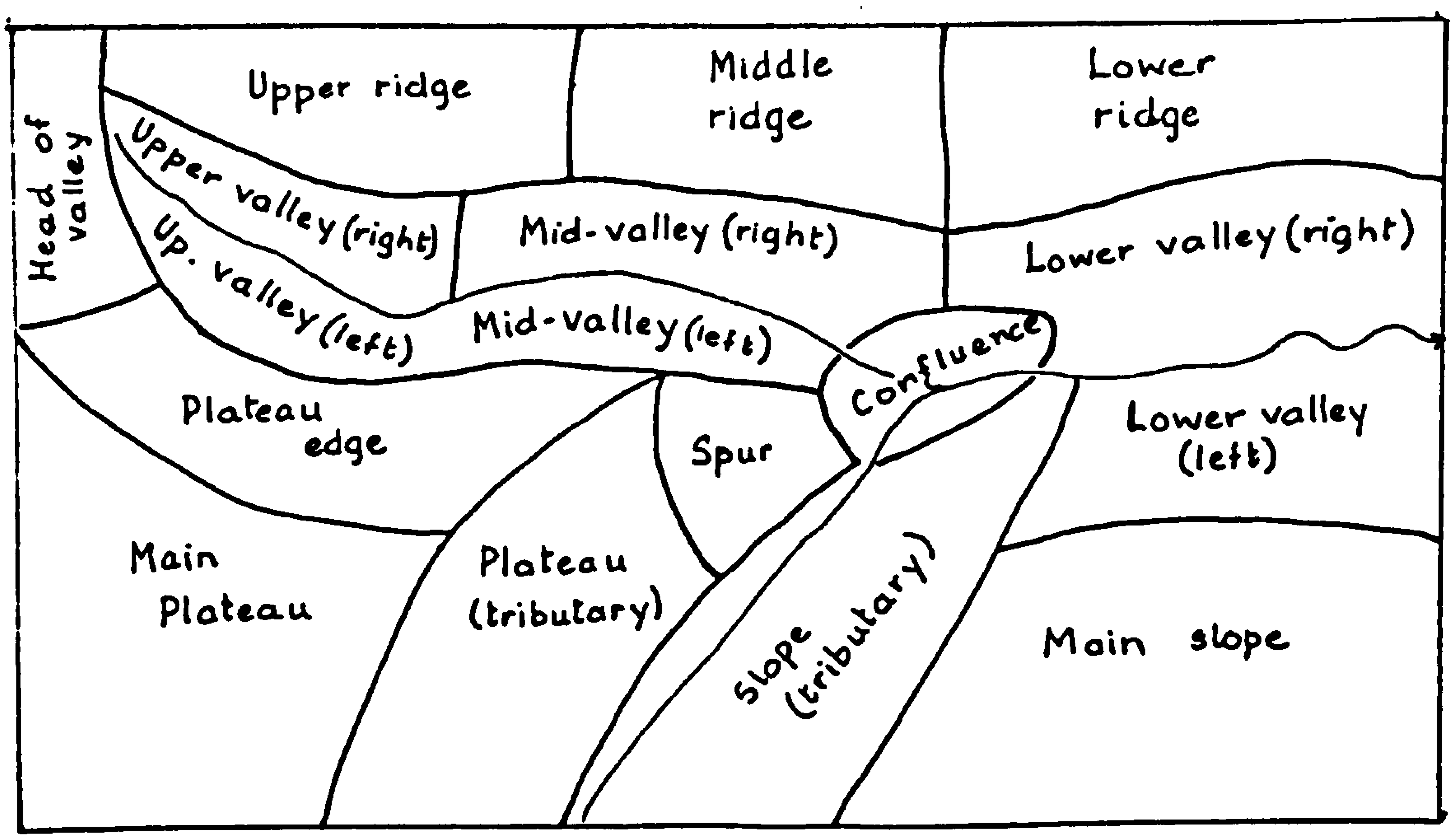

Figure VII. 2. Division of model for settlement sites

Generalised Analysis of Concept Development

Settlement Pattern

<table>
<tr><th>AGE GROUP</th><th>Plateau and Ridge</th><th>Slopes</th><th>Confluence</th><th>Lower Valley</th><th>Constricted upper valley</th><th>Spur</th></tr>
<tr><td>30+</td><td rowspan="2">↑ Occasionly dominant ↓</td><td rowspan="13">↑ Occur through all age groups ↓</td><td>↑ Dominant ↓</td><td rowspan="9">↑ scattered through all groups ↓</td><td rowspan="9">↑ occasionally through all groups ↓</td><td rowspan="13">↑ Occasionally through whole range ↓</td></tr>
<tr><td>18-20</td><td rowspan="2">↑ Frequent ↓</td></tr>
<tr><td>17+</td><td rowspan="4">none</td></tr>
<tr><td>16+</td><td rowspan="6">↑ Occasional ↓</td></tr>
<tr><td>15+</td></tr>
<tr><td>14+</td></tr>
<tr><td>13+</td><td rowspan="4">↑ sometimes dominant ↓</td></tr>
<tr><td>12+</td></tr>
<tr><td>11+</td></tr>
<tr><td>10+</td><td rowspan="4">none</td><td rowspan="4">one only</td><td rowspan="4">one only</td></tr>
<tr><td>9+</td><td rowspan="3">↑ Dominant ↓</td></tr>
<tr><td>8+</td></tr>
<tr><td>7+</td></tr>
</table>

Fig VII.3.

From the broad tabulation in Fig. VII.3 (p. 117), it will be seen that there are two age-linked relationships. The younger children used plateau and ridge sites, very rarely siting any house in the valley. They were strongly influenced by the steepness of slopes on the model, but possibly more strongly by the fact that in their own limited environment all the houses in their estate are built on a broad shelf above the incised lower part of their valley. There was a strong feeling about the consequences of bad weather[x] if living by the stream:

"when it's windy it might flood and the water might come in the houses" (7.9):

"if there's a wind coming if you were hanging clothes out or summat they might fall in the stream"(10.5)

"rain might top up stream, it might get flooded" (8.4):

"when the wind blows the water might splash through the houses and they wouldn't be able to go in the houses"(10.0).

It may be relevant that in the previous month Bradford had had three times its average rainfall and all streams were abnormally full. All the children except one ("the woods were not safe" - parental prohibition?) played by the stream.

The other aged-linked characteristic occurs at the top of the age range, i.e. the use of the confluence-site; to be aware of the significance of this site evidently required a schema which embodied the socio-economic implications which had been received through transmitted socialised knowledge in school. It was most dominant in the older student group where this was re-inforced by adult experience of

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x Comparable feelings about weather appeared in Rhys' research (1966) (Ref. II. 23)

GENERALISED ANALYSIS OF CONCEPT DEVELOPMENT

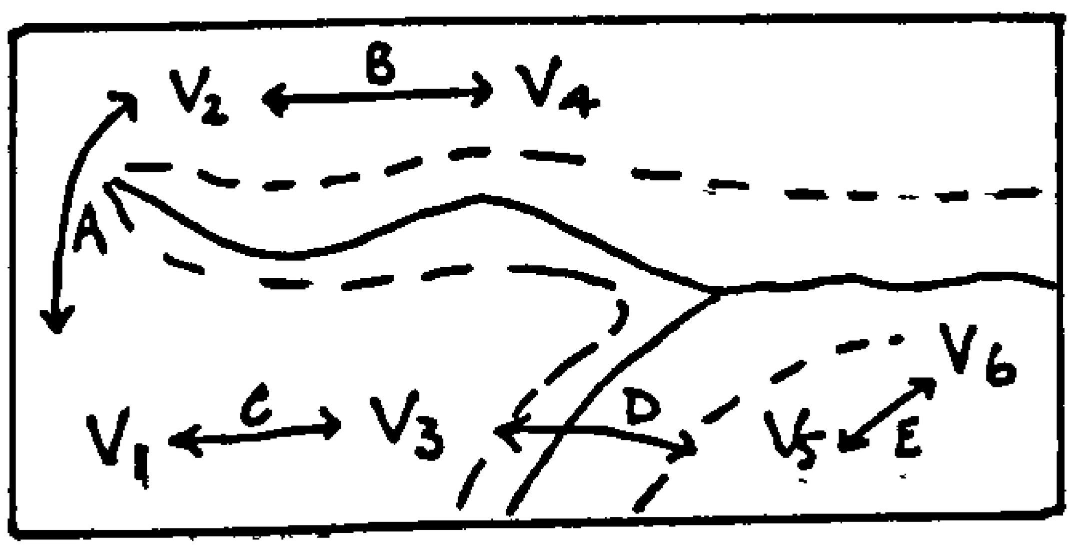
Road Pattern

AGE GROUP	DOMINANT PATTERN	MIXED PATTERN IN VALLEY & ON HILLS	CONTINUITY OR DISJUNCTION	RELATION TO MODEL AREA
30+	↑	↑	↑	↑
18-20	valley			extended
17+	routes			view
16+	dominant	mixed	continuity	beyond
15+	↓		dominant	model
14+	↑	patterns		usual
13+	ring	occur	↓	↓
12+	pattern	↓	↑	↑
11+	avoiding	↓		limitation
10+	valley		disjunction	to me
9+	dominant		frequent	model
8+	↓			area
7+	↓		↓	frequent ↓

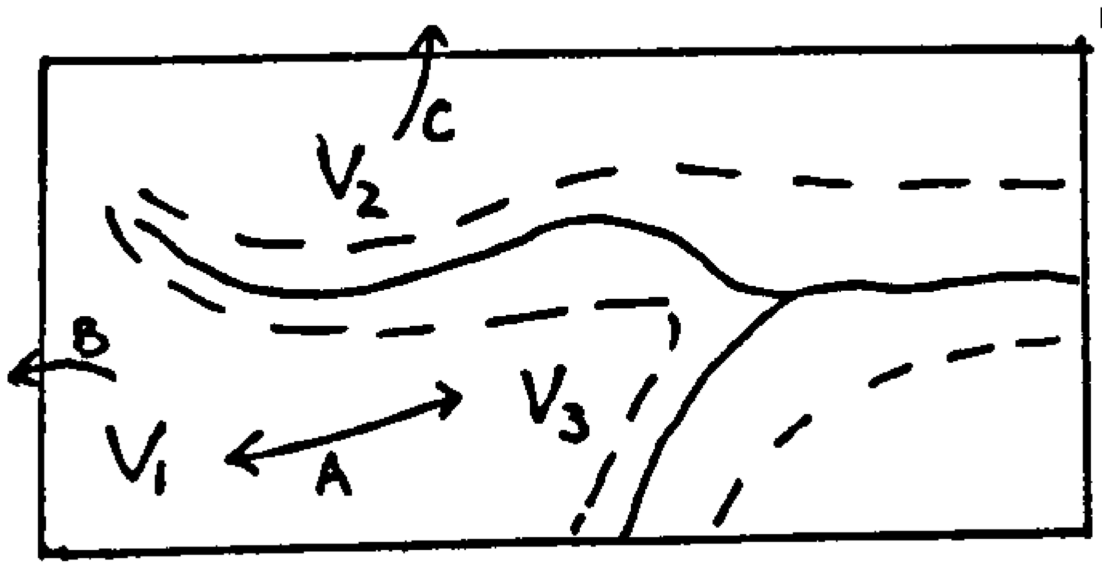
Fig. VII.4.

Place-Work-Folk. (cf. the "valley section", p.87)

Patterns appear best in association with roads. Fig.VII.10 shows that there were two dominant types and one which was a mixture of the other two. The <u>ring pattern</u> was associated with the plateau-ridge siting used by the younger children; the <u>valley-routes pattern</u> fits in with the confluence site used by sixth-formers and students.

(a)* 

A good example of <u>ring-pattern</u> is shown in (a) No. 26 (12.10). All the markers have been used, when asked for reasons she said "because some places straight (i.e. flat) and some places near the stream" (this is the low ability stream child again, but she is well up with her contemporaries in the <u>continuity</u> of her pattern). Below this age <u>disjunction</u> was frequent, i.e. settlements were not linked in a continuous pattern.

(b) 

In (b) No. 22 (11.11) the valley appears as an obstacle "you can't get across to that village (i.e. from V2 to V3)". But in this case the disjunction is connected with the relief obstacle, because road B is stated to be going to a town, and road C to another village, so an <u>extended landscape</u> beyond the model area is being envisaged, which Fig. VII.4. (p. 119.) will reveal as more characteristic of older groups.**

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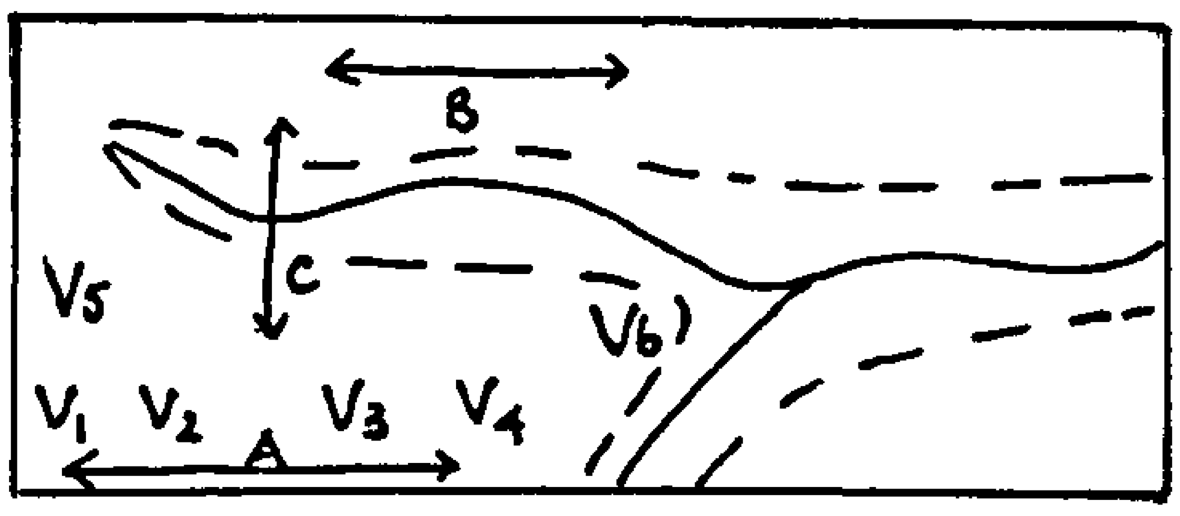
*V1 .... V2 .... etc. Sites in order of placing.
A .....B .....etc. Roads in order of placing

**Rhys (1966) also comments on the way in which younger children regarded the area shown on a photograph as self-contained, the extended spatial framework being more often appreciated from 12 years upwards.

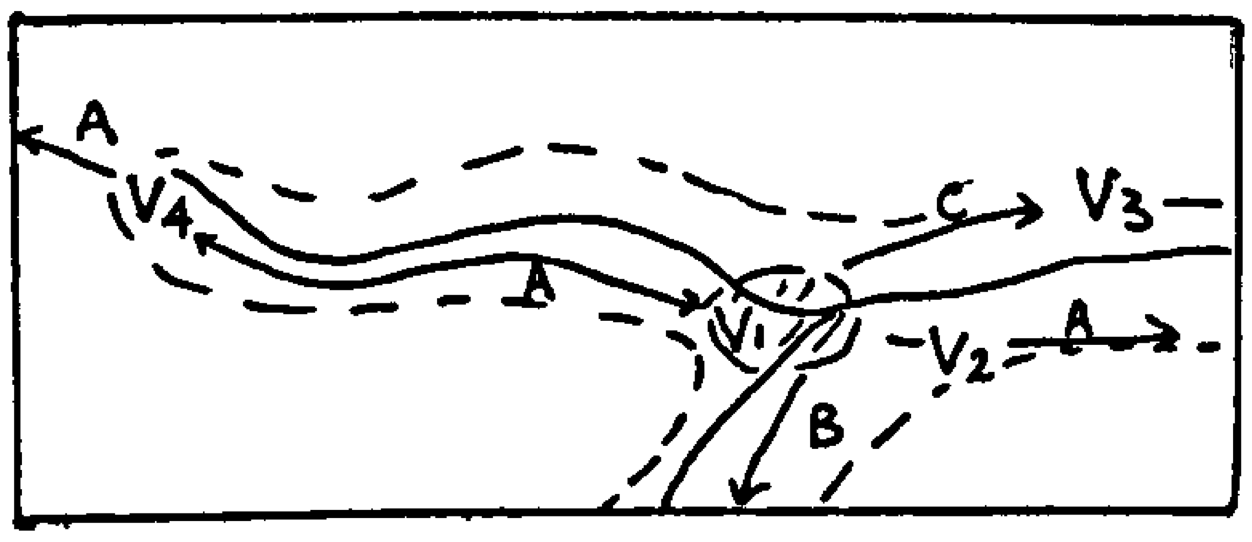


(c)

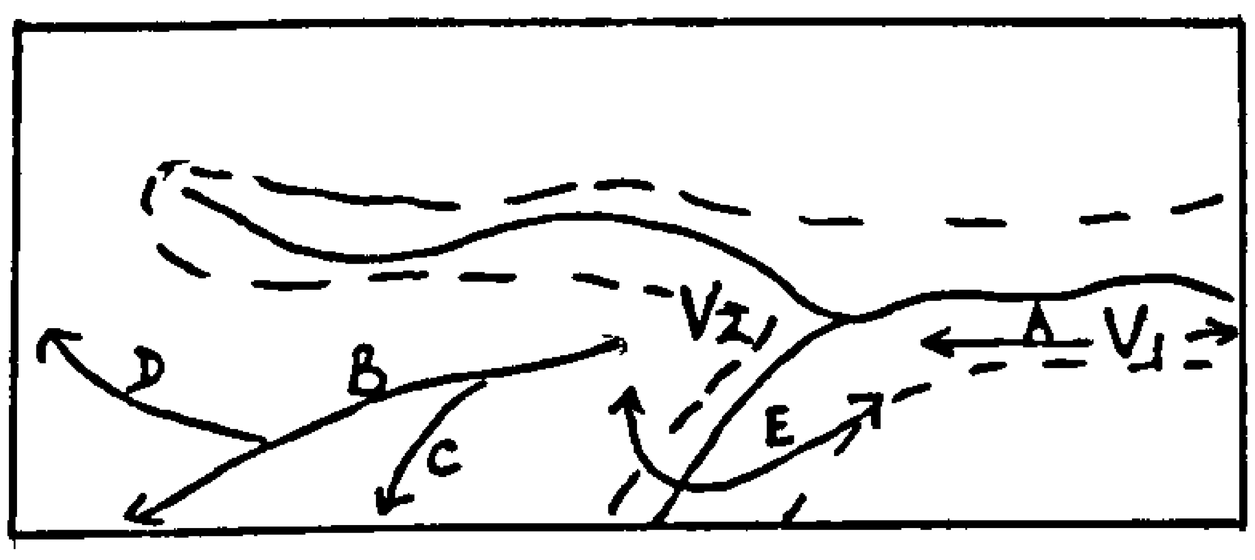
An example showing characteristics of a particularly elementary pattern is given in (c) No. 1. (7.4). The markers are used as single houses, and were placed on top "because if you put house down there you'd have to walk up the hill" (later replies suggested that this implied going to shops). She put roads A, "this one to get from one house to another", and B, "and over here one by itself". Road C was elicited by asking how people would get from A to B if there were any houses by B. She said "could have a bridge over ". Although this is the youngest child interviewed, this does not represent the most elementary pattern; one child of 10.0 years showed only one line of houses and the road beside them. The whole Junior school age group showed tremendous individual variation amongst the random collection interviewed.

The plateau/ridge siting re-appeared in student interviews, although it had disappeared completely in the Grammar School group (that is to say, such sites were mixed with valley sites in the pattern, not shown exclusively). It was associated with complete avoidance of the valley by roads, which went off the model in search of easier ground rather than tackle the valley. The most marked avoidance of the steep slopes occurred with a mature student No. 59 whose landscape experience was markedly different from the average. Although he had lived in Yorkshire for over ten years, he was of East German origin and had spent his early life in displaced persons camps; he had therefore lived in a number of north

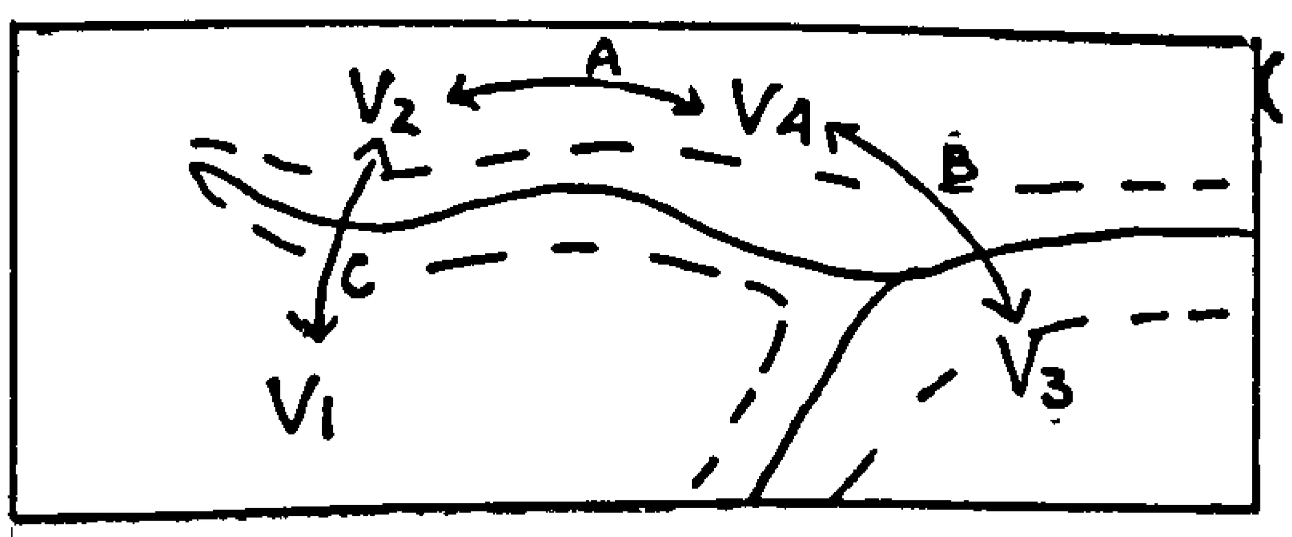
European landscapes, and also a short experience of eastern United States landscapes. He had a remarkably strong feeling of isolation on the plateau, regarded the valley slopes as impassible because of their steepness, and would only use the narrow ridge, which he saw as having a possible gentler descent to lower ground.



(d) The most perfect example of valley routing in association with the confluence site is shown in No. 56. (d) (31 yrs.) "The most immediate site would be there, right bang on the confluence, this is a natural meeting place both of rivers and people". He put "farming type settlements" at V_2 and V_3, then V_4 at the foot of a pass, "where a road might go over the col or mountain". A is a main road up the valley, C a minor road, "just a communications type of road, as is this one sliding up the tributary"(B).

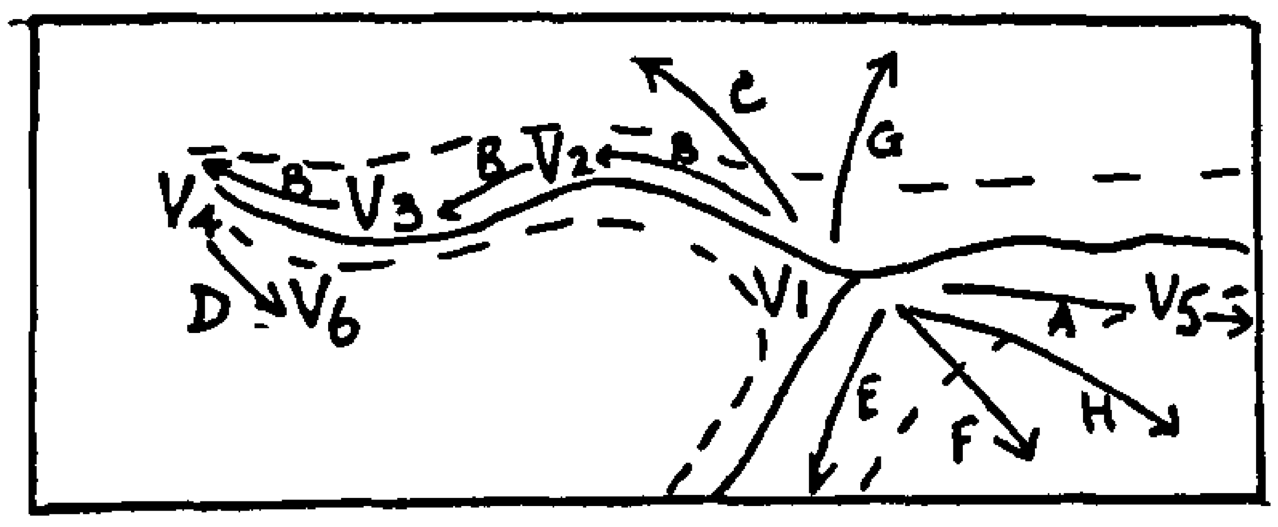


(e) The defensive site on the spur was used only occasionally, and usually specifically identified as defensive, as in (e) No.41(16.6). The upper valley is regarded as unsuitable, and the whole area as rather negative in terms of land use. The lettering will show that the road E was added last, the crossing of the tributary by a bridge only being decided on after a long meditative pause.



(f) By contrast (f) No. 30 (13.10) has two bridgings of the river, though the sites are plateau/ridge type. The class was working on a topic on "Bridges" and all the children selected from it used the bridge concept positively in making their road net.

The last illustration (g) No. 53 (20 yrs) show a pattern involving hill crossings other than head-of-the-valley passes.



(g) There was a great deal of reasoned comment going on with the building of this pattern. The site V_1 is on the lower slope of the spur; in fact all the sites are seen as being away from flood danger although within the valley. C and D reflect selection of gentler gradients for the minor roads. E, along the tributary valley, is seen as a major road. It is evident that there is a strong sense of the nodality of the site V_1. The settlements are considered as towns, and the whole valley concept seems to be on the scale of Geddes' "valley section". Sufficient patterns have now been given to show how all the possibilities of the model were taken up in one way and another. The final sophistication might be indicated by the use of the <u>ridge</u> for a motorway, isolated from the valley towns except for access routes No. 55 (30 yrs.)

3. <u>The LOCATION concept</u>*

From the evidence appearing above, "location" is being influenced by factors as diverse as the kinaesthetic play experience of the younger children and the reasoned principles of economic geography of the mature students. But an adult can be influenced strongly by the "feel" of the landscape, and a nine-year-old can discuss the relative advantages of routes for people walking and for cars. <u>Continuity of relations</u> and

*For the socialised concept see pp. 89-91 above.

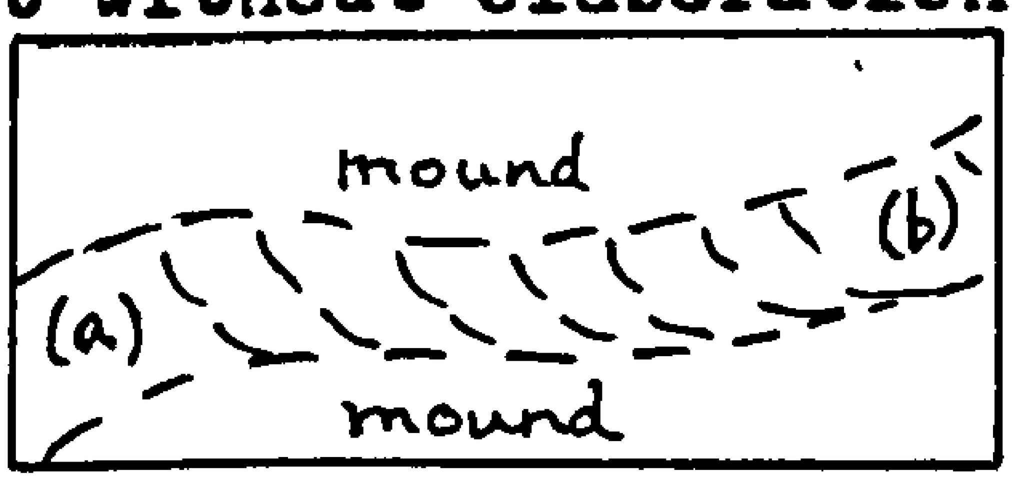
extent of area visualised show more progression. The kinds of discriminations that can be made will be best discussed along with the criteria for grading the quality of the concepts which follows.

Grading of Quality of Concepts

With plenty of evidence of the variety of individual versions of the selected concepts the task of classifying them is a formidable one. Yet alongside the Epistemic Analysis some standard of the individual concept in comparison with the socialised concept is needed. It was decided to take five aspects of each of the three concepts and use three levels for each of these, making a total of 15 points for each.* The criteria are summarized in Fig. VII.5. (p. 125). Two aspects are common to all three concepts. One of these is the level of verbalisation, the other has been called "Spatial Sense" for the first two concepts, and "Personal Awareness" for LOCATION.

I Criteria for "VALLEY" A. Long Profile

Level 1 Awareness: evidence of a sense of length of valley but without elaboration. e.g. No. 24 (12.6)



That carries on (a) ... it's like a deep bowl ... it goes on up (b) and carries on but there's hills (x), they go back."

Level 2. Simple detail: at least showing evidence of changes in nature of the cross section, i.e. narrow and/or young valley, broadening/mature, source, going to the sea. e.g. No. 47 (18.0)

*Also possible score of 0 where there was no sign of the concept element.

Grading of Quality of Concepts

Criteria for Scoring (absolutely negative cases counted as 0)

1. VALLEY

	1	2	3
Long Profile	Awareness	Simple detail	Complex detail
Cross Profile	Awareness	Simple detail	Complex detail
Process	Awareness	Simple detail	Complex detail
Spatial Sense	Limited part of valley	Whole of Valley	Extended land-scape sense
Verbalisation	Limited common language	Clear common language	Genetic/generic terminology

2. Settlement Pattern

Ranking	Equal status	Some ranking within model	regional hierarchy
Site scatter	Single or one cluster	Limited type distribution	distributed various types
Reasons	Relief only or simple social	Simple human (economic strategic)	Complex region-al activity
Spatial Sense	Subjective feeling	local links, responsive	spontaneous regional patt-ern
Verbalisation	Limited common language	Clear common language	Genetic/generic terminology

3. LOCATION

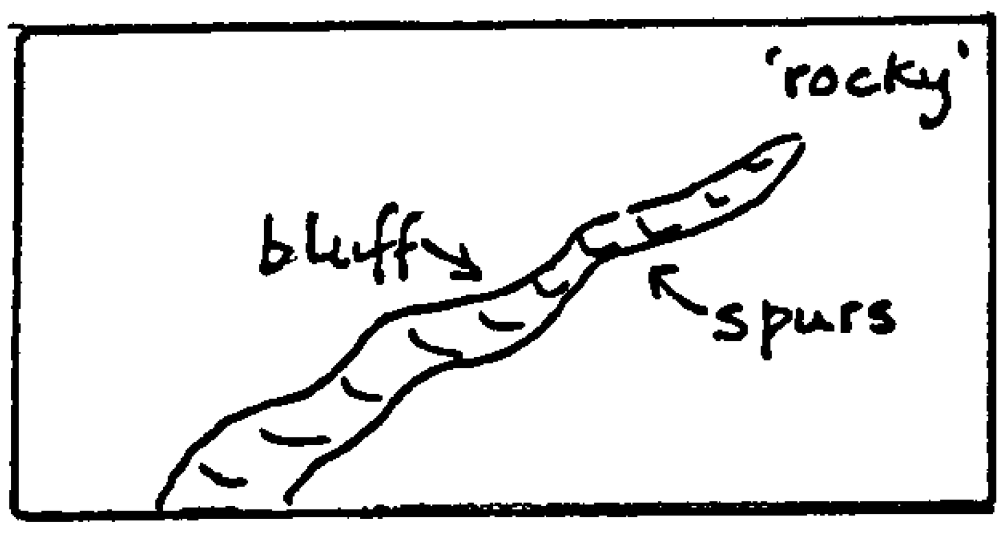
Nodality[1]	Single links	Some nodal pattern	Complex nodal pattern
Extent[2]	Localised	Comparison of areas	Extended areal differentiation
Socialised Reasons	Personal activities	Simple land use concepts	Regional pattern identified
Personal Awareness	Fragmentary mental maps	Continuity of mental maps	Personal mental map integrated into regional patterns
Verbalisation	Limited common language	Clear common language	Geographical terminology

1. from model network. 2. from land use comments.

Fig. VII. 5.

(short section shown) "this is only part of the valley, the valley starts narrow, and then widening, the beginning can be formed in various ways. If it's a river it's likely to be small at first, but if started by a glacier it would have a kind of bowl at the beginning, and come down. It's not necessarily straight".

Level 3. Complex details: amplification of information about stages of examples, e.g. No. 44. (17.9)



"Goes steeply at first, steep V, truncated spurs, gradually gets narrower and then you start to get your meander plain towards the bottom. These are supposed to be interlocking spurs, where it's steep it's all rocky, then gradually flattens out, might get a river bluff, flood plain".

B. Cross Profile

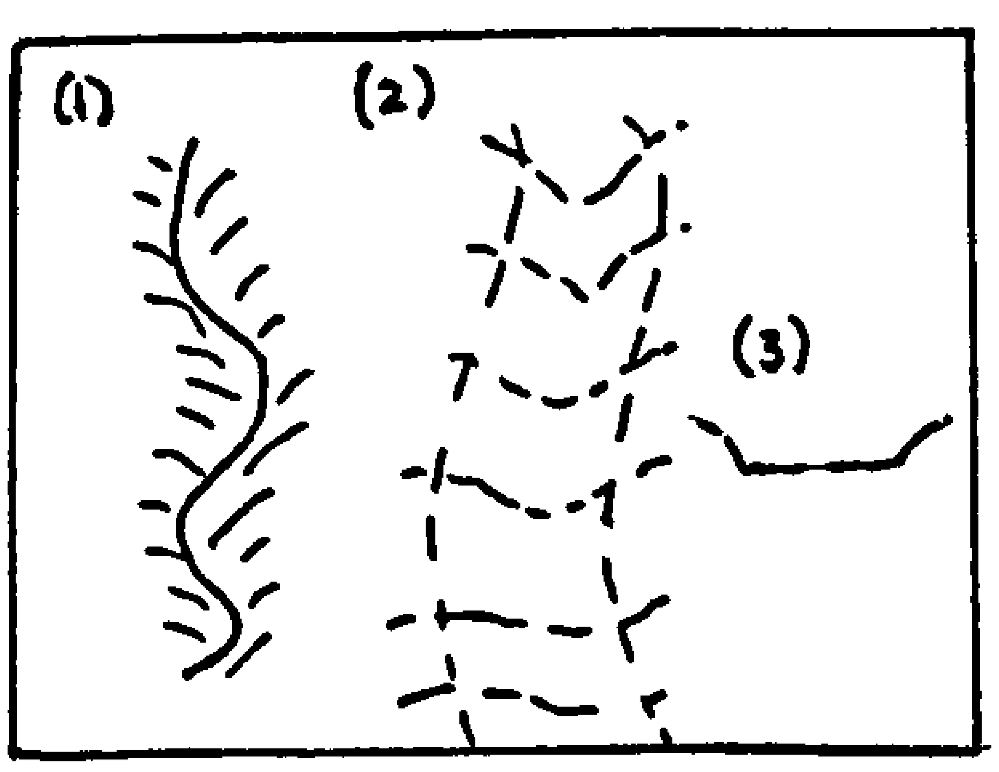
Level 1. Awareness: indication of the continuity of slopes across the valley, in words and modelling, e.g. No.28 (13.0)

(short section shown) "land that dips in the middle, into a sort of curve, and dips into the middle where you find stream and villages there."

Level 2. Simple detail: indication of the character of the cross section, such as V-shape and U-shape, changes of cross section in long profile. e.g. No.46 (18.0)

"a river runs in a valley, ... they are V-shaped or U-shape" (with reference to her model) "supposed to be a flat valley floor, steep sides ..."

Level 3. Complex detail: enlargement on details of shape an example is difficult to quote economically as the relevant information might be scattered through the interview, however No. 55 (30) will serve to illustrate,



(he altered his model while talking so 3 stages of this are shown in the diagram).
"This would be the young valley (1) very steep cross section going in and out, what we call interlocking spurs ... very steep

sides, more vertical than lateral erosion, something like this - this is more gorgelike .... then you get your middle valley, (2) the mature valley, much wider curve, and the meander rather than the sharp curves you get in the young stages... you'd get the river cliff.... and the final stage, it's not so distinguishable, it's spread out, you may get this bluff (3), very wide, shallow, slow-moving ... (continues with delta and estuary detail)."*

He looks equally systematically at the cross section of the model when it is presented to him; no other subject concentrated on the concept of the cross section in such a positive way, but the same type of information emerged in other cases, spread through the interview as a whole (this mature student (ex R.A.F.) had the second highest total score for quality of concepts).

C. <u>Process</u>, that is to say, realisation of the making of the valley the operations of river, glacier, weather conditions and so forth, in the development of the landform. A glance at the table in Fig. VII6p. 141 will show that there was little of this until the examination-preparation classes were reached.

<u>Level</u> 1. <u>Awareness</u>: at least some term suggesting that a valley was "made", e.g. No. 32 (14.0)

"just a hillside being cut away in the middle, and sometimes it could be when the glaciers came down."

<u>Level</u> 2. <u>Simple detail</u>: suggesting some knowledge of processes and the results of their operations, e.g. No.48 (18.0)

".... caused sometimes by a downfold, sometimes by erosion, eroded by river, sometimes by glacier.... (comment on her sand model) it's supposed to be a U-shaped valley, straight sides caused by the glacier coming through and straightening it out, carving it out".

There is further mention of erosion when looking at

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*Compare with quotation from W.M.Davis on p. 83 above.

the polystyrene model.

Level 3. Complex detail: more elaboration of operation of processes, e.g. No. 42 (17.5)

"The valley sides could be steep or less steep, depending on the amount of glaciation... and whatever else might have gone on. In a desert, could be erosion of some sort which has left a great valley... could be the weather, would take a lot of time.... interlocking spurs further up here, they will have been worn away and as the river advances further down here they will gradually wear away... meanders, abandoned meanders, debris which has been brought and left, river terraces, paired terraces, as in the valley here" (this is taken from several items in the interview).

This particular subject's schemata are rather overloaded with theoretical "socialised concepts" not yet very well integrated (see p.113 above on his "debased radial drainage" type concept), but the ingredients are there. It must be remembered that this was a fifteen-minute interview in isolation from the documentary aids of geographical study.

D. Spatial Sense: this is less easy to set out in examples, because it was judged from the general tenor of replies and modelling action, in so far as they seemed suggestive of the extent of visualised landform. The evidence is taken from the part of the interview before the polystyrene valley model was shown. It was considered limited if there seemed to be very localised visualisation of a feature even if the feature was complex in itself.

Level 1. Limited part of valley, e.g. No. 54 (19.6), though he had Level 2 concepts of the cross profile and processes, was only at Level 1 of the long profile (awareness), and any comments relating one part of the valley to another were only extracted by supplementary questions; he was only able to operate with his acquired socialised concepts when he had the visual stimulus of the given model. He came from Lincolnshire, and the whole of the human aspects he dealt with later in the interview were strongly influencedby his native environment; he had visited highland areas (e.g. Snowdonia), but not to do field work.

Level 2. Whole of valley, e.g. No. 24 (12.6). already quoted on p.124 for Level 1-awareness of long profile - it is the spatial sense which helps him to have the long profile concept at any level at all, since he does not know any long profile details.

Level 3. Extended landscape sense, i.e. visualisation of the valley as part of a larger landscape, in every case, this was associated with landscape experience; in the example given here it was also specifically associated with maprrepresentation, No. 29 (13.9), who modelled his valley with strong recall of his local environment said,

"this would be the end of the valley, I've never seen the source, it's more Wilsden way. If you look at Thornton on the map it's really one big hill with the village on the side.... this particular valley goes further past the school"...

He lives on the markedly dissected plateau above Thornton where the deep valley heads of the streams running down to Bradford Beck make communication difficult, one of them (coming from "Wilsden way", see quotation above) being a glacial spillway in part. This is the youngest subject to reach this level; it was more evident amongst the students, particularly the mature students. However the latter are a highly self-selective group, and one is tempted to postulate that only those adults who possessed a good "landscape sense" would choose the subject in their college course, and be selected for entry since in the absence of evidence of much formal geographical learning, evidence of informed awareness of their environment is an obvious factor in their favour.

E. Verbalisation

Since the use of words is important to the individual in handling his conceptualisations, verbalisation must have been an element in the evidence already presented, but it has not been graded on verbal expression only. In this section, the actual expression in words has been taken as a specific element.

Level 1. Limited Common Language: i.e. verbal expression did not match the level of concept which they were trying to express, resulting in circumlocutions, e.g. No. 33 (14.6)

"two hills.... it's the slope in the middle" accompanied by a good model of a stretch of valley.

Level 2. Clear Common Language: e.g. No. 25 (12.9), "two hills on either side, sloping down to make a gap"

Level 3. Genetic/generic terms are used, e.g. No. 55 (30.0), "a feature of the landscape, generally formed in normal erosion by river action, ... generally within the valley-three-stage development".

Only three subjects (one sixth-former and two students) reached this level at which technical language was characteristic of their concept; others used technical language occasionally but "clear common language" was more characteristic. Muddled use of technical terms was not counted as Level 3; efficient expression, whatever the verbal level, is implied.

II Criteria for "SETTLEMENT PATTERN"

A Ranking

Mention has been made above of the different status which the markers might represent, i.e. house, farm, village, town, city.

Level 1. Equal Status: no differentiation amongst the settlements shown. Houses were not counted if nothing else was shown, since they were associated with personal feeling rather than a concept of "site". This level therefore implies at least "farms", villages or towns.

Level 2. Some ranking within model: at this level at least two types, e.g. farms and villages, or villages and towns were distinguished amongst the sites shown, not necessarily immediately on placing them, but during the ensuing conversation about routes and land use. Little ranking was done before 15+, but an earlier example is found in No. 30 (13.10) whose settlement pattern has already been shown (example (f) on p. 122), who said,

"I think up here (V_1) because this is flat land for a farm... might be a town or a village (V_2).... there might be some houses (V_3) and near the town (V_4)."

This probably the most specific example at any age of the concept of a settlement hierarchy related to relief dominating the immediate selection of sites.

<u>Level</u> 3. <u>Regional Hierarchy</u>: at this level the settlements actually shown on the model were seen as part of a larger settlement hierarchy. For instance, No. 39 (15.9)

"it widens out, there might be bigger towns out of the valley"

which explains why he has only placed two settlements in the model area itself. No. 40 (16.0), after distinguishing a "main village" from others (the main one being at the confluence site) says,

"there could be a big town here for trade and the coast or something" (i.e. beyond a pass through which a road was shown).

B. <u>Site scatter</u>: This was in terms of the use of sites in the divisions shown in Fig. VII.3.p.117 and any relevant verbal evidence to back up the model placing.

<u>Level</u> 1. <u>Single or one cluster</u>: this might occur at any age (see the example of the mature student No. 59 cited on p.121 above).

<u>Level</u> 2. <u>Limited type of distribution</u>:the ring-pattern plateau/ridge/slope associated type of pattern already illustrated on p. 120 was at this level.

<u>Level</u> 3. <u>Distributed various types</u>: No. 53 (20 yrs), whose road pattern was shown on P. 123 above, included, (i) the confluence site, (ii) "along the course of the river", (iii) at the source of the river, (iv) in the lowlands, "at more raised part, above the

vale".*

C. Reasons: the same site might be selected for different reasons.

Level 1. Relief only or simple social: to select with regard only to the relief (e.g. the younger children's plateau sites), or with a "social feeling" seemed to be the most rudimentary type. e.g. No. 27 (12.10) says of a plateau site,

"and it's more flat land up here, and more land for children to play on, and put buildings on".

Only from 14+ onwards is more than this achieved, except in two cases.

Level 2. Simple Human (economic or strategic): relief of course continues to play a part in the reasoning, but relief-related-to-human-activity is now dealt with. No. 38 (15.6), having used the spur site, says,

"because, say a long time ago, they would have defence, because they've got water at the bottom. and also they've got two slopes at the side, leaves only that area to defend".

In other cases, position with regard to possible routes was mentioned, or farming activities, for instance in the upper part of the valley.

Level 3. Complex Regional Activity: at this level there was cited, not just the local activities for a particular settlement, but its place in a local pattern of activities. One sixth-former and three students did this. No. 58 (34 yrs) gives something very much akin to Geddes "valley section",**

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*Quoted in full on P.225 below.

**Compare with quotation on p.87-88 above.

"You'd have the towns - the biggest areas of settlement down in the broadest part of the valley. You'd have a settlement here where the two streams meet, because of the change of land use and the access from this valley and this valley meeting.... and you'd get smaller settlement up here, villages, probably, and then scattered farms up here, depending on what type of countryside it is."

D. Spatial Sense: the evidence is taken from a later phase of the interview than that for the "spatial sense" of the landform; and it might be called "socio-spatial feeling".

Level 1. "Subjective feeling": this corresponds to the ego-centricity of the younger children, e.g. No.18, (11.5),

"and the ones on top wouldn't want to be too near the edge, it would be windy on top, so they'd keep away from the edge".

This child is just on the turning-point of getting away from this strong personal feeling, since he does mention farming activity later on.

Level 2. Feeling for local links: No. 30 (13.10) quoted for Level 2 of "ranking" shows this in placing settlement in relation to other settlement. This level was also considered appropriate, when the feeling for relative connectedness was elicited although not appearing spontaneously. It is not easy to give criteria, except disjunctively, i.e. "more than Level 1 but not up to Level 3".

Level 3. Spontaneous regional pattern: whereas No. 58 as quoted for Level 3 reasons gives a regional pattern explicitly, in many cases it was evident that there was an implicit sense of an extensive pattern; this often went with reference to landscape experience in which existed the sort of pattern that was being built into the model. The most unusual combination with other elements in his schema occurred with the mature student No. 59 cited on p. 121 as only using the ridge site. This might suggest a limited spatial schema, but in fact was related to a marked regional sense, much concerned with linkage to lowlands which must be envisaged beyond the model, only seeing steep slopes as isolating areas within the general schema.

E. Verbalisation: the same distinctions were made as for the "valley" concept. Thus No. 30 (13.10) and No. 58 (34.0) cited above on pp. 131 and 133 are both using Clear Common Language (Level 1/2) although the adult is more fluent than the child. No. 61 (39 yrs), for comparision with No. 58, uses more "geographical" language,

> "I would expect to find a settlement at the confluence of the two rivers. It could be broadly built across the confluence in fact. Settlements I expect would be more numerous further down the valley, getting to more arable land, more easily cultivated".

and has been classed at Level 3, which still implied the use of much common language, but more efficently expressed, and more usage of terms such as "confluence" instead of phrases such as "where two streams meet".

III. Criteria for LOCATION

A. Nodality:[x] i.e. the degree to which a site was seen as a route centre. This evidence was taken from the settlement/roads network on the model.

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[x] The figure quoted on P. 92 above gives a socialised concept of this (Fig. V.4.)

Level 1. Single links, e.g. as in example (f) on p.122, a settlement being linked to one other settlement, or to two settlements in a single "village-chain".

Level 2. Some nodal pattern, e.g. example (e) on p. 122, although the sited settlements have single links, the road over the plateau divides into three, giving nodal junctions where C and D leave B.

Level 3. Complex nodal pattern, e.g. (d) on p. 122 and (g) on p. 123, in which four or more roads meet at the confluence site.

B. Extent: this is taken from the comments on land use in relation to the settlement/road pattern which they had established.

Level 1. Localised: i.e. "patches" of land use dealt with in isolation, their "location" related to the immediate landform on that bit of the model, without comparing or contrasting any other area on the model. e.g. No. 52 (19.0) comments on the slope without differentiation,

"it's a bit steep to cultivate it here, should think sheep or might be forests".

Level 2. Comparison of areas: on the same question No.46 (18.0) says,

"maybe on the slope here (on the ridge) could be forest... and mainly down in the valley bottom the farmland, and higher up below the forest rough pasture".

Level 3. Extended areal variation: No. 44 (17.9) says,

"the valley bottoms would be meadows, but with the danger of flooding they would be hay meadows, but you would get cows in the lower slopes, and sheep on top, and trees on the steep slopes. And here it looks to be a bit flat, perhaps oats, here quite flat, you could have cultivated that, but on top it would be too windy for trees, just moorland".

As so often occurred with the more widely extended view, it was based on actual landscape experience (Wharfedale). With the older students especially a good deal of land use comment arose spontaneously in connection with the placing of settlements and roads, which was also used as evidence for this element of location of areas, as distinct from the point/line indications of "nodality".

C. Socialised Reasons:

Level 1. Personal activities: e.g. No. 10 (9.9) says of his routes,

"this house could lead to a town over there. These might be friends, so make a pathh to join it up. This one might lead to the woods to have a bit of pleasure".

This kind of reason dominated up to 12+.

Level 2. Simple land use concepts: mainly farming activities of the type arising in the quotations illustrating the "extant" concepts just dealt with above.

Level 3. Regional Pattern Identified: this might be landscape experience, such as the Yorkshire Dales, or school learning, e.g. the sixth formers were using the pattern of Alpine landscape which they happened to be studying at the time of the interviews. In the case of the locally experienced landscape, this implied an identification as a "regional type", not just the use of elements of that kind of landscape without integration into the "type" which is communicable by, for instance, saying "Yorkshire Dales landscape" and expecting this to be intelligible to the hearer.

D. Personal Awareness: what was looked for here was evidence that the subject was working within some mental representation of area.

Level 1. Fragmentary mental maps: some of the younger children did not seem to hold any area in their mind, but more usually there seemed to be limited areas that they were "looking at " e.g. No. 1 (7.4) could say how she got to the stream,

"cross and go down to Greengates and then turn up the other way (i.e., right) and go down a street and go over roadat bottom of it and go in long grass, and walk down a hill and get to stream"

Level 2. Continuity of mental maps: there were two children, one (No. 3 (7.6) who was half West Indian, and one, No. 5 (8.0), a West Indian, who showed a remarkable facility in mentally rambling over their local landscape with which their play activities had made them familiar. For No. 3, the given model was completely clothed with his own mental map; No. 5 drew an elaborate map with much running commentary in the modelling clay,

"it's right big and something like a bridge... it's all bricks, not like a bridge but you can go over it and there's a thing there, and you go on a bit and it's damp down there, and then there's the next bridge, going up like that, sometimes children play war and they go from there and go straight up there. And pretend that's where we live, we've a little way to go and there's a street coming there, and that's where they make boats, and there's a long stream. it goes right up to.. I think it turns round there, that's the next street, and comes round there"

This continued with other details such as the postbox and a "conker" tree. The "all bricks, not like a bridge but you can go over it" is easily identifiable in the locality. An older child No. 25(12.9), on looking at the Aloplast dome, before touching it, gave a long verbal description of a valley beginning in a hill area (at "limited common language level, which could not convey his mental map very adequately). It is not easy to quote for older subjects, for the judgment of continuity depended a great deal on the sequence of replies and modelling activity, quite complex detail could be given which appeared to be a sequence of verbal associations, while in other cases it seemed to be a visual moving over a pattern with verbal accompaniment. "Extended areal variation" or even "comparison of areas ("extent" element above) could not be achieved without it.

<u>Level</u> 3. <u>Personal mental map integrated into regional pattern</u>: because of the greater familiarity, this was more likely to be achieved with the local "Yorkshire Dales" pattern for instance, than the "Alpine" pattern, even if briefly visited on holiday. All the mature students were at this level, e.g. No. 61, having referred to the Aire valley in respect of his sand tray model, then compares the given model as more characteristic of the Hebden Bridge area; later he makes other comparisons with the Nidd valley. It is likely of course, that these students had more need to make use of their mental maps of regions in this way because they could not so

easily draw on "textbook concepts" with which to clothe the model landscape.

E. <u>Verbalisation</u>: the distinction of the use of limited common language (Level 1.) and clear common language (Level 2.) are similarly employed here. At Level 3 (one sixth former and six students, words such as "communications", areal indications like "industrial region", "lowlands", "highlands", relationship to North and South, occur. By contrast, at Level 1, "here" and "there", with reference to the equipment, are frequent.

Summary Table of Concept Grading Scores

The range of scores for each age group is given; these age groups are only broadly divided, but within each group the range of scores does not correlate with the internal age range. The Location scores are the most widely scattered. Individual scores are tabulated in Appendix B.

AGE GROUP	VALLEY	SETTLEMENT PATTERN	LOCATION	COMBINED SCORES
Students 18-20: 30-39	6 - 15	8 - 14	8 - 15	21 - 44
Grammar Examination forms 15+ - 17+	6 - 15	8 - 15	8 - 15	24 - 42
Grammar 13+ - 14+	3 - 9	7 - 11	5 - 11	18 - 29
Junior High 11+ - 13+	0 - 6	1 - 9	1 - 10	2 - 25
Junior 7+ - 10+	0 - 3	2 - 6	2 - 7	5 - 15

N.B. It should be borne in mind that the two top age groups are self-selective in terms of having a favourable attitude to the Subject since they have chosen to continue to study it.

Fig. VII.6.

CHAPTER VIII

DYNAMIC EPISTEMIC ANALYSIS

In Hannam's previous study of the use of concepts in fieldwork a logical sequence of thought about the problem presented was worked out, and was used as a standard for comparison with students' individual attempts to identify the problem of landscape interpretation and to produce hypotheses. By this means the general level of their logical thought operations was distinguished in a way which was comparable with their performance in some of the physical science tests used by Piaget and Inhelder. (Piaget and Inhelder, 1956, VIII.1.) These tests were administered on the pattern used by Lovell in his follow-up studies. (Lovell, 1961. VIII.2.) The structure of the analysis was strictly geared to extracting the logical elements in the performance. As has already been recalled in Chapter I (p.1), a whole series of questions was opened up by the surplus information provided by the interviews. One aspect, the quality of the individual schemata, may be dealt with by the kind of analysis presented in Chapter VII above. The other important major aspect, i.e., how were there ideas handled, what strategies of thought were being used? required some other mode of attack. The problem has been discussed at length by Bruner, (Bruner et al, 1956. VIII. 3.)

> "With respect to.... techniques for the study of cognitive processes, the processes whereby information about the environment is achieved, retained and transformed so that it may be utilised in situations other than the one in which acquisition occurred,

> it seems to us that there are several desiderata. First of all, to understand the intelligent or adaptive nature of behaviour, one must work with units larger than a single response, no matter how "molar" that response may be. One must, moreover, work with <u>sequences</u> of response if one is to appreciate the unfolding interplay between successive responses in reaction to prior circumstances ...... If, in studying problem-solving and conceptualizing and other allied activities, we are to emphasise the analysis of behaviour sequences, then it becomes necessary to <u>externalise</u> the component steps and decisions in order to get at them.... If behaviour is to be viewed as strategy, the task of analysis can only be accomplished by devising experiments that can get a lot of sequentially linked behaviour out of the organism where it can be observed".

"A Study of Thinking" is concerned primarily with categorizing operations: this might be one element among many in the present experiment, but the quotation above summarises the nature of the task involved, since the interviews have provided "a lot of sequentially linked behaviour". Now, can we retain the linked sequences and still relate them to the Epistemic categories which we have already applied to the socialised concepts of the academic discipline?

Meredith looked at the problem of "externalising" the behaviour sequences involved in teacher-pupil activities in classroom learning, and used the term, "Mathetics",

> "Mathetics represents the psycho-physical study of actual learning processes and is thus a branch of Epistemics".
> (Meredith, 1966b.VIII.4.)

In the original statement of Mathetics (Meredith, 1948. VIII.5) Meredith distinguishes it as being concerned with the variety of mental processes going on simultaneously in any learning process. In any lesson, however, at one particular moment, different phases may be dominant, e.g. the taking in of experience, inner events in the mind, or performance of actions. The teacher may be responsible for this "Mathetic structure" in his planning, but he will also adapt to the pupils' phases.

> "The role of the Mathetic Structure is primarily as a tool of research. When we have a sufficient number of such structures recorded for different teachers, different classes, and different topics we shall have some extremely valuable patterns to analyse, as psychological data, to throw fresh light on teaching and learning".
> (Meredith, 1966b. VIII. 6)

In other words, its function is to provide a work study tool, with the idea that it will provide a type of record equivalent to a musical score. With ruled paper a direct recording could be made. This would however demand extremely rapid judgments and recording decisions, though this might be possible in terms of the three phases instanced above.

To make a more detailed study of learning processes poses greater problems because of the complex judgments to be made in discrimination of the nature of the episode in the sequence. To use the eight syntactic Constants presented at the eight corners of the Cube may be possible if the progress is slow. To use the twenty four categories of vectors (i.e. the twelve edge relationships, in both directions) should give a more dynamic analysis, but more easily conceivable with pre-recorded material, for the Epistemic judgment will have to be made with the structural relations of the Cube in mind as the background to the focal point, line or area being considered as relevant to the episode(see Fig. IV.9. p. 74 above for the Geographer attending to Environmental Incidents).

For the present experiment first attempts to design a Mathetic tool which could serve to analyse interviews testing out geographical concepts of the individual were made using the recorded interviews from the earlier research on students' landform concepts. A "Process Vector" matrix was drawn up in an attempt to identify the twentyfour categories; verbal definitions was difficult to arrive at, so a rather curious jumble of phrases was produced, but serving their

U-E α	P - N - T The geographer determines his target.	R - S - L Perception determines the 'likeness'	J - X - W Phenomena mediated as cultural concepts	Q - H - B Equipment used determines the symbols, words.
E-U α	T - N - P Motivation influences decision	L - S - R Personal concepts direct perception	W - X - J Cultural concepts attributed to real landscape	B - H - Q Verbal & other symbols direct instrumentation
I-O β	Q - C - P Instruments influence personal interpretation	J - Z - R Phenomena as object of observation e.g. valley	W - F - L Cultural concepts in themselves as schemata	B - V - T Verbal concepts influence aims "teacher directives"
O-I β	P - C - Q The geographer constructs his instruments	R - Z - J Observation bringing environment into focus	L - F - W Personal concepts mediate library knowledge	T - V - B Motivation mediates interpretation of signs
A-Y γ	R - D - P Receptors influence personal achievement	L - M - T Formed concepts determine aims in geographical activities	W - K - B Cultural concepts emerge as words and symbols	J - G - Q Geographical phenomena mediated by instruments
Y-A γ	P - D - R Geographer's personal decisions effect selective perception	T - M - L Motivation selecting the schemata employed	B - K - W Words/symbols contribute to cultural concepts	Q - G - J Designed equipment selectively mediates geographical phenomena

Fig. VIII.1. Geographical Concepts: process vectors.

purpose at this stage of development. (Fig. VIII.1.)

The definitions (or more accurately, "verbal indicators") in Fig. VIII.1. were arrived at by attending not only to the relations between the pair of Syntactic Constants, but also to the orthogonal axis poles, i.e. the Surfaces. Thus the top row (α U to E) is causative, and the second (α E to U) embodies experience. The third row emphasised external events (β I to O) with an input to the organism, and the fourth row (β O to I) emphasises the organism controlling the events attended to. The fifth row, (γ A to Y) represents the input of accumulated associations, and the sixth (γ Y to A), focal decisive operations. (Compare with Figures III.6,7,8. pp.49-51

Attempts to make a sequence of judgments on the episodes in the interview records suggested that this matrix could form the basis of a "Thesaurus" of categories distinguishing cognitive episodes, but the two-dimensional matrix tended to lose touch with the Cultural Cube structure, and the first methods of recording tried out seemed very clumsy. In the spring of 1968, however, Professor Meredith, in exploring the possibilities of solid geometry, developed a type of tetrahedron which proved to be the key to unlock many problems of concentrating attention on one part of the Cultural Cube without losing touch with the basic orthogonal structure. This "Orthotron" functions as a "drop" of information (cf. semantic information, see p. 36 above).

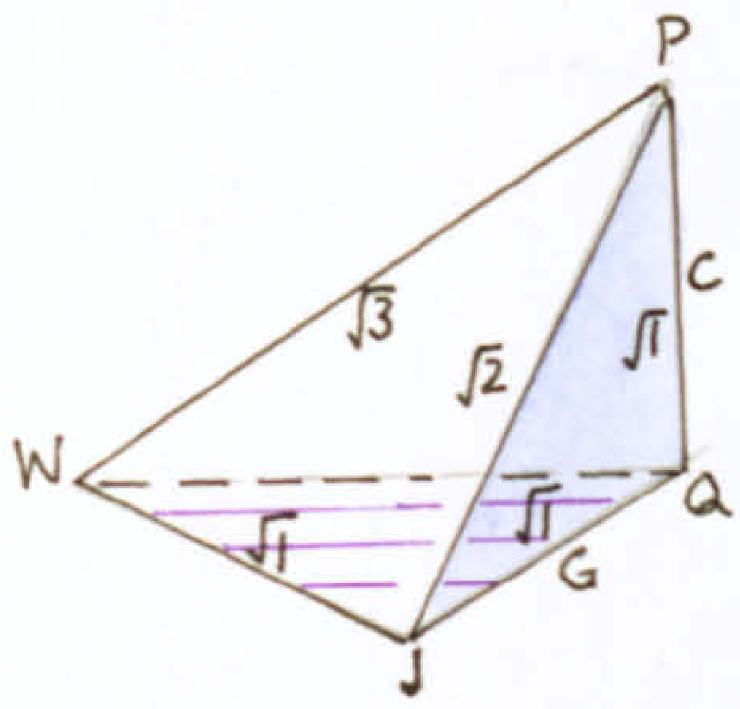

Fig. VIII.2.

Two faces of the tetrahedron (PQJ and QJW) in Fig. VIII.2. are isosceles right angled triangles with sides $\sqrt{1}, \sqrt{1}, \sqrt{2}$. The other two surfaces have sides $\sqrt{1}, \sqrt{2}, \sqrt{3}$. Thus each surface is a rightangled triangle, which maintains the orthochoric structure.*

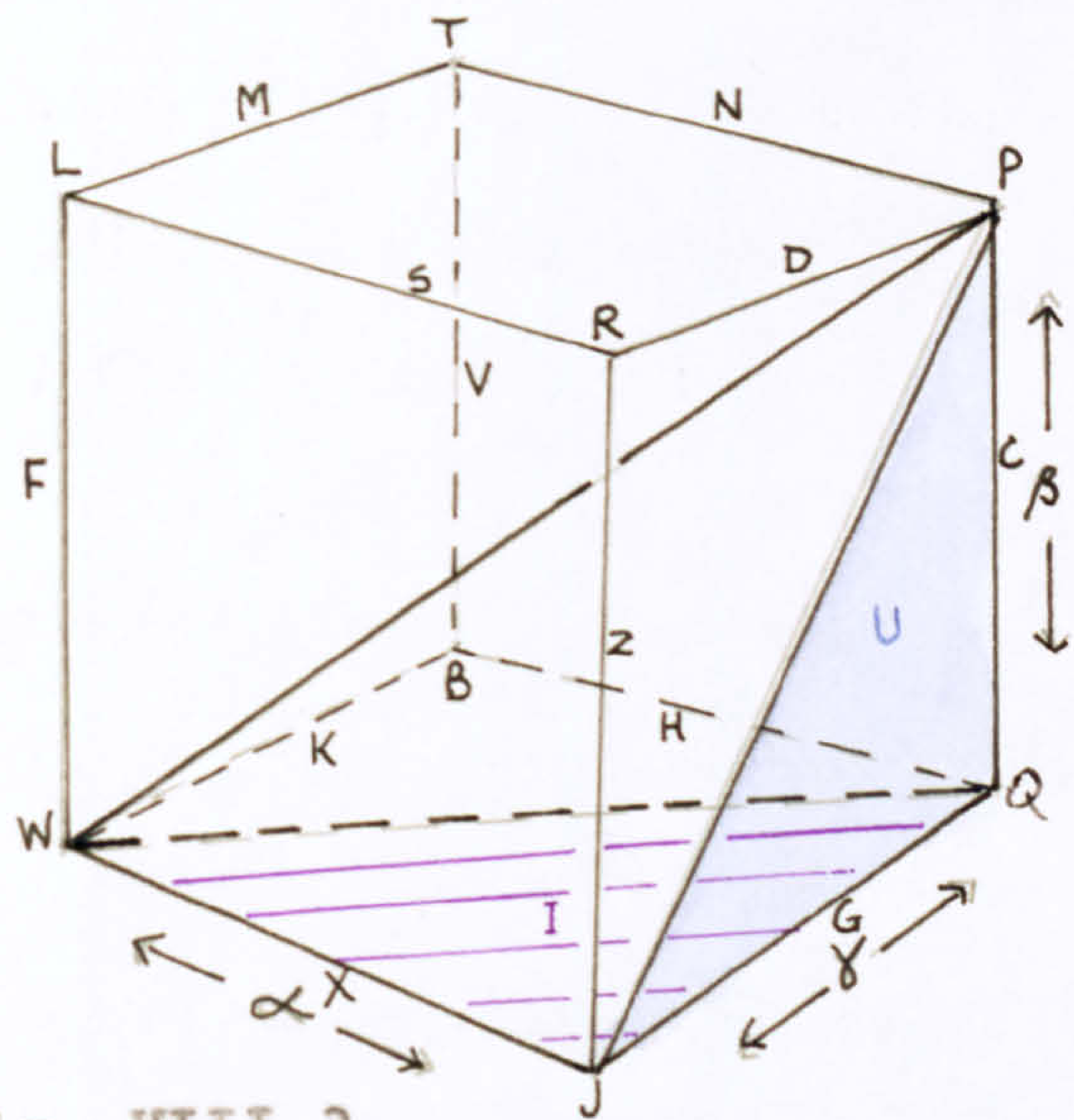

Fig. VIII.3.

A Cube can be sliced up into <u>six Orthotrons</u>, i.e. three Orthotrons in two paired sets which meet along one of the Oppositionals.** This means that there are <u>four ways</u> of building up the Cultural Cube, corresponding with the four Oppositional axes, "Making"(PW), "Minding" (TJ), "Mapping" (LQ), and "Meaning" (BR).

Used in this way, each Orthotron will include <u>three "process vectors"</u> (at rightangles to each other, thus including <u>all three orthogonal axes</u>, α, β, γ), <u>two adjacent surfaces</u>, and <u>one Oppositional axis</u>. Thus in the example in Fig. VIII.3. we have preserved a 3-dimensional path between W and P
W and P, embracing the three vectors X, G, and C, and half of

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*"determinate polyhedral forms of any degree of complexity including solid projections of polytopes (multi-dimensional structures) could all be analysed into a simple solid element which I have called the 'Orthotron' (Ortho-tetrahedron - i.e. tetrahedron on whose faces are all rightangled triangles)."
Meredith 1969. VIII.7.

**To build a Cube pairs of 'mirror-image' orthotrons are required, each set of 3 having 2/1 of the 2 types.

the surfaces I and U.

Here we have a "drop of information" which does not exceed Miller's "magical number seven, plus or minus two" in the number of its elements. Like the polypeptide chain of the bio-chemist it has built into its structure particular ways of linking as part of a string of beads in a sequence. If the Process Vector G is regarded as central in this example, links can be made through the vectors X and C which lie on either side of it, since they may appear as part of other Orthotrons in which are assembled another set of elements from the Cultural Cube.

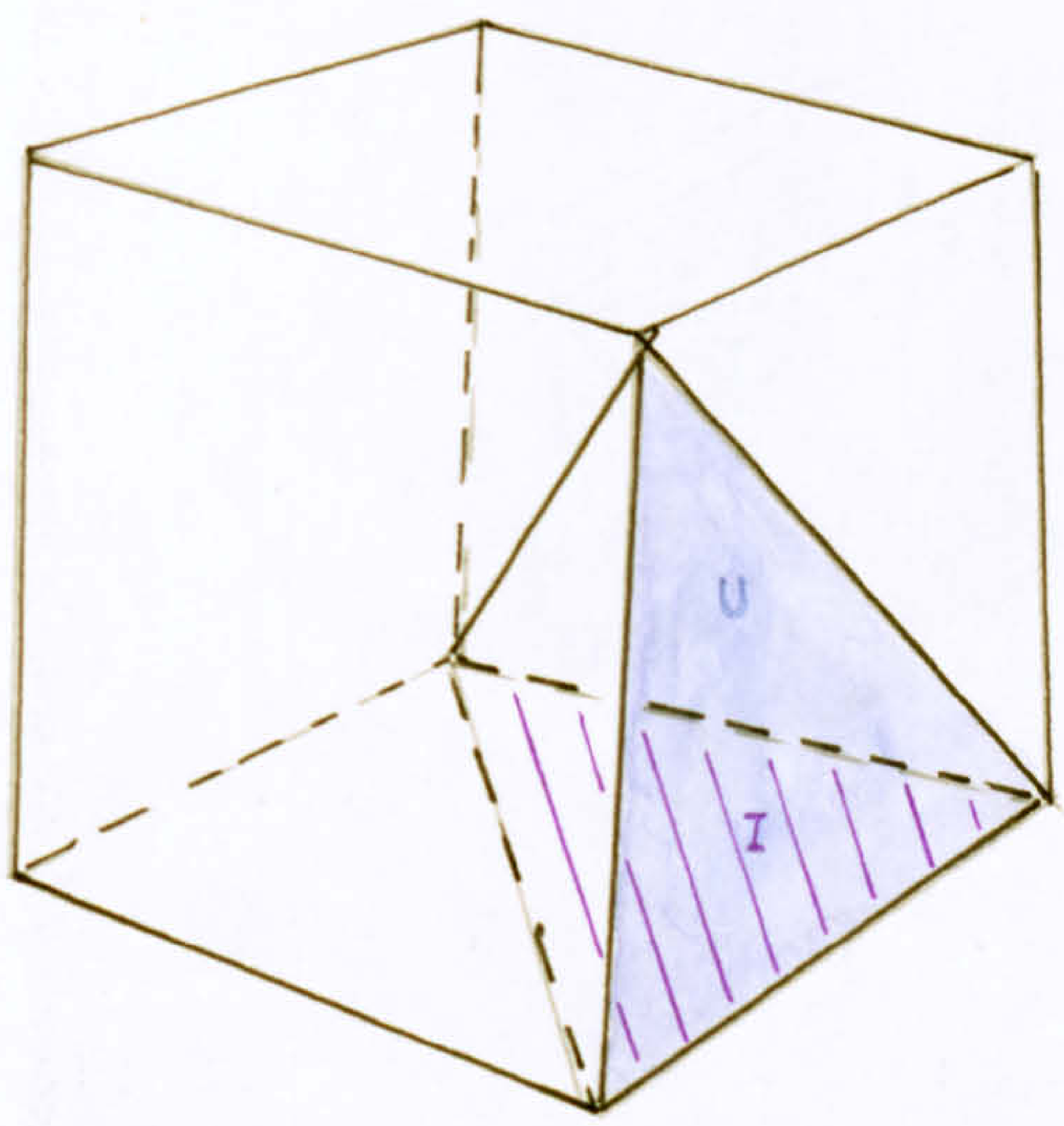


Fig. VIII.4.

In Fig VIII.4. a "mirror image" Orthotron is shown. The common elements are the vector G, which is a side of both isosceles triangles, and the surfaces U and I adjacent to it. But now the other possible related vectors Z and H appear, and the 3-dimensional path lies between B and R, which are linked more directly by the "Meaning" Oppositional BR, which forms the long edge of the Orthotron. Thus in this pair of Orthotrons two different bundles of information in which the vector G is central are held together Orthochorically.*

*Reference back to Figures IV. 7,8, p. 71 , will show that one Orthotron could be developed from Figure IV.8, p. 71 and two from Figure IV.7, p.71 , vector X being common to both.

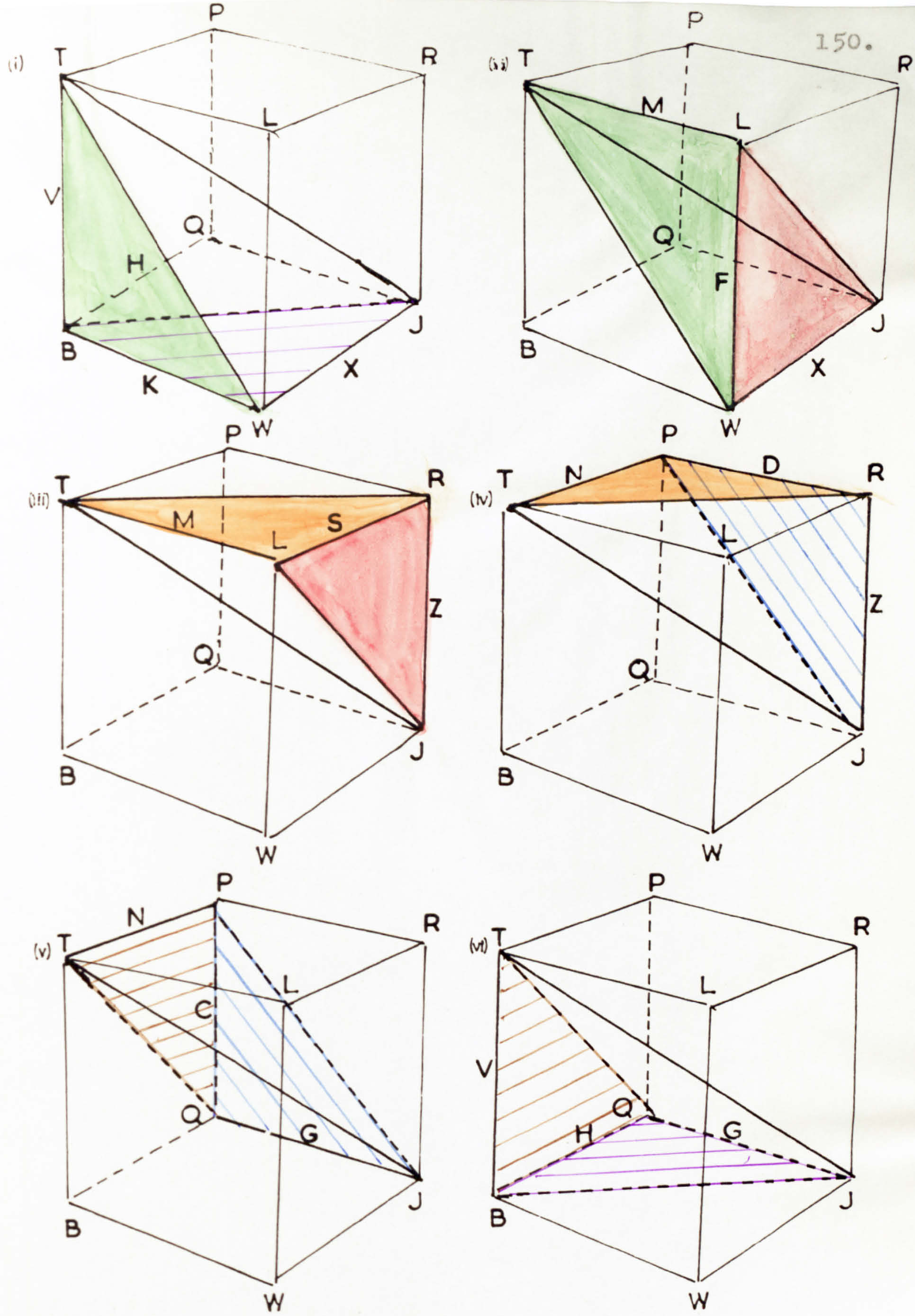
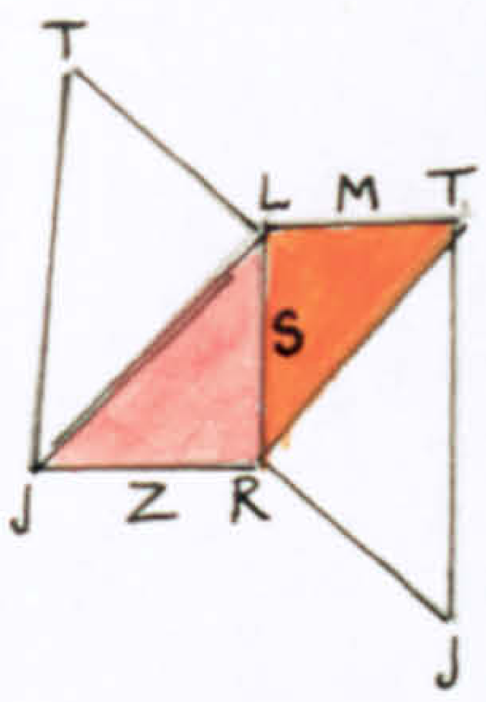


Figure VIII.5. The TJ Cube Set of Orthotrons.

The twenty-four Orthotrons were constructed and labelled. The actual manipulation of the solids was vital in analysis because of the limitations of two-dimensional representation, which has of course to be used in recording, so a cut-out set of Orthotrons to form one Cube set is to be found at the back of this volume* to assist in the presentation. The set is illustrated in Fig. VIII.5.

To provide a simpler form of presenting an Orthotron two-dimensionally part of its constructional net has been used.



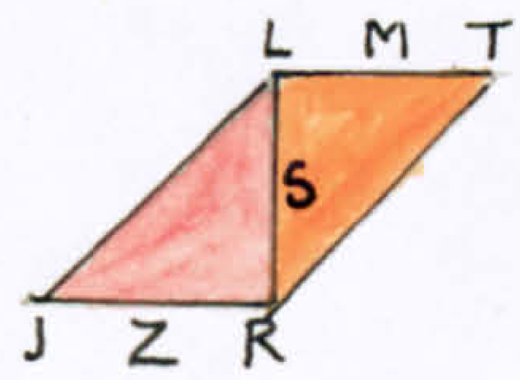


Fig. VIII.6. Orthotron Net

(i) shows the full net for the solid construction.

(ii) shows the curtailed net; no information is lost about the Orthochoric relations.

Some symbolic means of identifying the individual Orthotrons is needed. Each is referred to by the identifying letter of the vector which forms the side shared by the two isosceles triangles, combined with the Oppositional axis, thus S/JT

To distinguish the mirror-image pairs, the Orthotrons are regarded as "righthanded" and "lefthanded". This one is righthanded, i.e. as shown below, whichever way it stands on

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* In pocket in back cover.

the LQ Oppositional, the acute angle is to the right.

Fig. VIII.7.

Lefthanded is identified by 'minus', righthanded by 'Plus', so this one is $\overset{+}{S}$/JT.

Finally, to identify a positive* directional path through the Orthotron, the <u>dominant identified vector</u> is considered as moving outwards in a Neighbourhood, i.e. in this case <u>from R to L</u> (On the way from J to T by the three-dimensional path Z-S-M), which puts it into the Neighbourhood of R. Adding this to the code, it is $\overset{+}{S}$/JT(R). As <u>S</u> is the <u>dominant vector</u>, <u>M</u> and <u>Z</u> will be spoken of as the '<u>minor vectors</u>' in this Orthotron.

While this code may appear elaborate, it retains all the information necessary to place the Orthotron in the Epistemic Cube as shown in Fig. VIII.5. (iii) together with its dynamic direction. Having thus established a terminology for reference to the Orthotrons it is possible to proceed to the "<u>Thesaurus</u>" of Orthotrons which was developed from the matrix of process vectors (Fig. VIII.1. p. 146). By refining

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*The directions U - E, I - O, A - Y, on the Orthogonal axes are taken as positive, the opposite as negative. See Fig.VIII. 8, p.155 for the consistency of this system. See also p.48 above; the positive direction may be thought of as leading from the physical to the psychological event, e.g. in this example from the perceptual intake of information to the structured conception.

the verbal indicators through empirical trials, and linking them in the Orthotron structure the nature of the operation represented in the episode was defined. They are tabulated first of all as twelve pairs with a common verbal indicator of generalised character. Again, it was not easy to find these indicators, and they are fully understandable only in the light of the full sequences of indicators in the Thesaurus definitions which follow.

ORTHOTRON THESAURUS

Introduction

1. The Orthotrons are presented in the sets associated with the orthogonal axes. This makes for easy co-ordination of the verbal iddicators.
2. For each pair of lefthanded and righthanded orthotrons a single generalised verbal indicator has been found. It is convenient to have such indicators for reference in exposition.
3. The alphabetic code indicator for each orthotron is given (see p. 151 - 153 for the general significance of this).
4. The curtailed net is then given. The letter beside it, e.g. $\overset{\uparrow}{E}$ shows the direction of movement on the dominant axis. This is done as a corrective because the net shows one pole of each of the other two orthogonal axes but has no remainder of the 'dominant'. (refer back to p. 151 for information about the net).
5. The name of the Oppositional axis is given (since the letters, e.g. LQ, appear at opposite ends of the net they are not repeated).
6. A summarizing verbal indicator is given for the whole orthotron.
7. This is followed by the detailed indicators for the three vectors, reading in a positive direction, i.e. towards the left in a lefthanded (minus) orthotron, and towards the right in a righthanded (plus) orthotron).
8. The Syntactic Constant in whose Neighbourhood the orthotron is regarded as lying is circled, e.g. (T) .
9. Tabulation of orthotrons in their Oppositional sets is to be found on pp. 237-257 below in Chapter X.

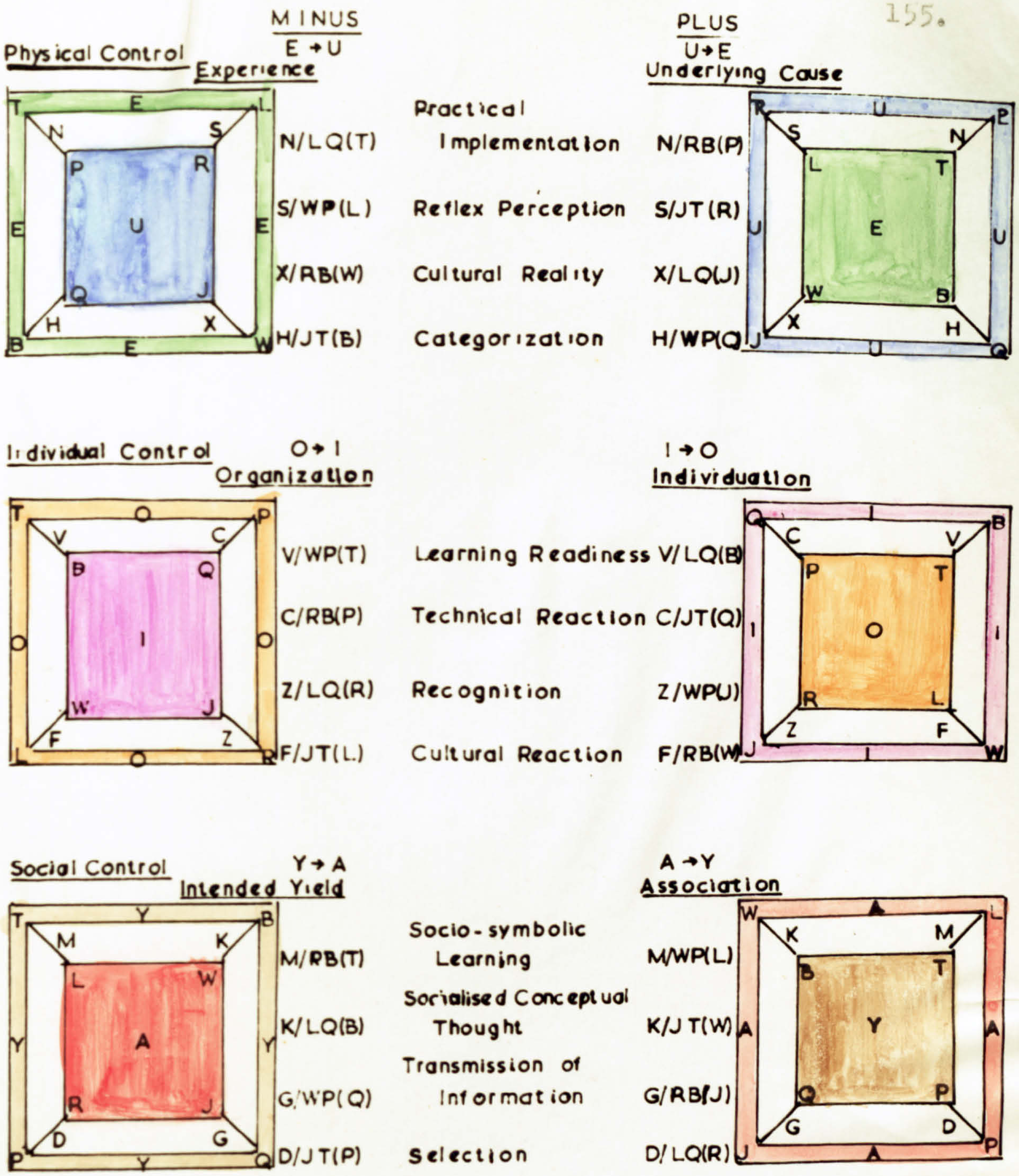
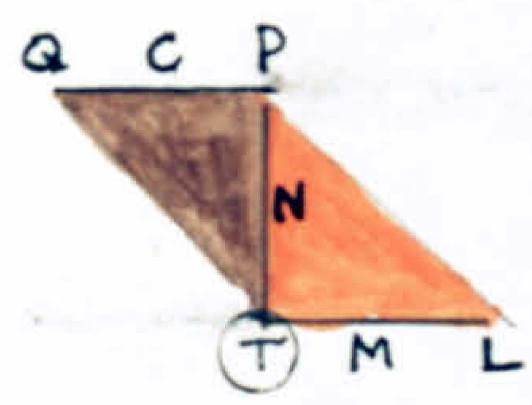


Figure VIII.8. Summary Table of Orthotrons relating to Orthochoric Surfaces.
(the projection is looking through the Cube to the opposite face)

Physical control*

Practical Demonstration or Expression

$\bar{N}$/LQ(T)



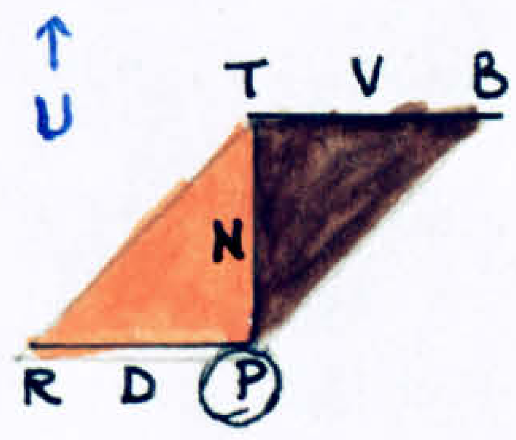
Mapping
A schema is put into action meaningfully

L-M-T Schema meaningful in thought

T-N-P Motivated thought triggers action by organism

P-C-Q Construction or use of equipment

$\overset{+}{N}$/RB(P)



Meaning
A percept is expressed in meaningful symbol

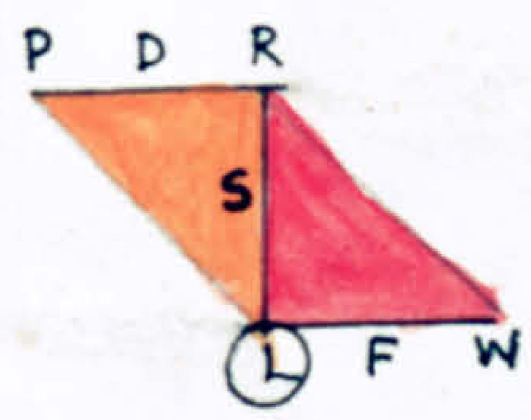
R-D-P Perceptual response triggers action by organism

P-N-T Organising a dynamic thought

T-V-B Motivated thought selects symbolic form

Reflex Perception

$\bar{S}$/WP(L)



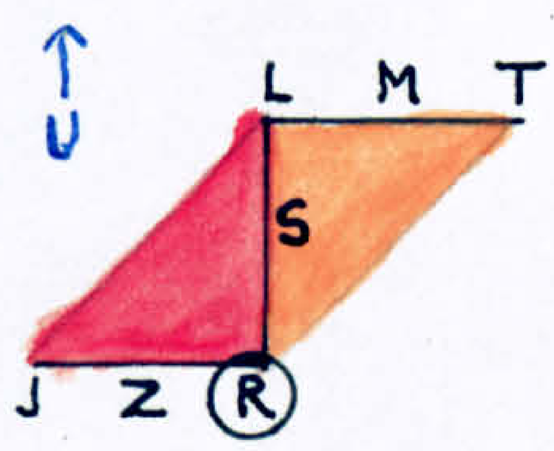
Making
Learning from cultural store structures perceptual decisions

W-F-L Socialised concept assimilated to individual schema

L-S-R Schema organises perceptual response

R-D-P Perceptual response triggers action by organism

$\overset{+}{S}$/JT(R)



Minding
Perceived reality matches structure of thought

J-Z-R Environmental phenomena as the object of perceptual response

R-S-L Phenomenon assimilated into schema

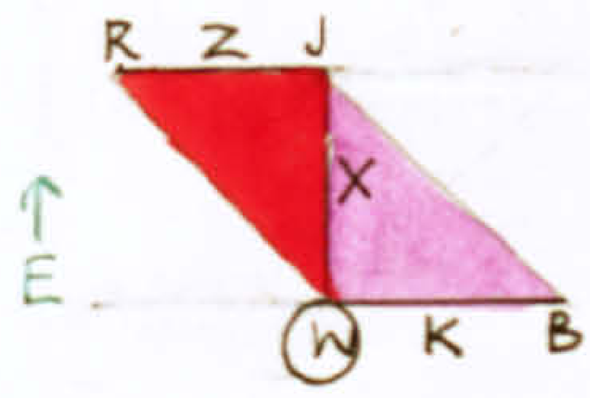
L-M-T Schema becoming meaningful in thought

Fig. VIII.9.

*Positive movement outwards, i.e. left in lefthanded (-) right in righthanded (+) Orthotrons. Negative movement in the opposite direction may also be invisaged.

Cultural Reality

$\bar{X}$/RB(W)



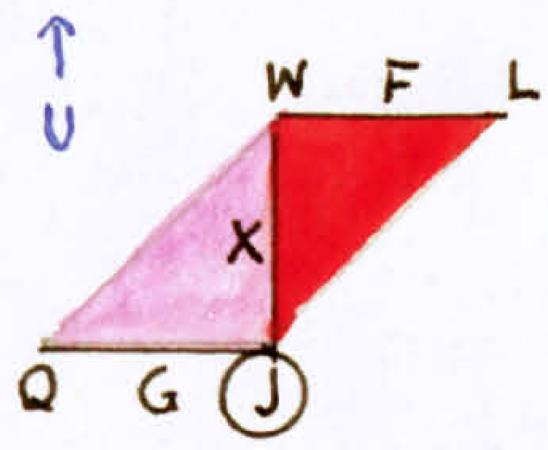
Meaning
Cultural Verbal Concepts mediating perceived reality

B-K-W Bits of information filed in symbols in cultural store

W-X-J Cultural bit representing environmental phenomenon

J-Z-R Phenomenon as the object of a perceptual response

$\overset{+}{X}$/LQ(J)



Mapping
Equipment mediating phenomenon to cultural store and functioning as schema

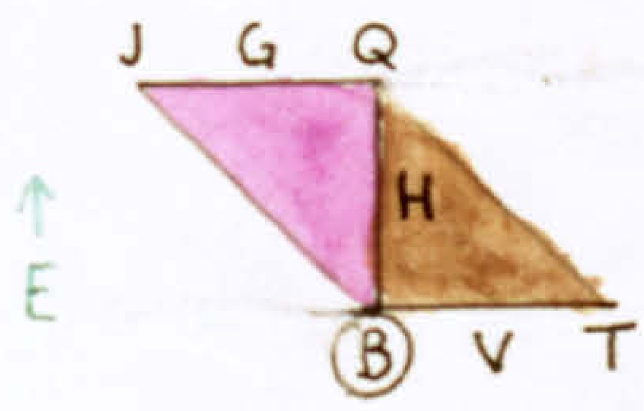
Q-G-J Equipment applied to transmitting phenomenal information

J-X-W Phenomenon filed in concept in cultural store

W-F-L Socialised concept assimilated to individual schema

Categorization

$\bar{H}$/JT(B)



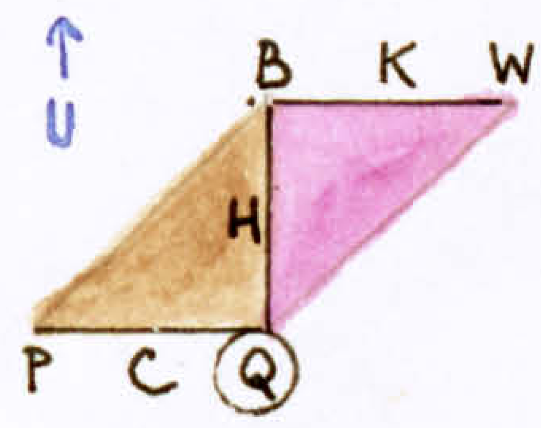
Minding
Verbal or other symbols guide (or serve as) instrumentation

T-V-B Motivated thought selects symbolic form

B-H-Q Symbolism embodied in instrumentation

Q-G-J Equipment applied to transmitting phenomenal information

$\overset{+}{H}$/WP(Q)



Making
Measurement of categorization into verbal (symbolic) concepts

P-C-Q Construction or use of equipment

Q-H-B Equipment issues ideas as symbols

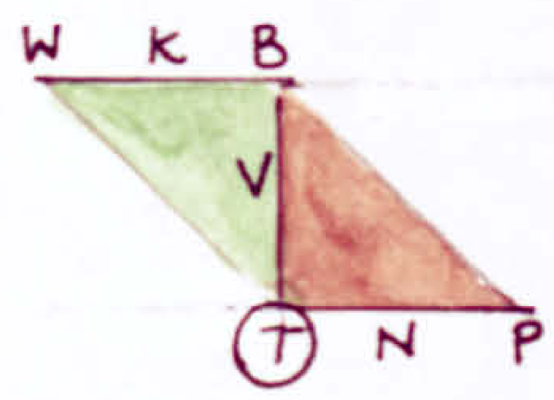
B-K-W Bits of information filed in cultural store

Fig. VIII.10.

Individual Control

Learning Readiness

$\bar{V}$/WP(T)



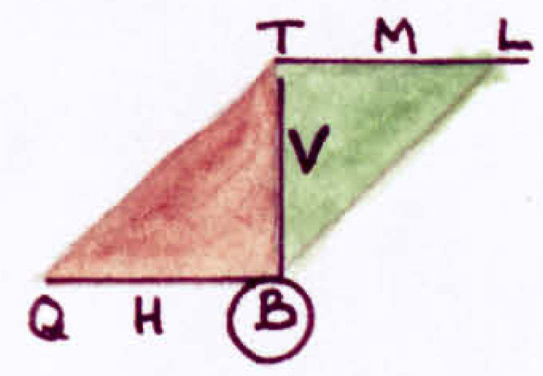
Making
In a state of readiness towards acceptance of a symbolised concept

P-N-T Organising a dynamic thought

T-V-B Motivated thought selects symbolic form

B-K-W Bits of information filed in symbols in cultural store

$\overset{+}{V}$/LQ(B)



Mapping
Transmission of symbols activates conceptual learning

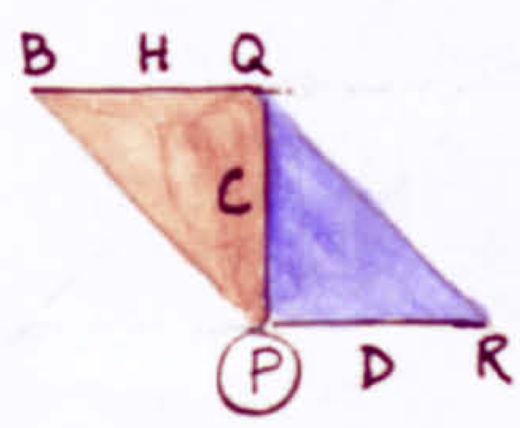
Q-H-B Equipment issues ideas as symbols

B-V-T Symbols trigger dynamic thought

T-M-L Dynamic thought activates schema

Technical Reaction

$\bar{C}$/RB(P)



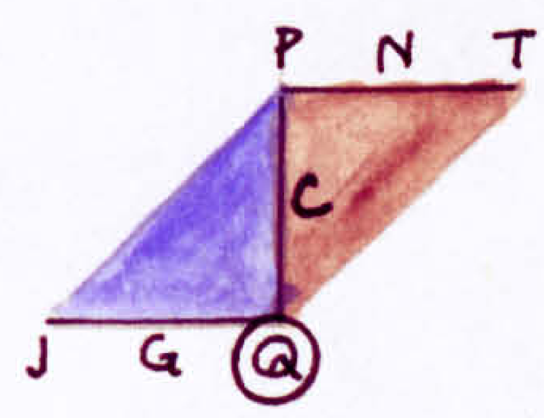
Meaning
Physical response triggers action to produce symbolic form

R-D-P Perceptual response triggers action by organism

P-C-Q Construction or use of equipment

Q-H-B Equipment issues ideas as symbols

$\overset{+}{C}$/JT(Q)



Minding
Information transmitted to the organism triggers motivation

J-G-Q Transmission of phenomenon as information (by instrument)

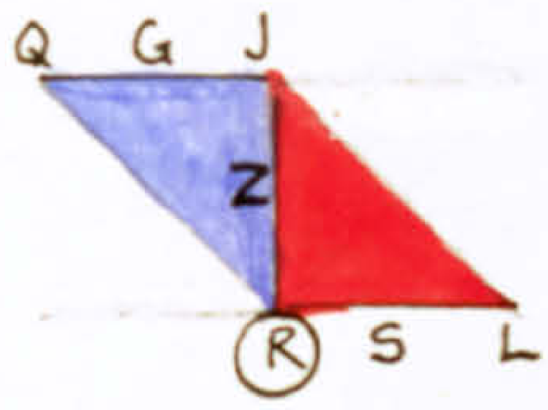
Q-C-P Equipment causing reaction by operator

P-N-T Organising a dynamic thought

Fig. VIII.11.

Recognition

$\overset{-}{Z}$/LQ(R)



Mapping

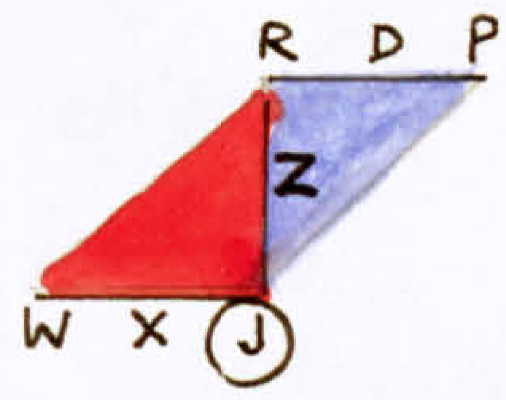
Structured perception brings reality into focus as an instrument (i.e. of thought)

L-S-R Schema organised perceptual response

R-Z-J Perceptual response mediates environmental phenomenon

J-G-Q Transmission of phenomenon as information (by instrument)

$\overset{+}{Z}$/WP(J)



Making

Cultural idea dominates perception and its interpretation

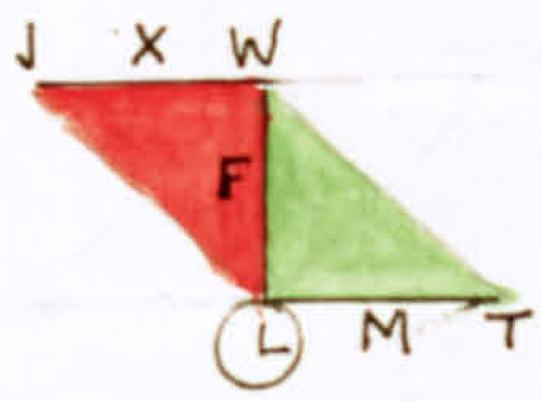
W-X-J Cultural bit representing environmental phenomenon

J-Z-R Environmental phenomenon as object of perceptual response

R-D-P Perceptual response triggers action by organism

Cultural reaction

$\overset{-}{F}$/JT(L)



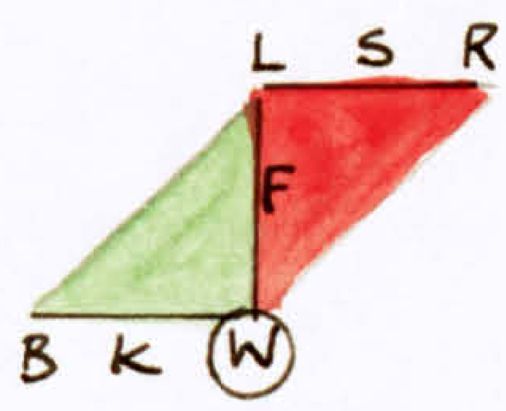
Triggering of a personal schema referring to a cultural interpretation of reality

T-M-L Dynamic thought activates schema

L-F-W Schema contacts a cultural concept

W-X-J Cultural bit representing environmental phenomenon

$\overset{+}{F}$/RB(W)



Symbol of cultural concept used in schema to view a percept

B-K-W Bits of information filed in symbols in cultural store

W-F-L Socialised concept assimilated to individual schema

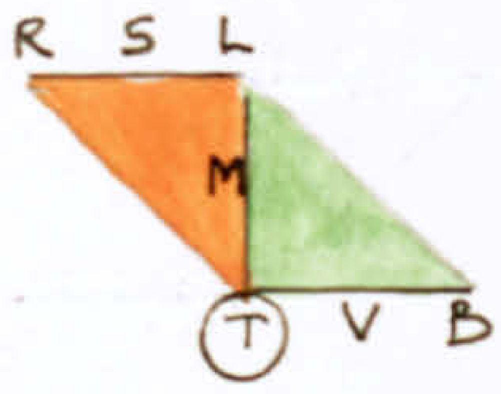
L-S-R Schema organises perceptual response

Fig. VIII.12.

Social Control

Socio-Symbolic Learning

$\bar{M}$/RB(T)



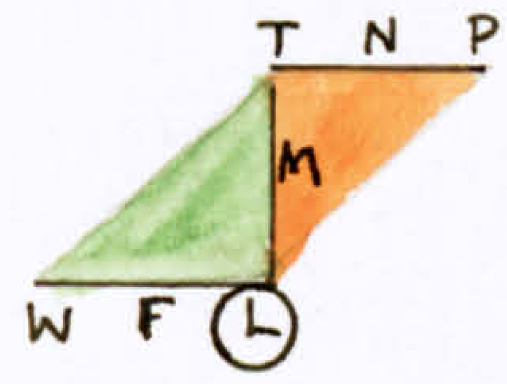
Meaning
A Symbol triggers thought behaviour and modulates schemata structuring perceptual response

B-V-T Symbols trigger dynamic thought

T-M-L Dynamic thought activates schema

L-S-R Schema organises perceptual response

$\overset{+}{M}$/WP(L)



Making
Cultural concepts assembled in a way relevant to the context, i.e. operational

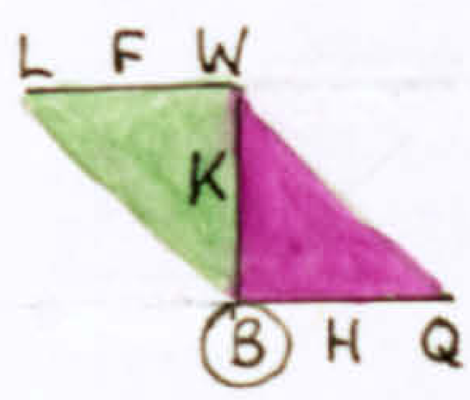
W-F-L Socialised concept assimilated to individual schema

L-M-T Schema becoming meaningful in thought

T-N-P Motivated thought triggers action by organism

Socialised Conceptual Thought

$\bar{K}$/LQ(B)



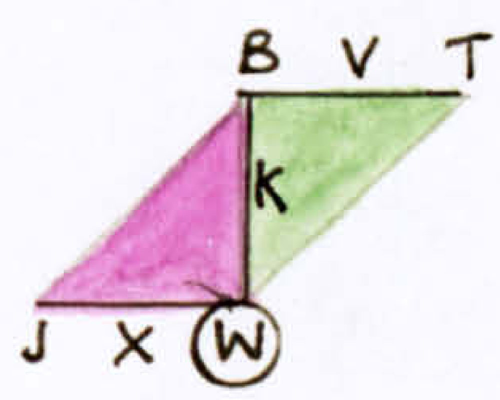
Mapping
Transmitted symbol going into cultural store is assimilated to conceptual schema

Q-H-B Equipment issues ideas as symbols

B-K-W Bits of information filed in symbols in cultural store

W-F-L Socialised concept assimilated to individual schema

$\overset{+}{K}$/JT(W)



Minding
Reality as represented in cultural store emerges as words (or symbols) triggering thought

J-X-W Phenomenon filed in concept in cultural store

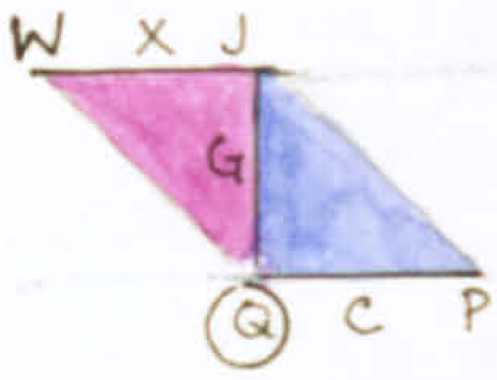
W-K-B Cultural concept mediated as symbol

B-V-T Symbols trigger dynamic thought

Fig. VIII.13.

Transmission of Information

$\overline{G}$/WP(G)



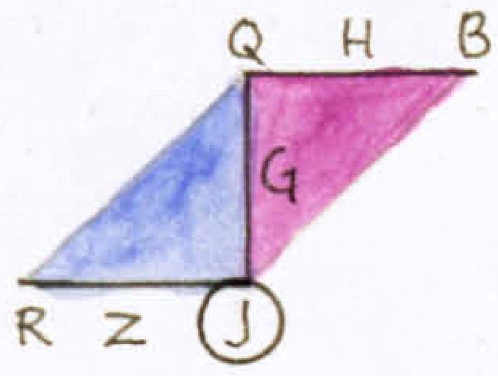
Making
Operation of equipment which transmits information from environment which is classified already in cultural store

P-C-Q Construction or use of equipment

Q-G-J Equipment applied to transmitting phenomenon

J-X-W Phenomenon filed in concept in cultural store

$\overset{+}{G}$/RB(J)



Meaning
Perceptual response to environmental phenomena is registered by instrument and is symbolised

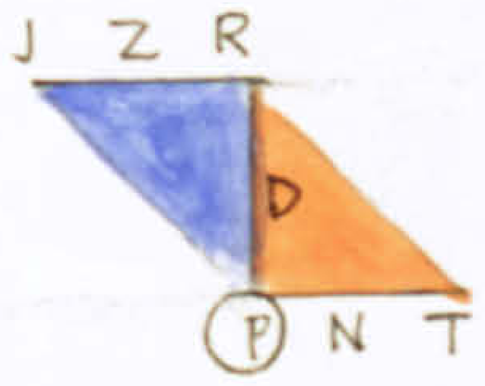
R-Z-J Perceptual response mediates environmental phenomena

J-G-Q Transmission of phenomenon as information (by instrument)

Q-H-B Equipment issues ideas as symbols

Selection

$\overline{D}$/JT(P)



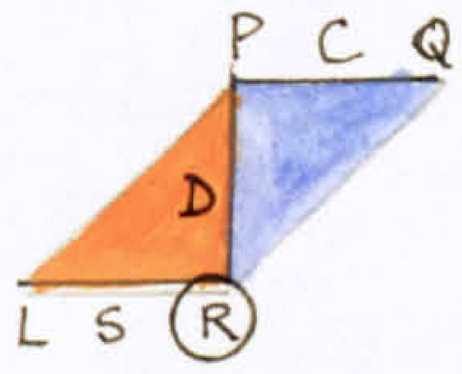
Minding
Motivation controlling selective perception

T-N-P Motivated thought triggers action by organism

P-D-R Positive direction of a perceptual response

R-Z-J Perceptual response mediates environmental phenomenon

$\overset{+}{D}$/LQ(R)



Mapping
Conceptual structuring of perceptual response leads to purposeful activity

L-S-R Schema organises perceptual response

R-D-P Perceptual response triggers action by organism

P-C-Q Construction or use of equipment

Fig. VIII.14.

A theoretical check on the Thesaurus

In presenting the Neighbourhoods of the Syntactic Constants in Chapter III (p.47-48) the verbal indicators used were taken from Meredith (1967 op cit.) They are introduced there in a sequential setting, which is reproduced in Figure VIII.15. He introduces this "string of pearls" as "but one instance of many alternative sequential structures among interrelated events". He is concerned with identifying the "epistemic status" of events in terms of the eight Syntactic functions, but he also shows the vectors between them. These verbal indicators do not cover the whole series of twenty-four but there are sufficient to serve to check the nature of the Thesaurus identifications.

(i) T-N-P: "theoretical information" -
Thesaurus:- "motivated thought triggers action by organism"
(the theoretical information is moving towards "procedural decision", P., so also implies "triggering action").

(ii) P-N-T: "decision to investigate"
Thesaurus:- "organising a dynamic thought"
(intention is similar)

(iii) T-M-L: "theoretical assertion" -
Thesaurus:- "Dynamic thought activates schema"
(intention is similar)

(iv) L-M-T: "structural basis of theoretical answer"
Thesaurus:- "schema becoming meaningful in thought"

(v) P-D-R: "sensory information"
Thesaurus:- "positive direction of a perceptual response"

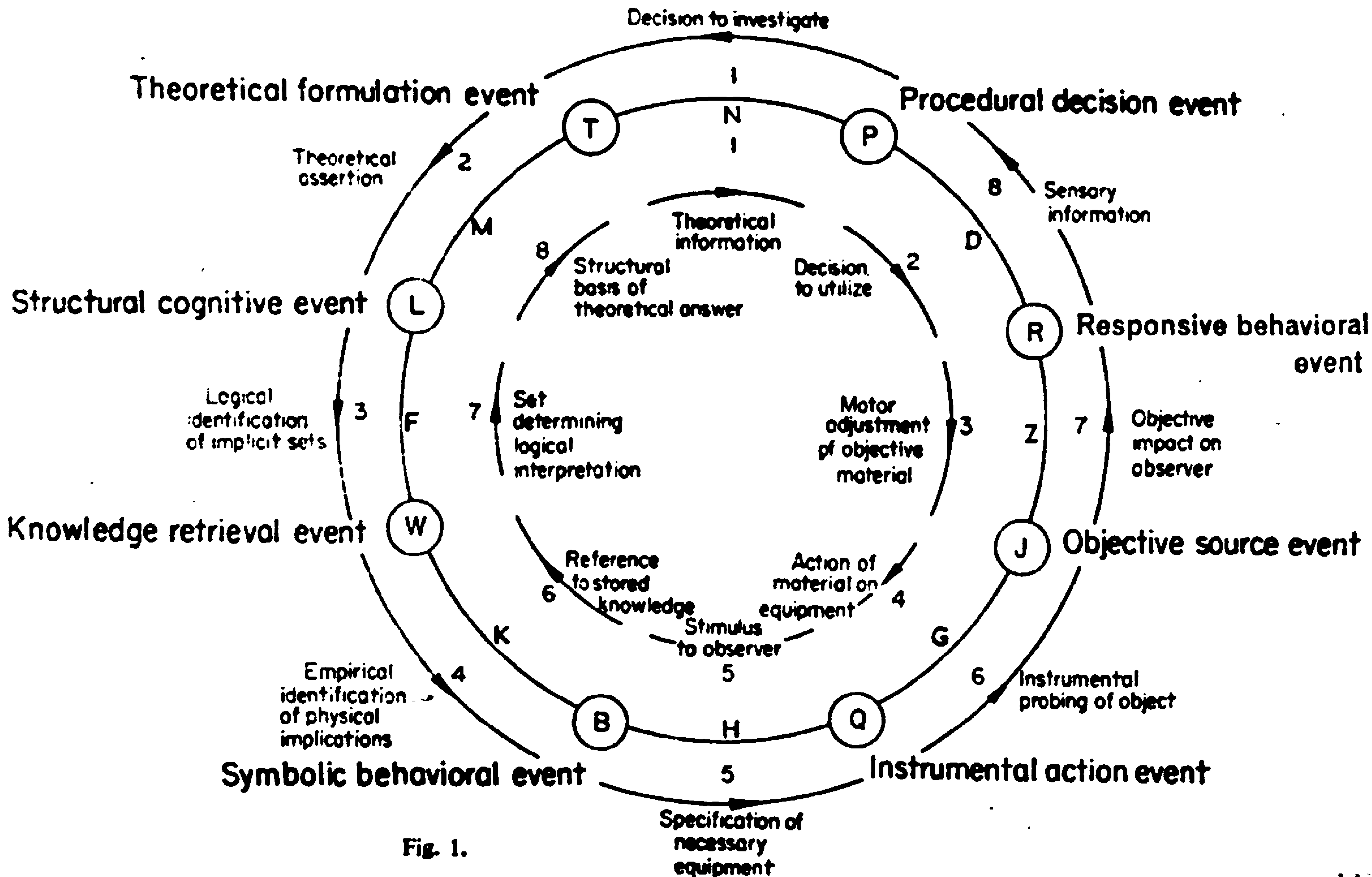


Fig. 1.

Figure VIII.15. **Theoretical Sequences from Meredith, 1967. III. 29, p. B2.**

(Process Vector letters have been added)

(vi) R-D-P:- "decision to utilise"
Thesaurus:- "perceptual response triggers action by organism"

Granted that these phrases have been devised, the one in the context of mathematical education, the other in the context of geographical education, there appears to be reasonable correspondence. The Thesaurus identifications are in fact more neutral, since Meredith has in mind "an instance" of sequential structure, whereas the Thesaurus was constructed non-sequentially except in the limited span of an Orthotron.

Since the Orthotrons are to be used in sequential Mathetic analysis and Meredith's "string of pearls" gives us an instance of a sequence, it is possible to translate his two sequences shown in circular form in Fig VIII.15 into two flow diagrams constructed with Orthotrons (Figs. VIII.16 and VIII.17.). One of the two minor vectors of an Orthotron becomes the dominant vector in the succeeding Orthotron. Orthotron nets are shown in sequence linked by arrows. The Syntactic Constants have been inserted in order, the chart reading upwards from the bottom of the page like an AA route map. Labelling of the dominant Orthotron vectors has been kept to the sides. Opposite are displayed the summary verbal indicators of the Orthotrons.

Looking at Fig. VIII.16 the introductory Orthotron $\bar{N}$/LQ(T) immediately gives us an answer to the slight disparity of expression in the comparison (ii) above. For this is the negative direction of the lefthanded Orthotron, not the positive direction of the righthanded one from which the

Thesaurus definition was taken.* Why then, has $\bar{N}$/LQ(T) been selected instead of $\overset{+}{N}$/RB(P)? Because this is a theoretical example in which the track is already defined; we have to move from N-to-M-to-F-to-K etc, so the minor vector M must appear in the first Orthotron so that it will lead to the dominant vector in $\overset{+}{M}$/WP(L)- which in its turn will chain its minor vector F to the dominant vector in $\overset{+}{F}$/RB(W)- and so forth. Each "episode" is thus linked to the next, the mode of connection retaining the Epistemic structure.

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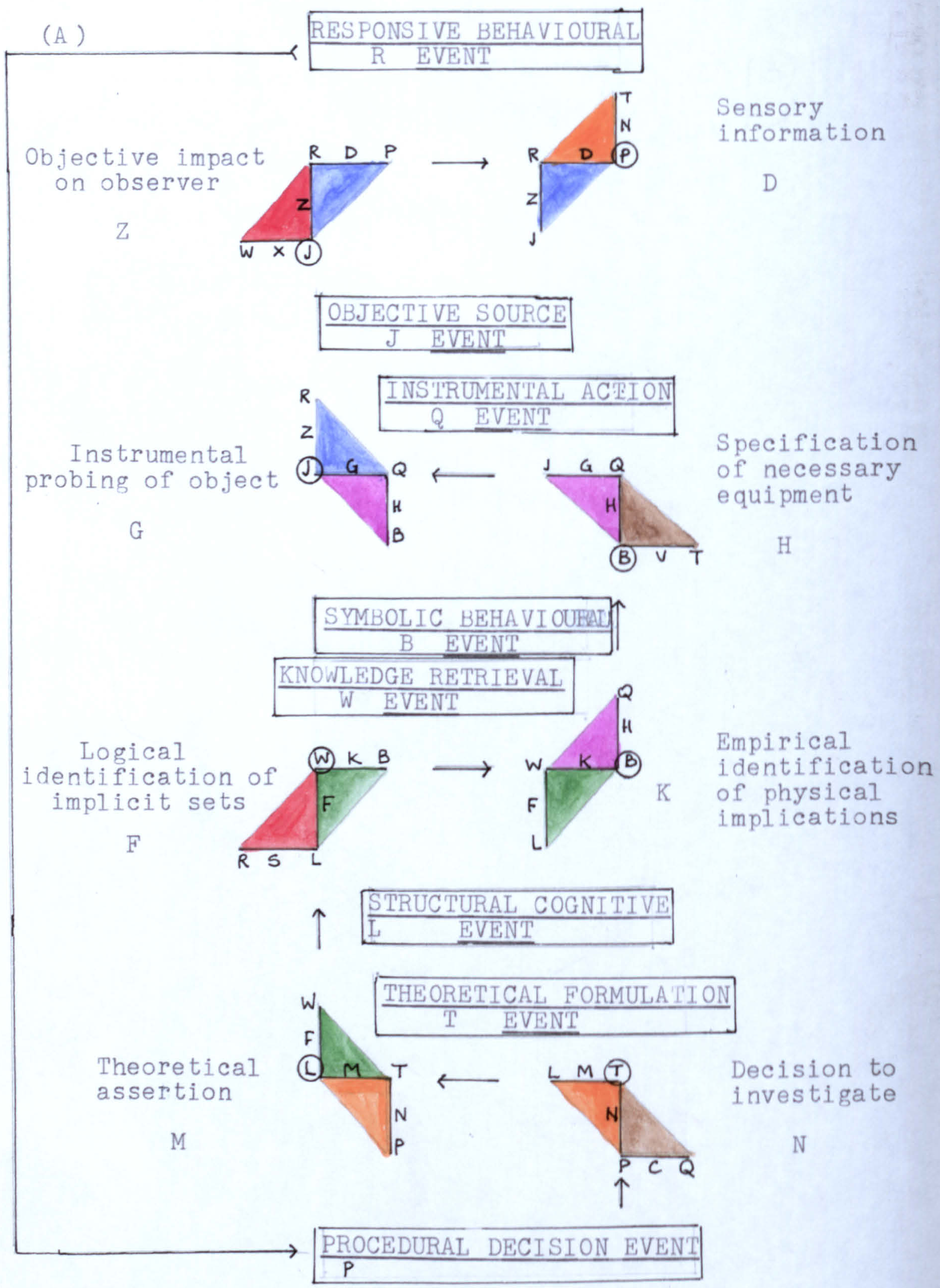
*Refer to p. 156.

Fig. VIII.16



(A)
RESPONSIVE BEHAVIOURAL
R EVENT
Objective impact on observer
Z
R D P
Z
W X J
R D P
T N
Z J
Sensory information
D
OBJECTIVE SOURCE
J EVENT
INSTRUMENTAL ACTION
Q EVENT
Instrumental probing of object
G
R Z J G Q H B
J G Q H B V T
Specification of necessary equipment
H
SYMBOLIC BEHAVIOURAL
B EVENT
KNOWLEDGE RETRIEVAL
W EVENT
Logical identification of implicit sets
F
W K B F R S L
Q H W K B F L
K
Empirical identification of physical implications
STRUCTURAL COGNITIVE
L EVENT
THEORETICAL FORMULATION
T EVENT
Theoretical assertion
M
W F L M T N P
L M T N P C Q
Decision to investigate
N
PROCEDURAL DECISION EVENT
P

Theory - Proof. Expanded flow diagram

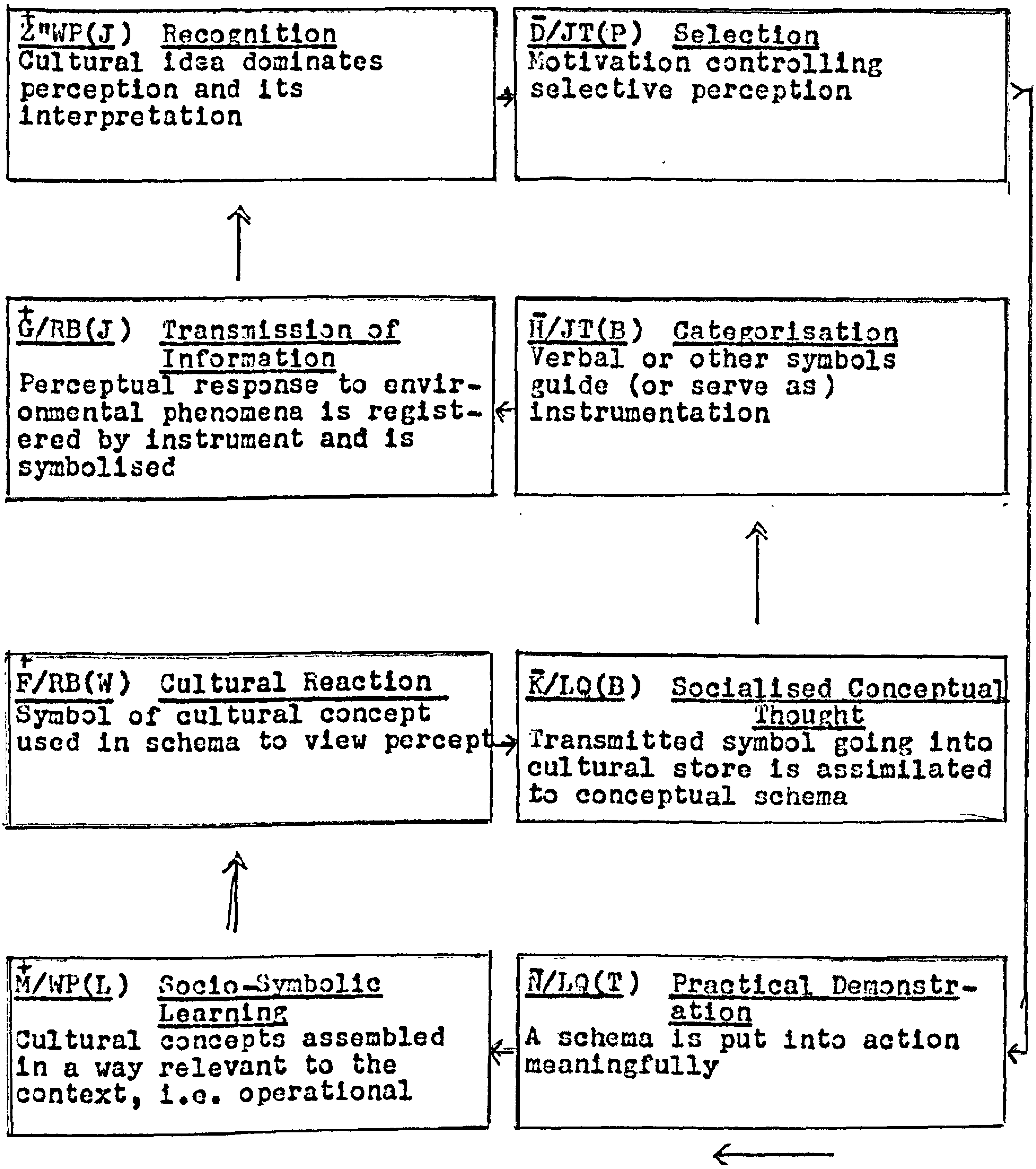
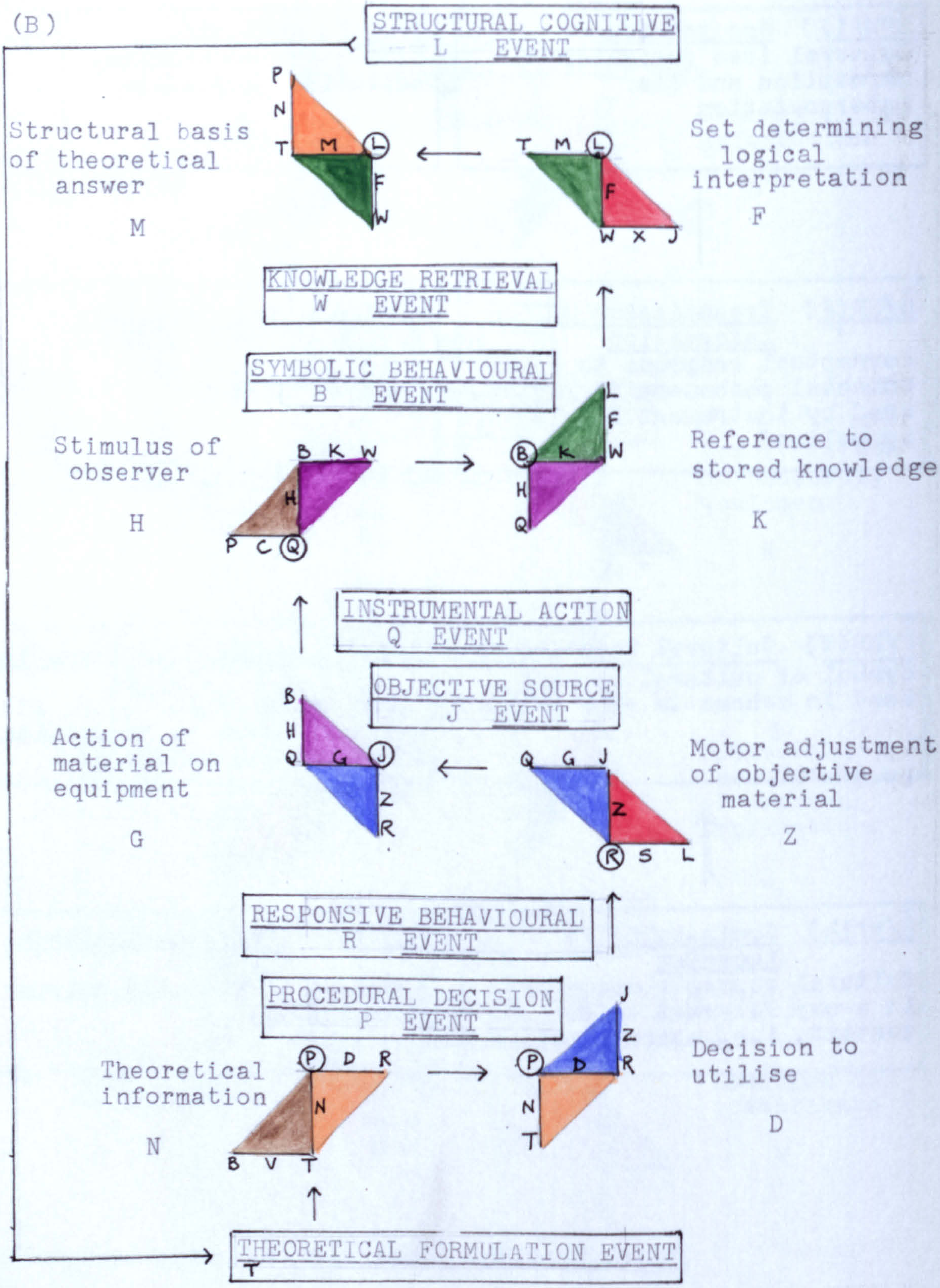
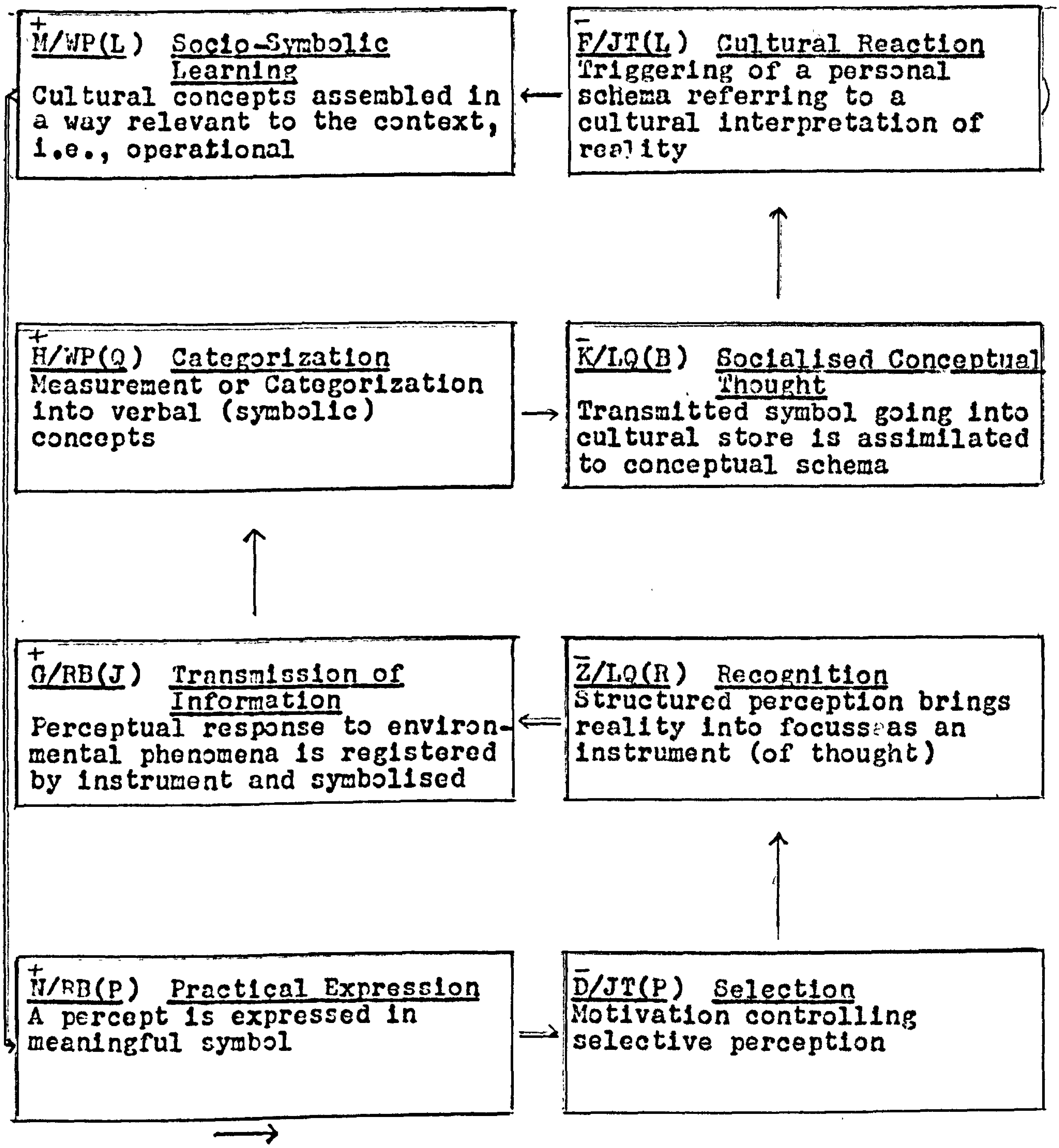


Fig. VIII.17.



(B)
STRUCTURAL COGNITIVE L EVENT
Structural basis of theoretical answer
M
Set determining logical interpretation
F
KNOWLEDGE RETRIEVAL W EVENT
SYMBOLIC BEHAVIOURAL B EVENT
Stimulus of observer
H
Reference to stored knowledge
K
INSTRUMENTAL ACTION Q EVENT
OBJECTIVE SOURCE J EVENT
Action of material on equipment
G
Motor adjustment of objective material
Z
RESPONSIVE BEHAVIOURAL R EVENT
PROCEDURAL DECISION P EVENT
Theoretical information
N
Decision to utilise
D
THEORETICAL FORMULATION EVENT T

Experiment - Theory. Expanded flow diagram



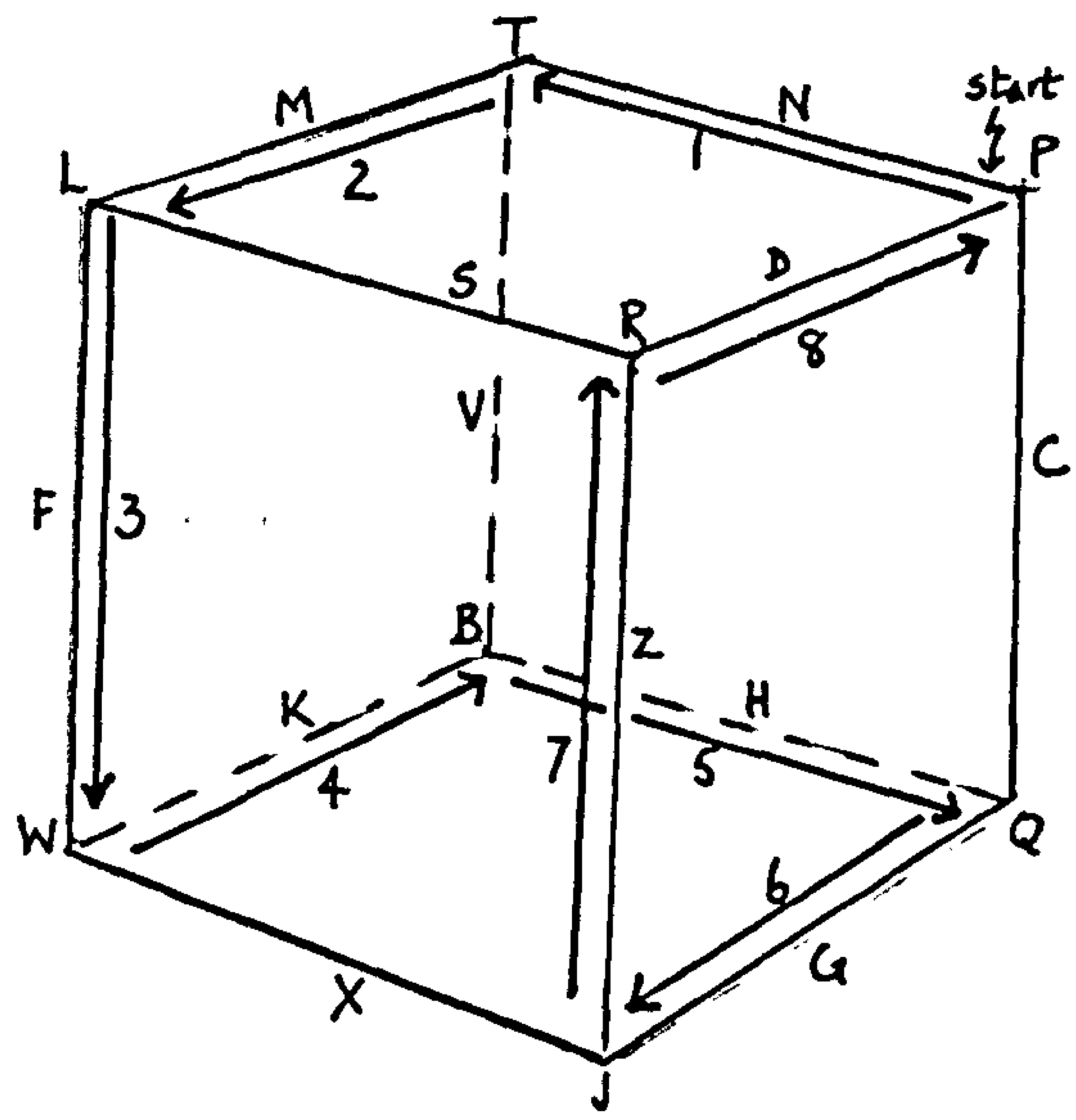


Fig. VIII. 18 The Epistemic Track of Fig. VIII.16.

Figure VIII. 18 shows the sequence of dominant vectors round the Cube. If the Orthotron nets in Fig. VIII.16 are examined it will be evident how the Orthotron is associating semantic structural information around each vector, including minor vectors, some of which do not appear on Fig. VIII.15.

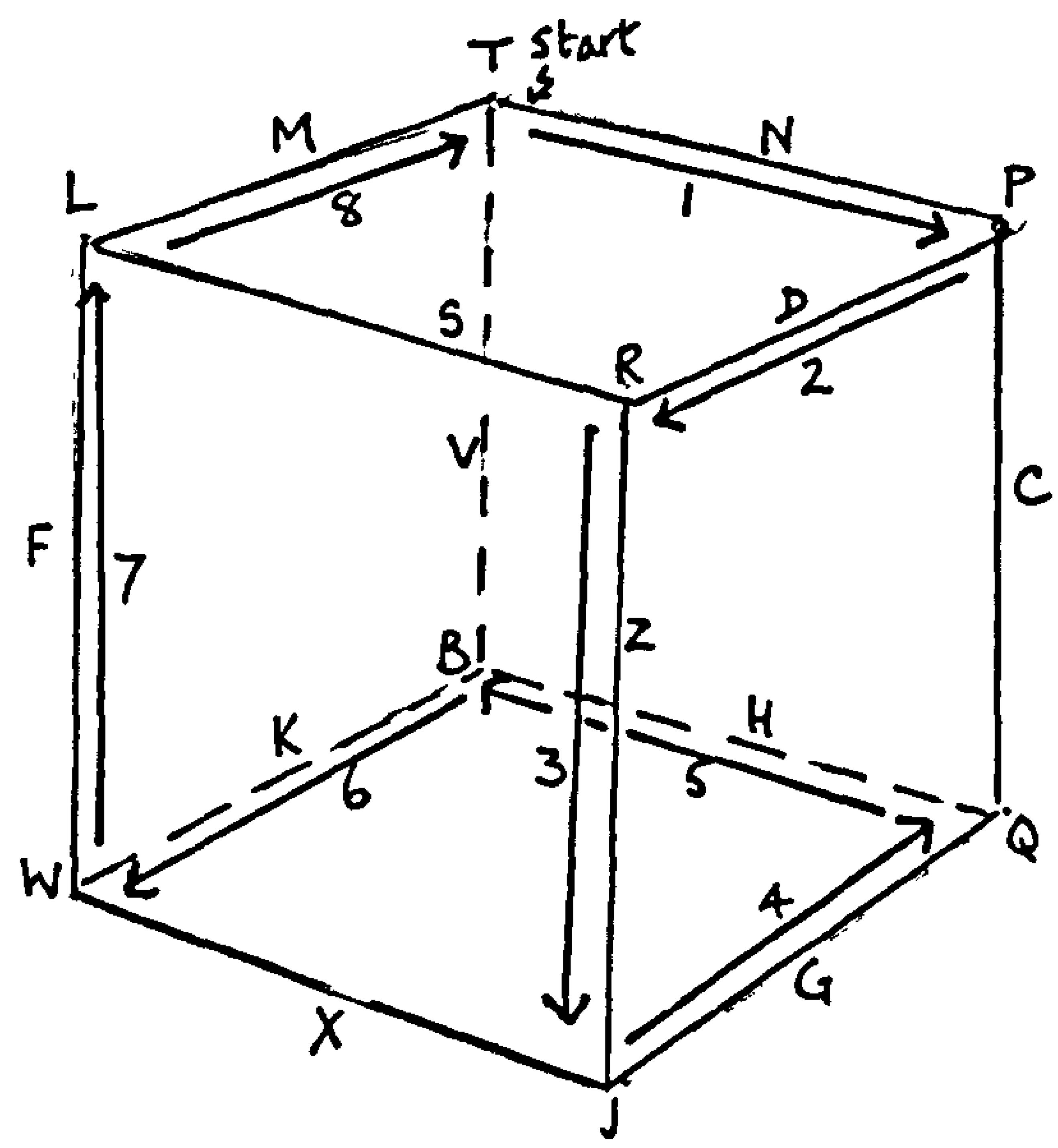
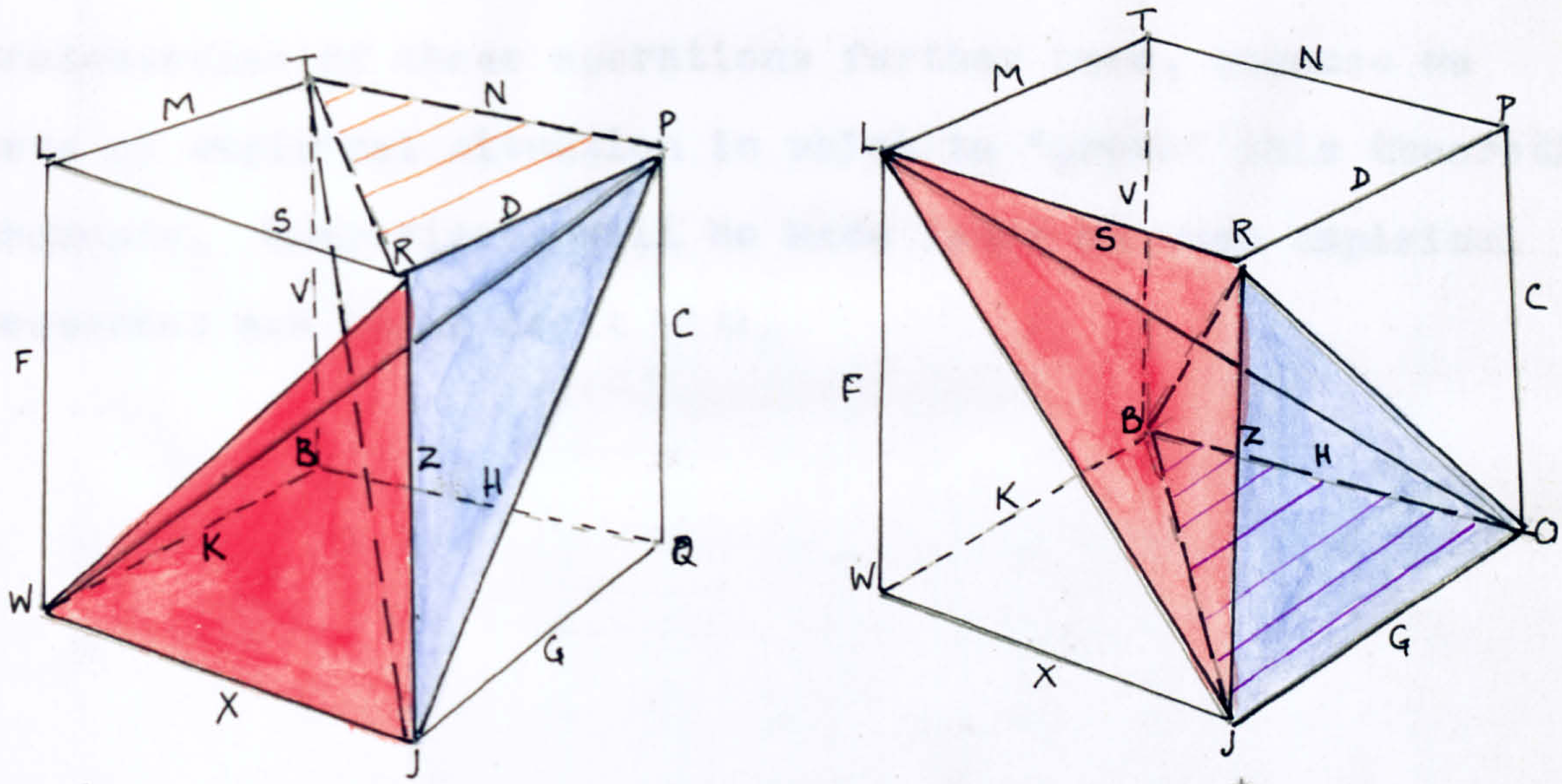


Fig. VIII.19. The Epistemic Track of Fig. VIII.17.

Figure VIII.19 shows the sequence of [illegible] dominant vectors of Fig. VIII.17. Examination of the Orthotrons will reveal that in the reverse sequence the same Orthotrons do not always appear; In the cases of N, F, H, and Z, where one sequence has a left-handed orthotron, the other has the righthanded one, so that differing minor vectors are brought into focus.



(A.) $\overset{+}{Z}$/WP(J) to $\bar{D}$/JT(P) (B.) $\bar{Z}$/LQ(R) to $\overset{+}{G}$/RB(J)

Fig. VIII.20 <u>Alternative Orthotrons and sequential connections</u> (second Orthotron shown with broken lines)

The alternative Z Orthotrons (<u>Recognition</u>)* are shown in Figure VIII.20. In A we have <u>$\overset{+}{Z}$/WP(J</u>) in its positive direction. (J-Z-R) The previous "objective source event" (J) has involved instrumental probing; this instrument has been specified, so that the minor vector X should appear incorporating a socialised conceptual reading of the phenomenal referent J therefore seems appropriate. The following "pearl" in the string, $\bar{D}$/JT(P) moves in the "negative" direction (R-D-P) The "sensory information" <u>R</u> is causing the organism <u>P</u> to select a further course of action.

In B. we have $\bar{Z}$/LQ(R) also moving positively (R-Z-J). The "recognition" of the phenomenal referent is transposed into the equipment, by action or mental operation; this time movement is away from the organism towards the Incident, which involves symbolic emission of information in the Orthotron $\overset{+}{G}$/RB(J) in the positive direction (J-G-Q).

It is not proposed to explore the significance of this

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*Refer to p. 159.

presentation of these operations further here, because we have no empirical situation in which to "prove" this theoretical sequence. Comparisons will be made later on when empirical sequences are being dealt with.

CHAPTER IX

ORTHOCHORIC ANALYSIS OF THE TRANSCRIPTS

I. THE "GEOGRAPHICAL" CUBE

Before discussing the Mathetic analysis of the transcripts the Constants of the Cube are reviewed in the particular context of this testing situation to facilitate reference in the reading of the analysis. With reference to the previous discussion of Geographical ideas,* the test lies mainly in the Topographic range of the Triadic Spatial Schema with the exception of the radial drainage concept, and some of the wider ranging concepts of the older students, which fall into the Chorological range. The G-Scale range is from about G 10 in the case of some of the seven-year-olds to about C 6 in the case of the older students; this is in terms of the apparent scale adopted by individuals for the valley model presentation.

The Eight Syntactic Constants

Objective Source Event

J the Referent from the Terrestrial Environment (which is not materially present in the testing situation).

Theoretical Formulation Event

T The subject's thought is "triggered" to go on to some kind of mental operation referring to J. He is involved; dynamic thought is set in motion.

Instrumental Action Event

Q The relevant material apparatus which is mediating J-information, i.e. forms in sand-tray modelling and aloplast; the polystyrene relief model.

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* pp. (55-58) above.

<u>Structural Cognitive Event</u>

L The subject's personal 'schemata', his stored conceptual structures which are going to be operative in considering J-information (schema' is used rather than'structure' to refer to this specifically individual context, leaving 'structure' free for more impersonal reference to structures of ideas).

<u>Responsive Behavioural Event</u>

R The physiological response to or reception of J-information (or to J-mediated-by-Q-information): this response being not only in the immediate past but also in the more remote past experience of the individual.

<u>Symbolic Behavioural Event</u>

B The symbolic referent mediating the J-information (or instructions to start operations concerning the J-information).

<u>Knowledge Retrieval Event</u>

W The stored "Cultural(or"Socialised") Concepts" which might be considered to be normally recognised as part of common experience; these may be (1) general to society referring to J, or (2) special to those members of society who have studied geography at certain levels of sophistication.

<u>Procedural Decision Event</u>

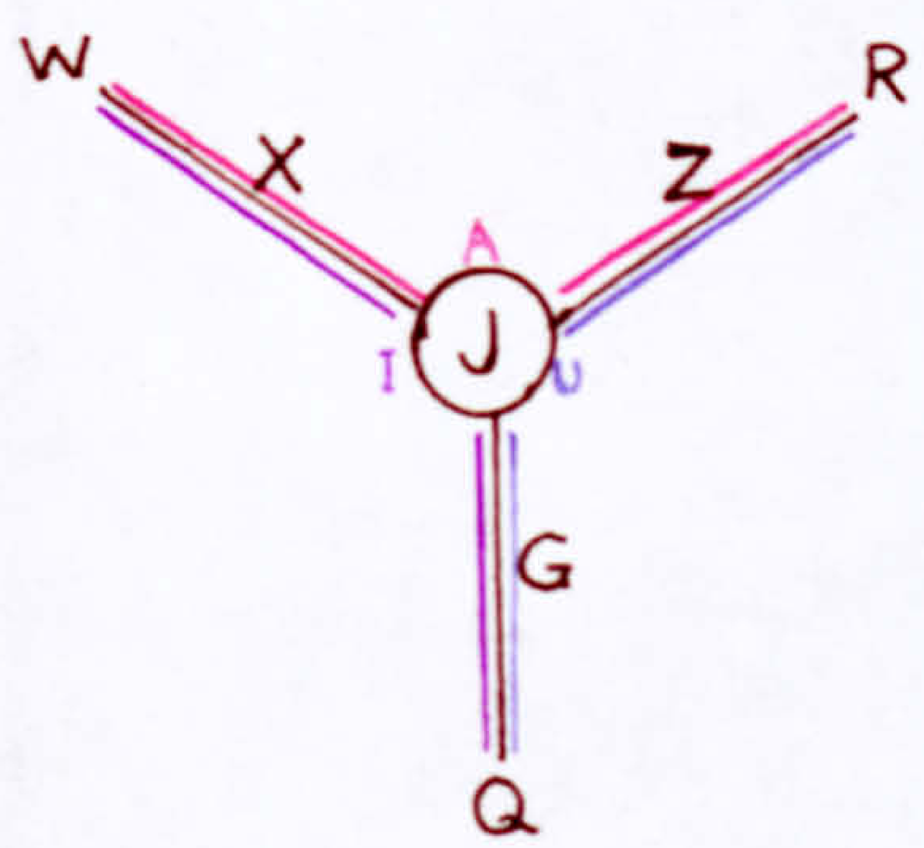
P The subject initiating and manipulating ideas about J-information; at whatever level of sophistication he is the "geographer" controlling his J-information, or controlling his Q- mediating-J apparatus.

The most significant adaptation of the possibilities of the Cube to be borne in mind here is the use of J and Q, since without qualification J-information could relate to the immediate physical environment of the test, i.e. a classroom, and even to the apparatus which is specifically identified as Q in the context.* Just as the geographer must make a judgment as to what scale of conceptual elements are relevant to the part of the G-scale on which he is operating, so must the psychologist the degree of detail of the response analysable in the testing situation.

NEIGHBOURHOODS AND ORTHOTRONS

The vectors represented by the edges of the Cube are shown below as parts of the Neighbourhoods of the Syntactic Constants. The definitions are taken from the Orthotron Thesaurus (pp.156-161). Each vector is defined twice, movement being taken as away from the Neighbourhood of the Constant; this corresponds with the definition no. 8 on p.154, with reference to the vector which is dominant in the Orthotron.

Fig. IX.1. Neighbourhood



Component Vectors

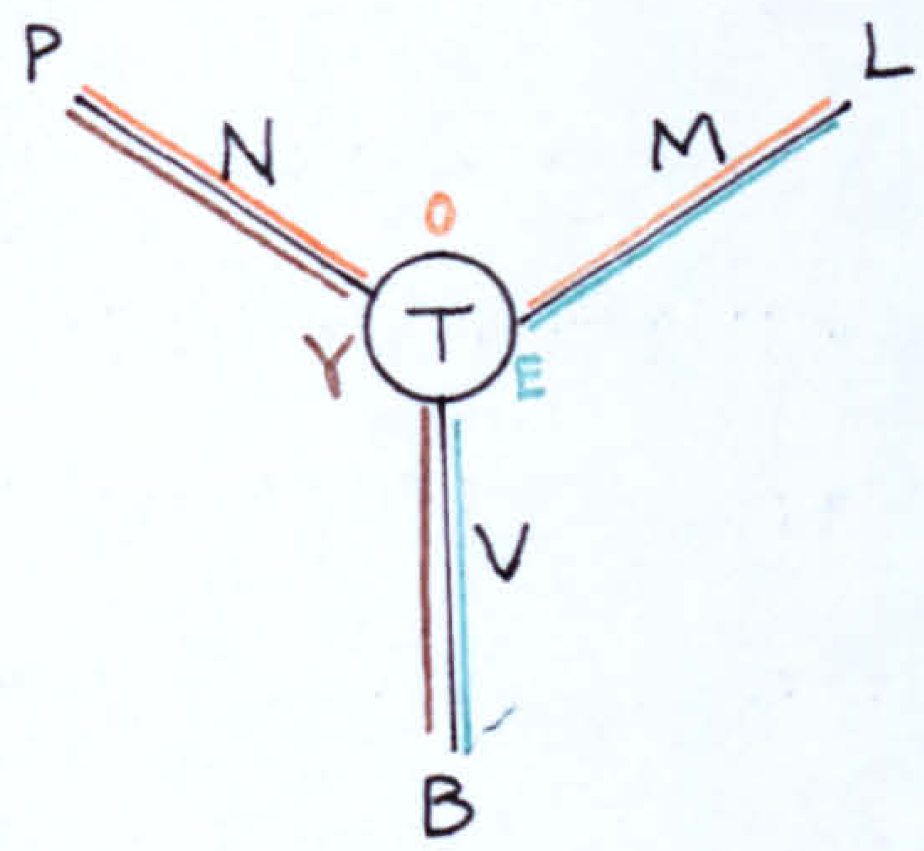
$\overset{\pm}{X}$ - Phenomenon filed in concept in cultural store

$\overset{\pm}{Z}$ - Environmental phenomenon as the object of perceptual response

$\overset{\pm}{G}$ - Transmission of phenomenon as information (by instrument)

---

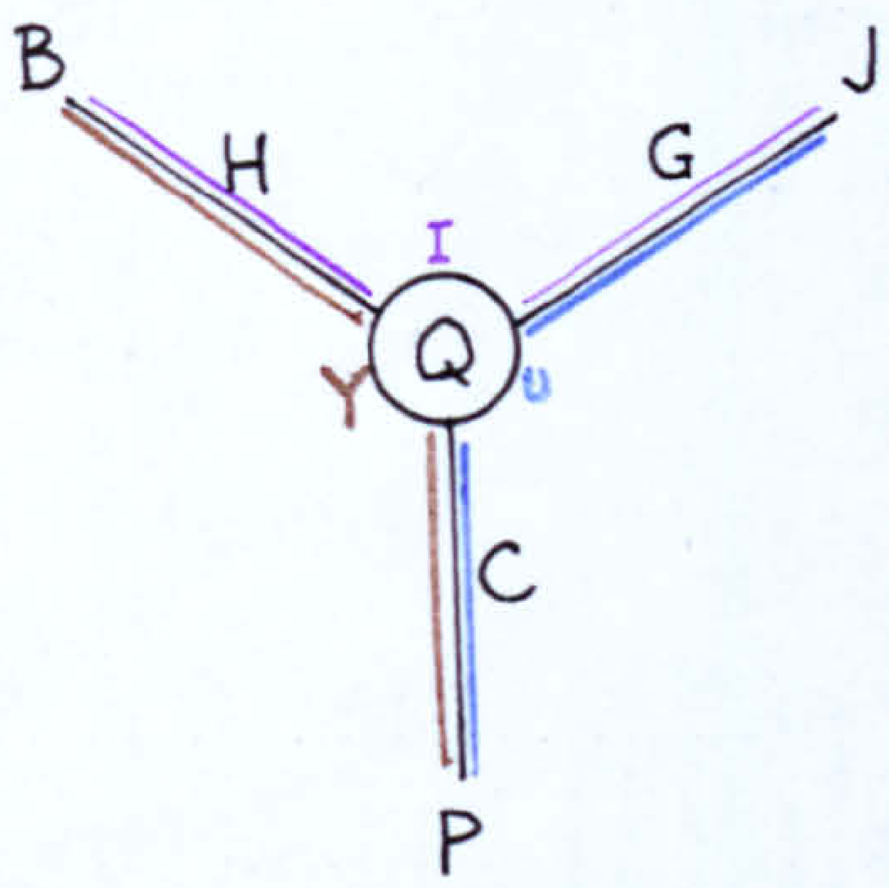
* and occasionally does so in the analyses.



$\overset{-}{N}$ - Motivated thought triggers action by organism

$\overset{-}{V}$ - Motivated thought selects symbolic form

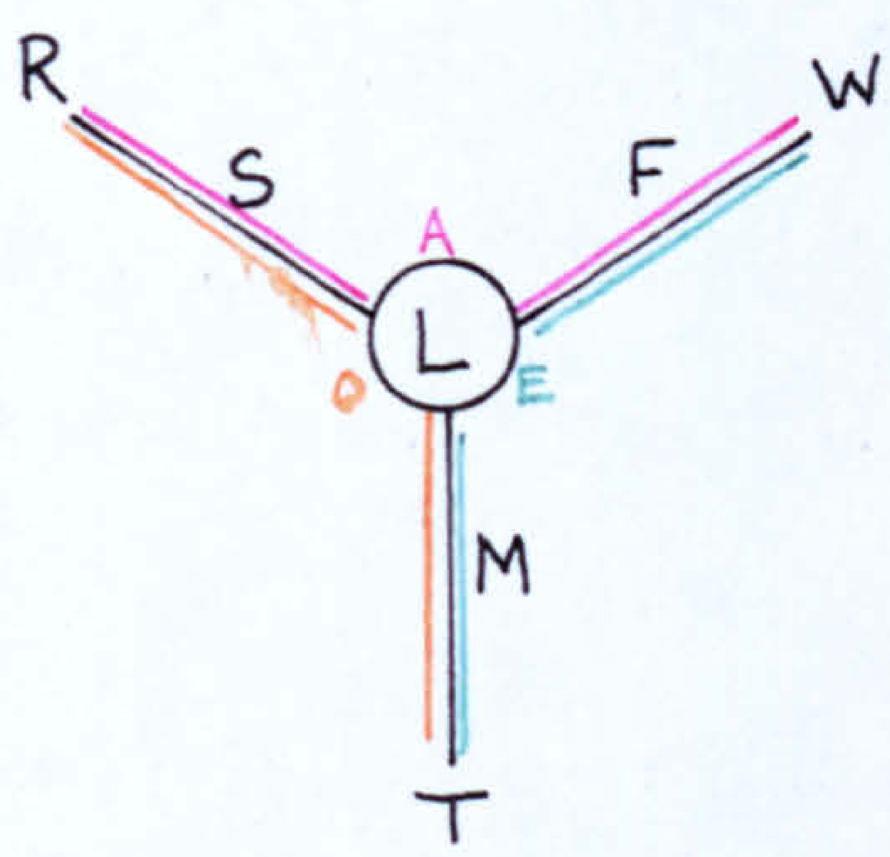
$\overset{-}{M}$ - Dynamic thought activates schema



$\overset{+}{H}$ - Equipment issues ideas as symbols

$\overset{+}{C}$ - Equipment causing reaction by operator

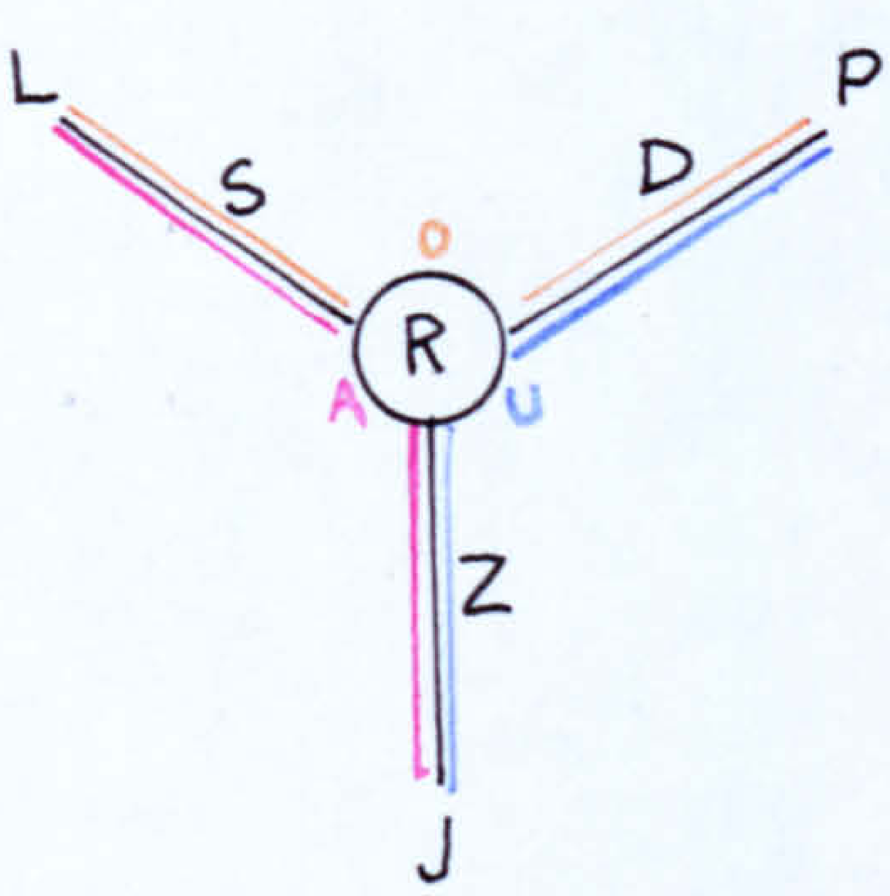
$\overset{-}{G}$ - Equipment applied to transmitting phenomenal information



$\overset{-}{S}$ - Schema organises perceptual response

$\overset{-}{F}$ - Schema contacts a cultural concept

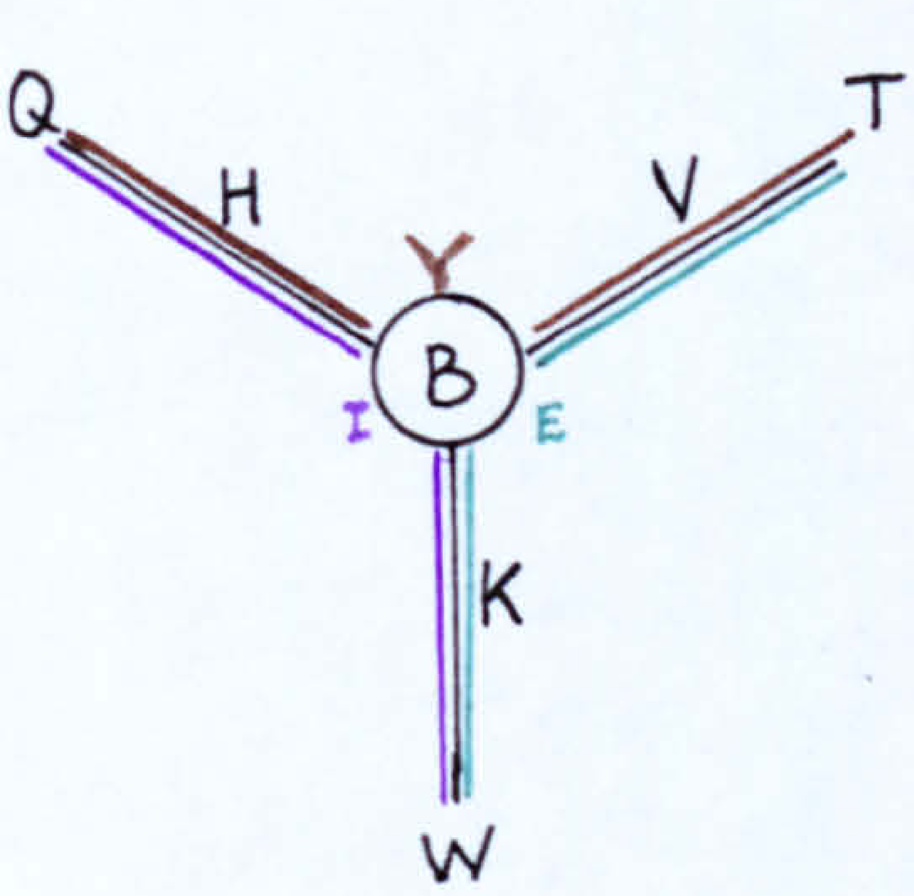
$\overset{+}{M}$ - Schema becoming meaningful in thought



$\overset{+}{S}$ - Phenomenon assimilated into schema

$\overset{-}{Z}$ - Perceptual response mediates environmental phenomenon

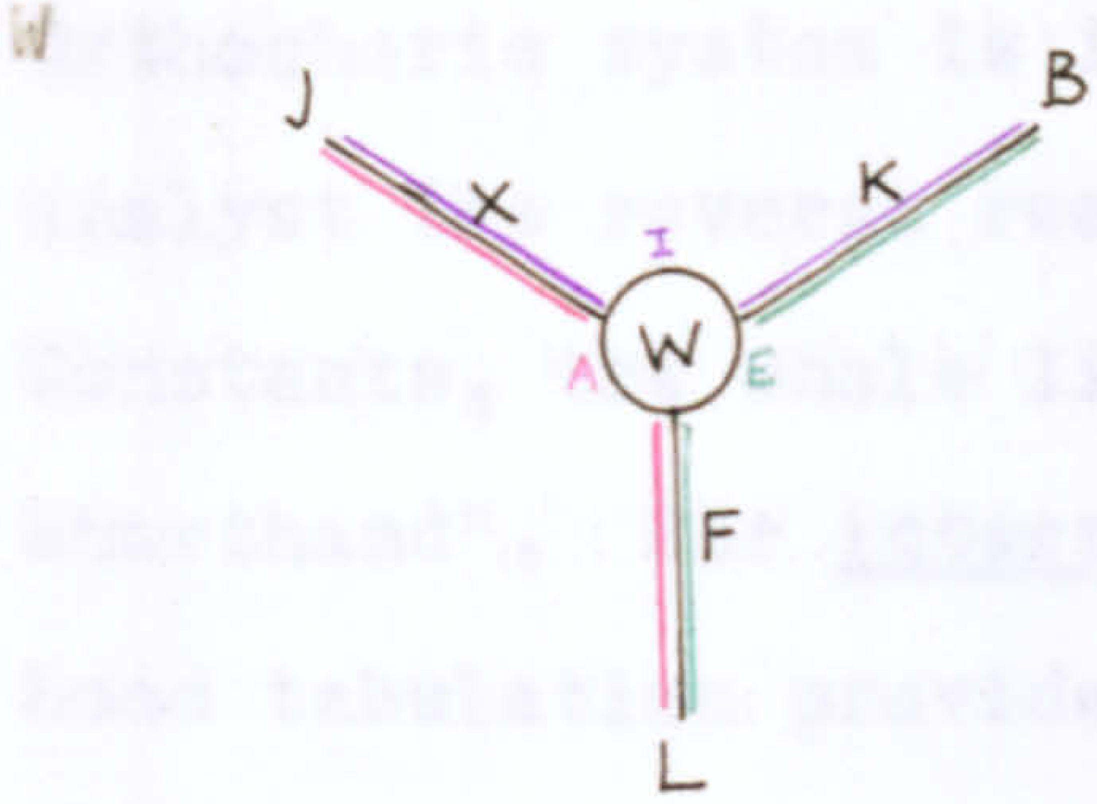
$\overset{+}{D}$ - Perceptual response triggers action by organism



$\overset{-}{H}$ - Symbolism embodied in instrumentation

$\overset{+}{V}$ - Symbols trigger dynamic thought

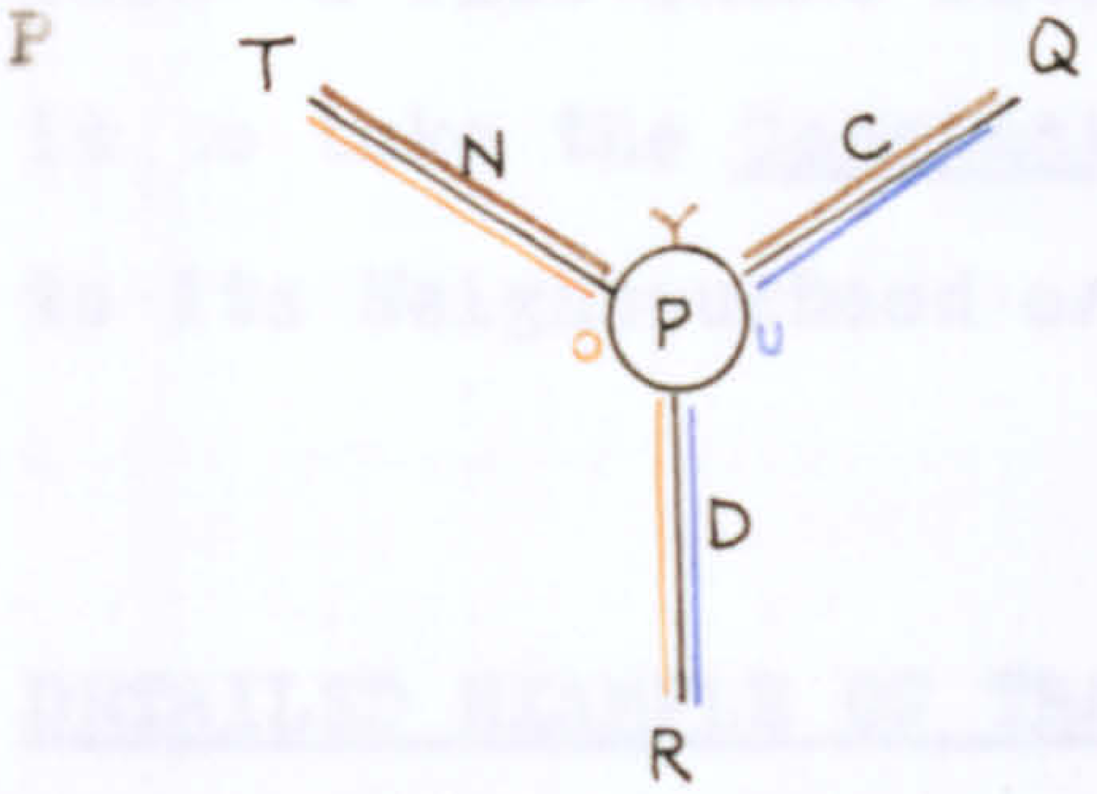
$\overset{-}{K}$ - Bits of information filed in symbols in cultural store



$\overset{-}{X}$ - Cultural bit representing environmental phenomenon

$\overset{\pm}{F}$ - Socialised concept assimilated to individual schema

$\overset{+}{K}$ - Cultural concept mediated as symbol



$\overset{+}{N}$ - Organising a dynamic thought

$\overset{=}{C}$ - Construction or use of equipment

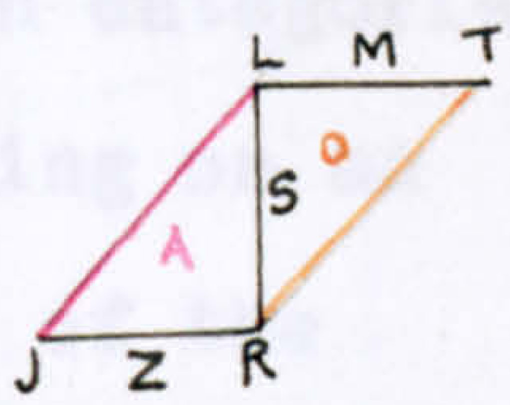
$\overset{=}{D}$ - Positive direction of a perceptual response

It is convenient to have such a summary of process vector verbal indicators because of the need for "negative" readings of the Orthotrons. For instance, if $\overset{+}{S}$/JT(R) is again taken as an example, it reads positively in the Thesaurus,

J-Z-R Environmental phenomenon as the object of a perceptual response -

- R-S-L Phenomenon assimilated into schema -

- L-M-T Schema becomes meaningful in thought



But negatively it reads,

T-M-L Dynamic thought activates schema -

- L-S-R Schema organises perceptual response -

- R-Z-J Perceptual response mediates environmental phenomenon

The negative reading is not given in the Thesaurus in terms of verbal indicators, since they are, after all, only clumsy renderings of the relationship between the Syntactic Constants, and in a particular context relevant phrases will arise within the particular sequence being analysed. When the

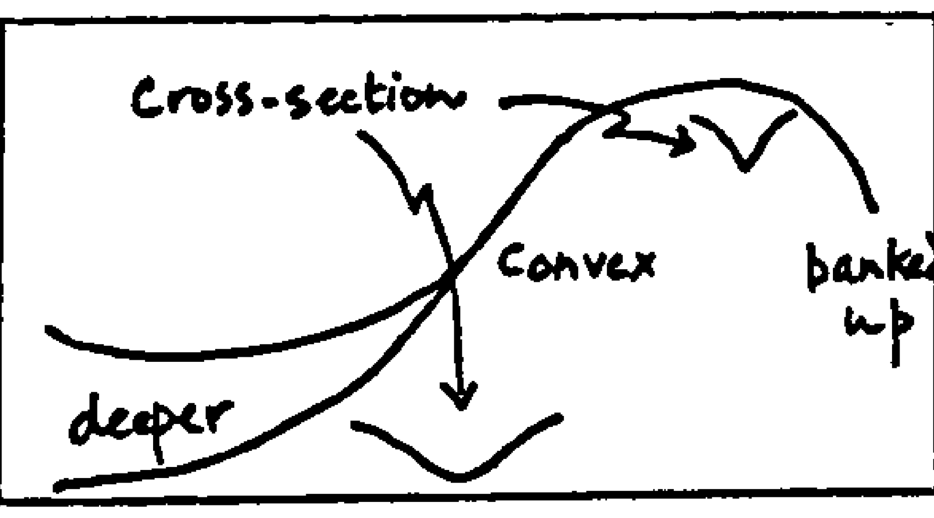
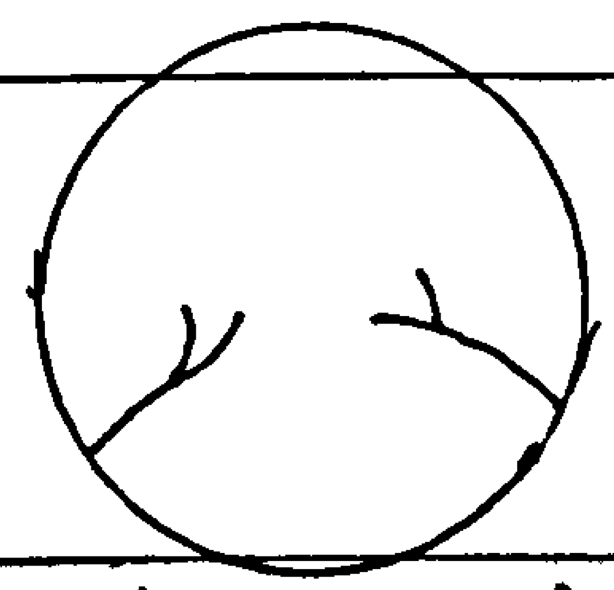
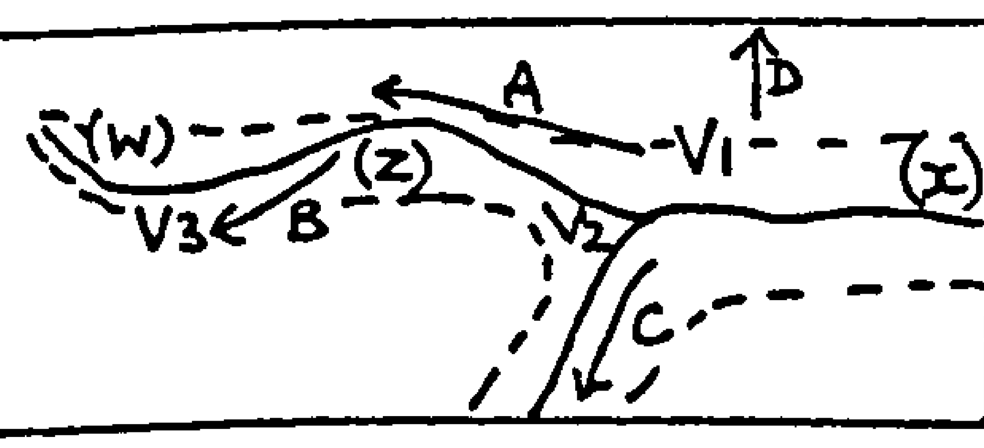
Orthochoric system is integrated into the schemata of the analyst the reverse reading can be followed by linking the Constants, the whole literal labelling forming a "conceptual shorthand". For interpretation of the analysis the Neighbourhood tabulation provides a quicker reference for "reading back" a flow-chart into verbal indicators; all that is needed is to take the Constant at the start of the vector and refer to its Neighbourhood on pp. 175-177.

DETAILED EXAMPLE OF TRANSCRIPT AND ANALYSIS

A transcript from the middle of the age range is presented in full, followed by the full lay-out of chained Orthotrons on the system already described in Chapter VIII above (pp. 164-172), with discussion of the judgments made. The dominant vectors were first recorded on a "score" alongside the items on the transcript, arranged in categories (1) of the Surfaces from which the vector was moving on an Orthogonal Axis, and (2) of the Oppositional Axis of the Orthotron (Making, Minding, Mapping and Meaning). The latter proved the most useful in organising the analysis, that is to say, in achieving its purpose of identifying a sequence of "episodes" of mental operations in conceptual thought.

No. 34.
MT. 14.11 yrs. male

Thornton G.S.
Home: Pit Lane, Thornton.
Form IVA. Classwork: Europe.

Response		No.	WP	JT	LQ	RB	
Valley? A dip between 2 high pieces of land, it can be formed by rivers or by folding, They usually work down and spread out gradually and become a flat plain.		1	M	F	V		28*
People? People usually live in valleys rather than hills, because of the river and flat land		2	M	F	V		28
Thinking of a place? no, general.		3			V	M	6
Sand tray	 good sense of form	4	M	C	V N		492
Comments? This is a hill where the river started, and it moves down between the pieces of high land and spreads out.		5	G				
Dome Patterns		6		S	V	M	
... small valleys.. streams making small valleys.. they go down pretty straight, where it gets more level they would start to move about more		7	G		Z		434
but they would be pretty straight with it being steep.... have them going out and joining up.... in different directions.as.		8					
Model. Does it fit your idea? Nearly the same		9			V	M	6
People?		10	S		V	M	

* Coding numbers will be clarified below (

		WP	JT	LQ	RB	
.. might not be many people down here (x), it would be too marshy.... here, still level, but not so level as to be marshy (V1)	11	Z	D			1709
... there (V2) because of the two rivers....	12			X		
...and there (V3) above the river	13			X		
Roads? (refer to item 10) A.. crossing the river...B..and upthere..C.. and coming across there...D, from other valleys and towns.	14	S Z	D	V X	M	1709
Slopes? the flatter areas by the river, farming areas....the part (w) and there (z) might be rocky.	15	S	D	V	M	106/49
Do you want just now, or history? (as you like) .. there might not be much vegetation now, but there might have been forest or marshland.	16	Z	K		X	

N.B. Very relaxed and confident in modelling, with obvious sense of form

The final decisions associated with the Orthotrons in the Thesaurus represents the end product of a long process of meditation on the relations of the Cube and their application in various geographical learning contexts. Similarly the decisions in the analyses of the transcripts is the end product of much revision of judgments in the light of experience. The judgments were made with not only the complete Orthotron Thesaurus visible for scanning, but with the Orthotrons themselves available for handling, their manipulation providing the essential check implicit in the discipline of the Cube.

A review of the Orthotron Thesaurus will show that this check operates on a binary system. Each Orthotron has two minor vectors: choice (1) selects the relevant one. The minor vector leads to a pair of Orthotrons in which it is dominant; choice (2) selects the left-handed or righthanded one of the pair. The selected Orthotron will belong to another Cube Set based on a particular oppositional. The process might be regarded as passing on to an adjacent Cube, or as a rotation of the Cube.* When initially handling the Orthotrons the rotation on the three dimensional axes of the Cube posed a difficult problem for two-dimensional representation. It was evident that there were two main types of rotation.

In the following flow diagrams of orthotrons not every item in the transcript is shown, since there were recurring patterns.

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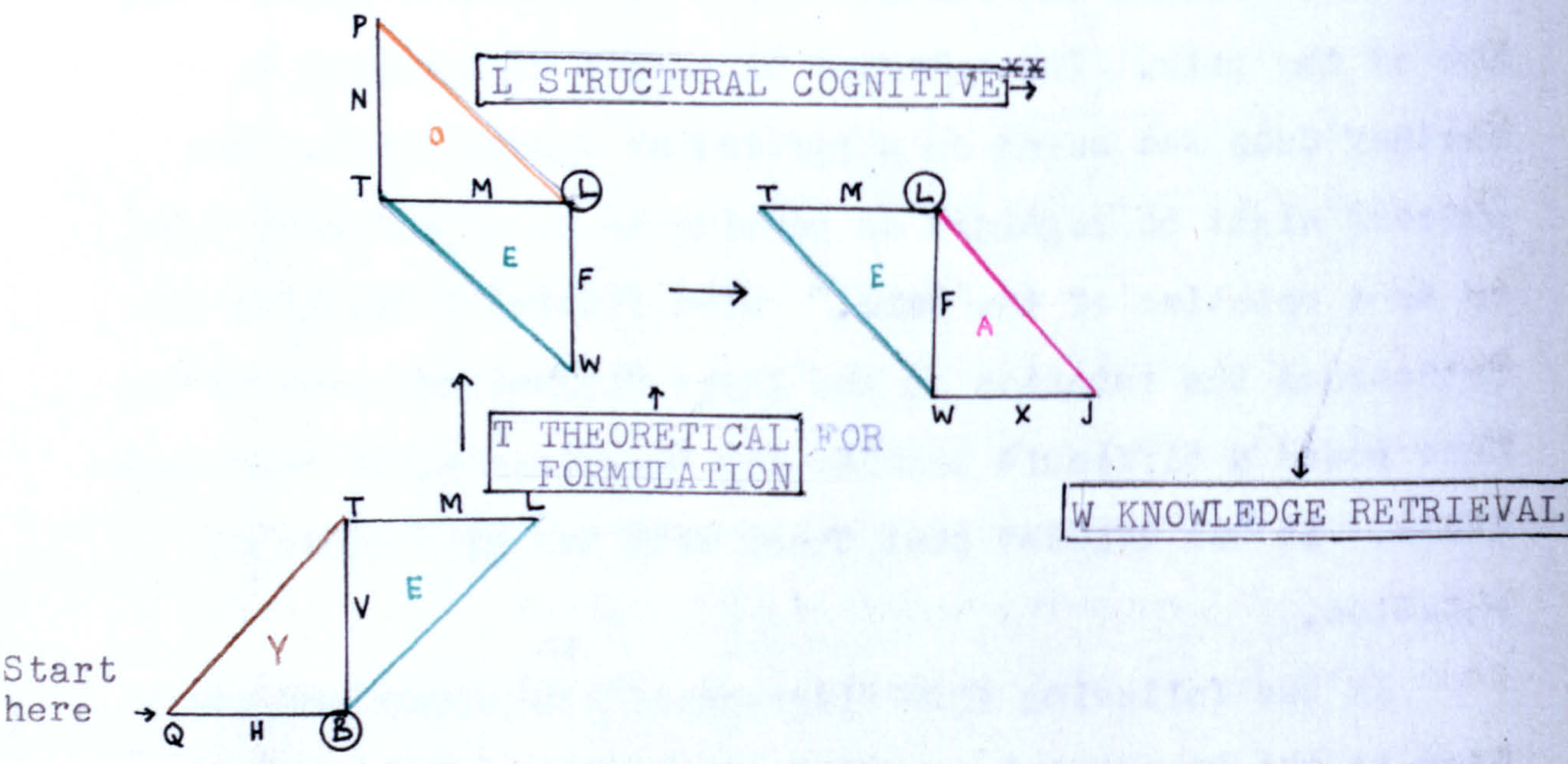
* See the example on p.171 above.

If the Flow-Diagram is read through as a complete sequence before considering details the accompanying comments can be more easily related to the pattern.

Item 1. Definition of valley in accepted form of geographical vocabulary

(28)*
Class (1).



$\overset{+}{M}$/WP(L) Socio-Symbolic Operative Thought	→	$\overset{-}{F}$/JT(L) Cultural Reaction
Socialised concepts assembled in a way relevant to the context (vector N is implicit but on the side; move to dominant F)		Triggering of a personal schema referring to a cultural interpretation of environmental phenomena.

↑

→ $\overset{+}{V}$/LQ(B) Learning Readiness
Transmission of symbols activates conceptual thought (minor vector M chains to a dominant M)

Fig. IX.2.

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*Later coding is given for convenience of subsequent reference.

**Meredith's labelling of 'Events' has been interspersed to assist comparison with Figs. VI.16 and VI.17. (p. 166, 168)

Comments on Flow-Diagrams

Item 1.

The Orthotron $\underline{\overset{+}{V}/LQ(B}$) has been used throughout to classify the initial question of the interviewer, who by the words uttered is setting up the task for the subject; the interviewer might be regarded as the "instrument embodying the symbols"(H). The mental operation leads off on the M vector as the subject's schemata are activated, and so to Orthotron $\underline{\overset{+}{M}/QP(L}$). At the first stage the task has been "Mapped" (QL) into the subject's mind; now he is Making (WP), in organising his experience; operative behaviour (N) is bound up with meaningful thought (M) drawing on a cultural concept (F), and it is to the Orthotron $\underline{\bar{F}/JT(L}$) that he moves on. In this his personal schema (L) is linked with the referent in the environment (J) through W, the common store of geographical concepts; communication has been established by means of "common knowledge", in which a bit of J-information is Minded (TJ) into a schema as "Valley" is a way which can be expressed meaningfully.

A dictioary definition of a valley can serve as an example of "common knowledge", for instance, from the Shorter Oxford Dictionary, Valley, "Allong depression or hollow between hills or stretches of high ground and usually having a river or stream flowing along its bottom". Compare this with MT's definition in the transcript.. "A dip between

Items 4-5. Modelling of valley in sand and comments (492)
Class (2)

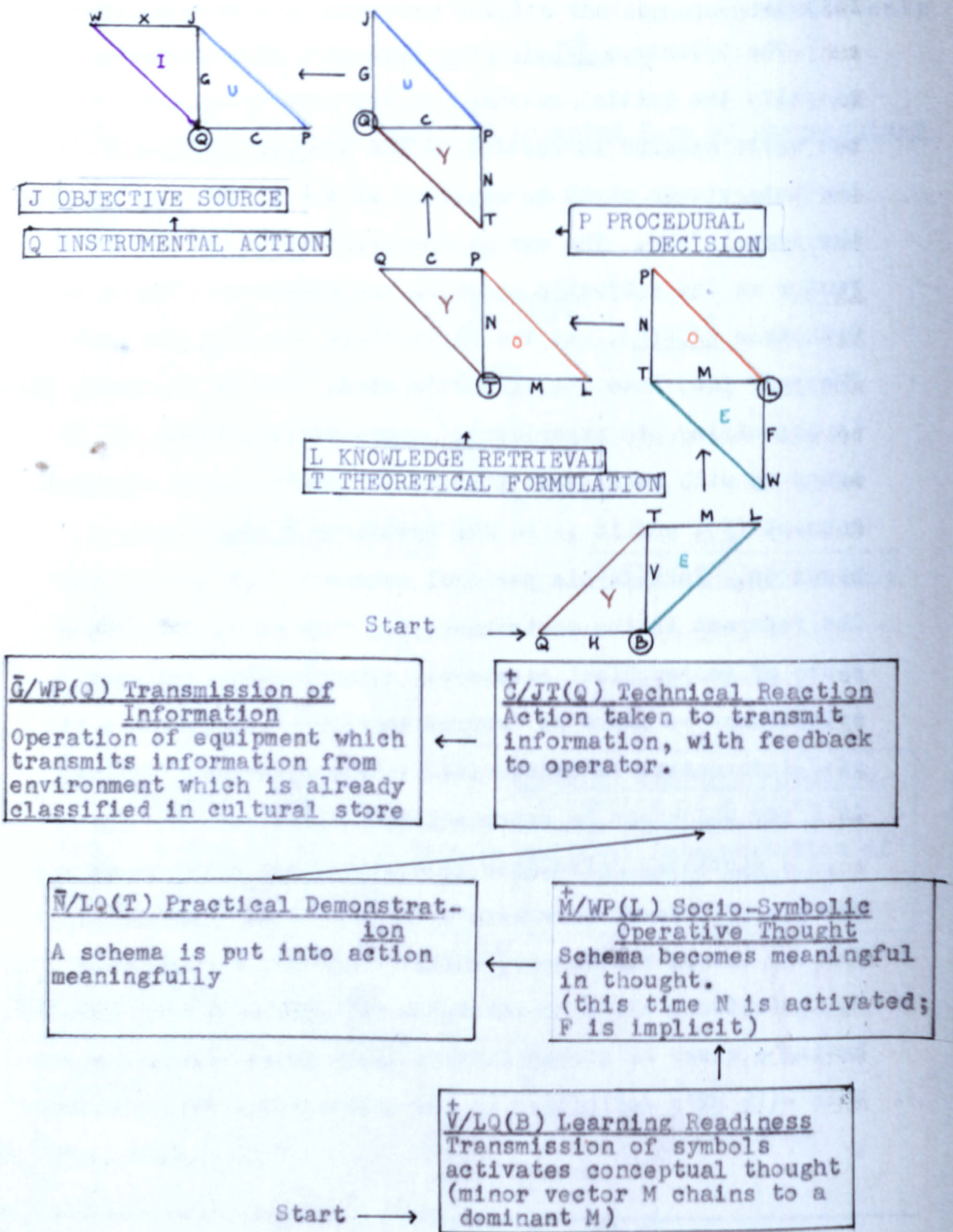


Fig. IX.3.

two high pieces of land, it can be formed by rivers or by folding....". What is incorporated in the individual's schema may vary in degree of complexity, as has been seen in the geographical analysis, but as long as something akin to the dictionary definition has been given the interview can proceed, so the V-M-F chain appears at the start of all interviews where this common knowledge could be established. Item 2 has a similar pattern; in judging "People usually live in valleys rather than hills, because of the river and flat land", this was taken as "common knowledge acquired", because the subject's local environment is a valley where the valley bottom is empty and housing is perched on the hills; there is not flat land at the bottom, and landscape experience would negate the statement made.

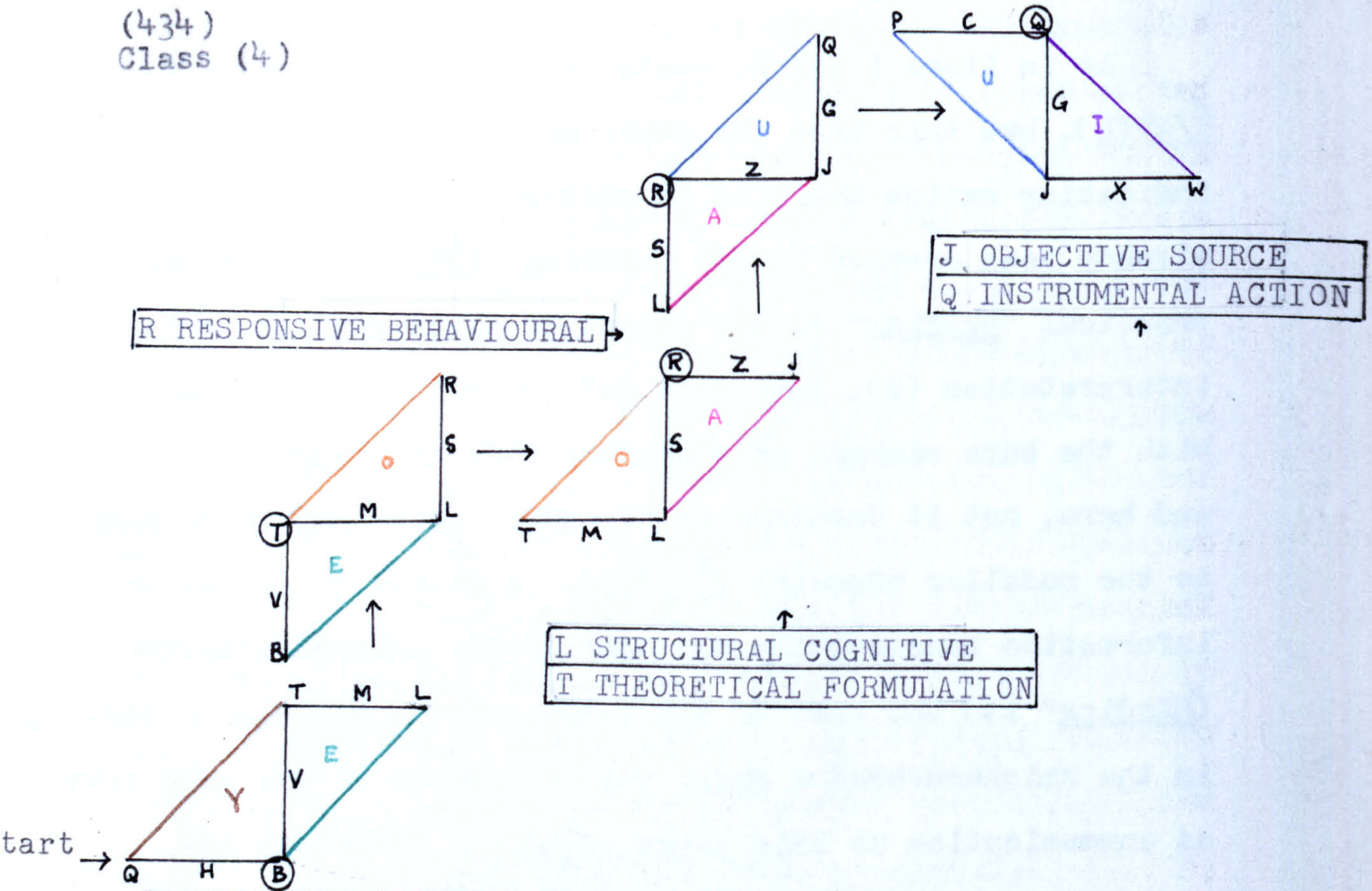
In Item 4-5 practical demonstration is required in the sand tray. This subject's representation was particularly clear; he showed a sensitivity to model form in the sand and above-average ability to demonstrate his concept in this way. From the geographical point of view, however, it is more significant that he has shown the length of the valley, its descent from higher land to low, and the widening of the cross-section; it is also shown as curving. It is hard to imagine anyone doing better than this with a small tray of damp sand. In fact the selection of this script for the most detailed analysis was largely governed by the clarity of this river valley modelling (see p. 110 above.)

As in Items 1 and 2, vector M chains to the dominant $\overset{+}{M}$/WP(L), but this time the other minor vector N is activated, indicating action taken to demonstrate the schema which has already been aroused in his thinking: ($\bar{N}$/LQ(T) indicates the practical "Mapping" of his schema into the sand, a personal interpretation (T), operative and creative (Neighbourhood T). With the bare minimum of representation the sequence would end here, but it develops as the model grows and feeds back to the modeller himself: ($\overset{+}{C}$/JT(Q). Moreover it transmits information successfully not only to the subject himself ("Minding" it) but also to his interlocutor. $\bar{G}$/WP(Q) by staying in the neighbourhood Q shows the importance of the sand tray as communication at this point, "Making" effective the communication, with the element of common cultural environmental referent, (W-X-J), the simplified valley form, which is no particular valley, but the simplified abstract which fits so well as a "textbook" valley, with a comment which relates it back to the initial definition given in Item 1.

Now that we have our single valley concept defined, in Items 6-7-8 we pass on to the valley-in-a-continuous landscape. The demand to show a pattern of valleys on a domed hill area is really seeking for information about two distinguishable schemata. First, is there any spatial pattern of valleys, and if so, how is it visualised?

Items 6-7-8 Tracing of drainage pattern on Aloplast and comments

(434)
Class (4)



$\bar{Z}$/LQ(R) Recognition
Structured perception brings 'reality' into focus as an 'instrument' (i.e. of thought) and through the apparatus.

→

$\bar{G}$/WP(Q) Transmission of Information
Operation of instrument which transmits information from environment which is already classified in cultural store

$\bar{M}$/RB(T) Socio-linguistic Operative Thought
Symbol triggers thought and modulates schema structuring perceptual response.

→

$\overset{+}{S}$/JT(R) Reflex Perception
Perceived reality matches structure of thought (minor vector Z chains to a dominant Z)

↑

$\overset{+}{V}$/LQ(B) Learning Readiness
Transmission of symbols activates conceptual learning (this time the other dominant M in a lefthanded orthotron is activated)

Fig. IX.4.

Secondly, are valleys seen as the product of the incision of a land surface by rivers? There are inherent difficulties here; apart from the different schemata required, there is a change of scale, a different material (plastic modelling clay), a pointed stick to be used. Older subjects, geared to use of paper and pencil, were more often put off initially by the material, younger ones accepted it. This subject, with modelling ability, handled it with confidence as with the sand. But for all, the clay was presented with a moulded curved surface instead of the neutral sand surface. This meant that the visual impression must be taken account of at once, and so vector M is chained to the lefthanded Orthotron $\underline{\bar{M}/RB(T)}$ incorporating L-S-R "Meaning" has to be sought, probably in some recall of perception of drainage patterns from a map, or else recall of movement in landscape, or "personalised" river flow. The latter seems evident here.. "small valleys... streams making small valleys... they go down pretty straight, where it gets more level they would start to move about more...". This running commentary makes the train of thought easier to diagnose. Visualised landscape is being referred to in a vivid fashion, and vector S is chained to $\underline{\overset{+}{S}/JT(R)}$ as the rivers are "Minded" to be "Mapped" into the model ($\underline{\bar{Z}/LQ(R)}$), "structured perception brings reality into focus as an instrument of thought", through the apparatus. "Recognition" seemed an appropriate label for this Orthotron, since some landscape basis is clearly being "re-cognised" - re-mapped mentally, matching the schema. The subject produces a "correct" mapping of a radial character with tributaries, which transmits information - $\underline{\bar{G}/WP(Q)}$ - thus the same Orthotron ending the Item 4-5 sequence is reached by a different Orthochoric route.

Items 10-11-12 Placing settlement sites on given model and for Item 14 Placing roads on model

(1709)
Class (3)

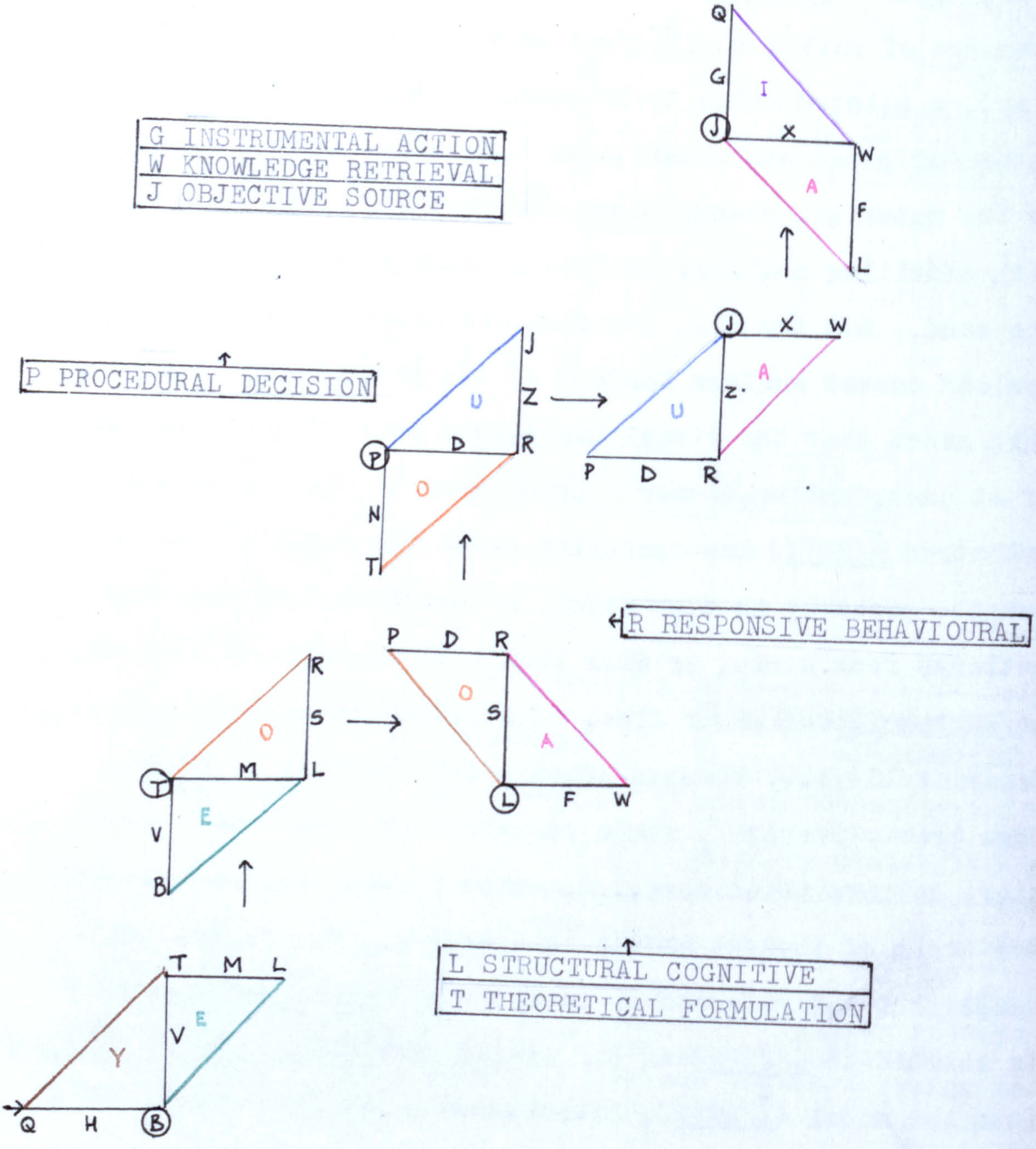
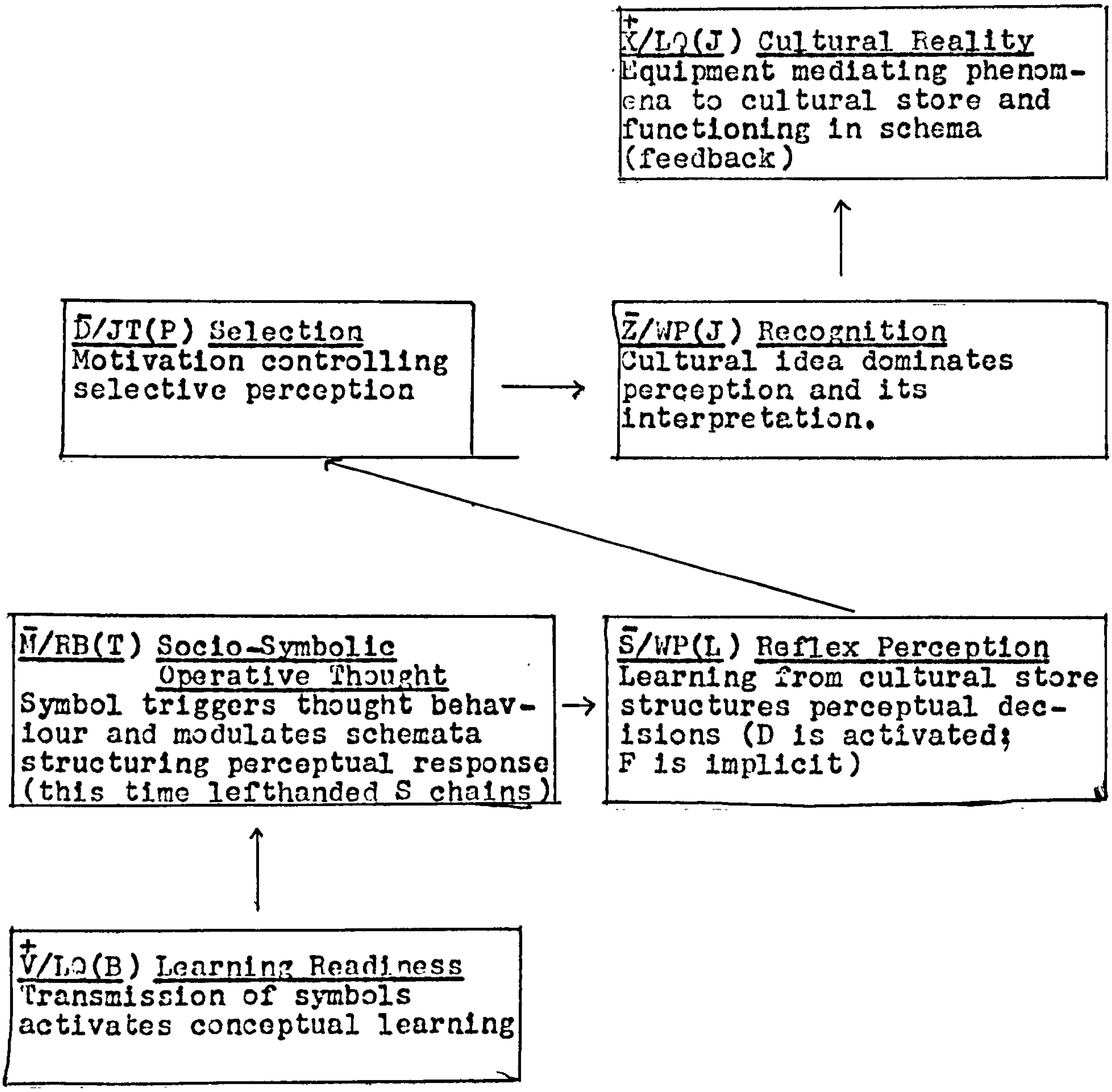


Fig. IX.5.


K/LQ(J) Cultural Reality
Equipment mediating phenomena to cultural store and functioning in schema (feedback)
D/JT(P) Selection
Motivation controlling selective perception
Z/WP(J) Recognition
Cultural idea dominates perception and its interpretation.
M/RB(T) Socio-Symbolic Operative Thought
Symbol triggers thought behaviour and modulates schemata structuring perceptual response (this time lefthanded S chains)
S/WP(L) Reflex Perception
Learning from cultural store structures perceptual decisions (D is activated; F is implicit)
V/LQ(B) Learning Readiness
Transmission of symbols activates conceptual learning

The next stage in the interview turns to the human aspect of a valley situation. Since reaction is started by the sight of the polystyrene model, the sequence of Items 10-11-12-13 starts as with the last one by chaining to $\bar{M}$/RB(T). Placing of settlements seems to be governed by the idea expressed in Item 2, associating people with the valley bottom, rather than the hills above, so the lefthanded orthotron $\bar{S}$/WP(L) is selected "Learning from cultural store structures perceptual decisions." Consider what is being read into the undifferentiated slight curve of the lower part of the model valley.... "might not be many people here (x), it would be too marshy... here, still level, but not so level as to be marshy." At $\bar{D}$/JT(P) Selection is being made of a specific situation of "Minded" landscape, which is "Recognised" - $\overset{+}{Z}$/WP(J). The subject is visually scanning the model and at the same time "conceptually scanning" his fund of valley settlement schemata, and the feedback of the river junction connects...."there, because of the two rivers".. (Item 12) - $\overset{+}{X}$/LQ(J) records this Mapping of the environmental referent into the model. The confluence site is a very social one, derived from associations with human geography normally received from teaching or reading, and not relevant in the local neighbourhood. No elaboration is given by this subject. The earlier Orthotron $\bar{S}$/WP(L) has been labelled "Reflex Perception" because it seemed to reflect an integrated socialised concept operating automatically in a schema, implicit rather than explicit in the thought.

Items 15-16 Comment on land use of slopes, with spontaneous mention of the concept of historical change

(106/49)
Class (3) - individual

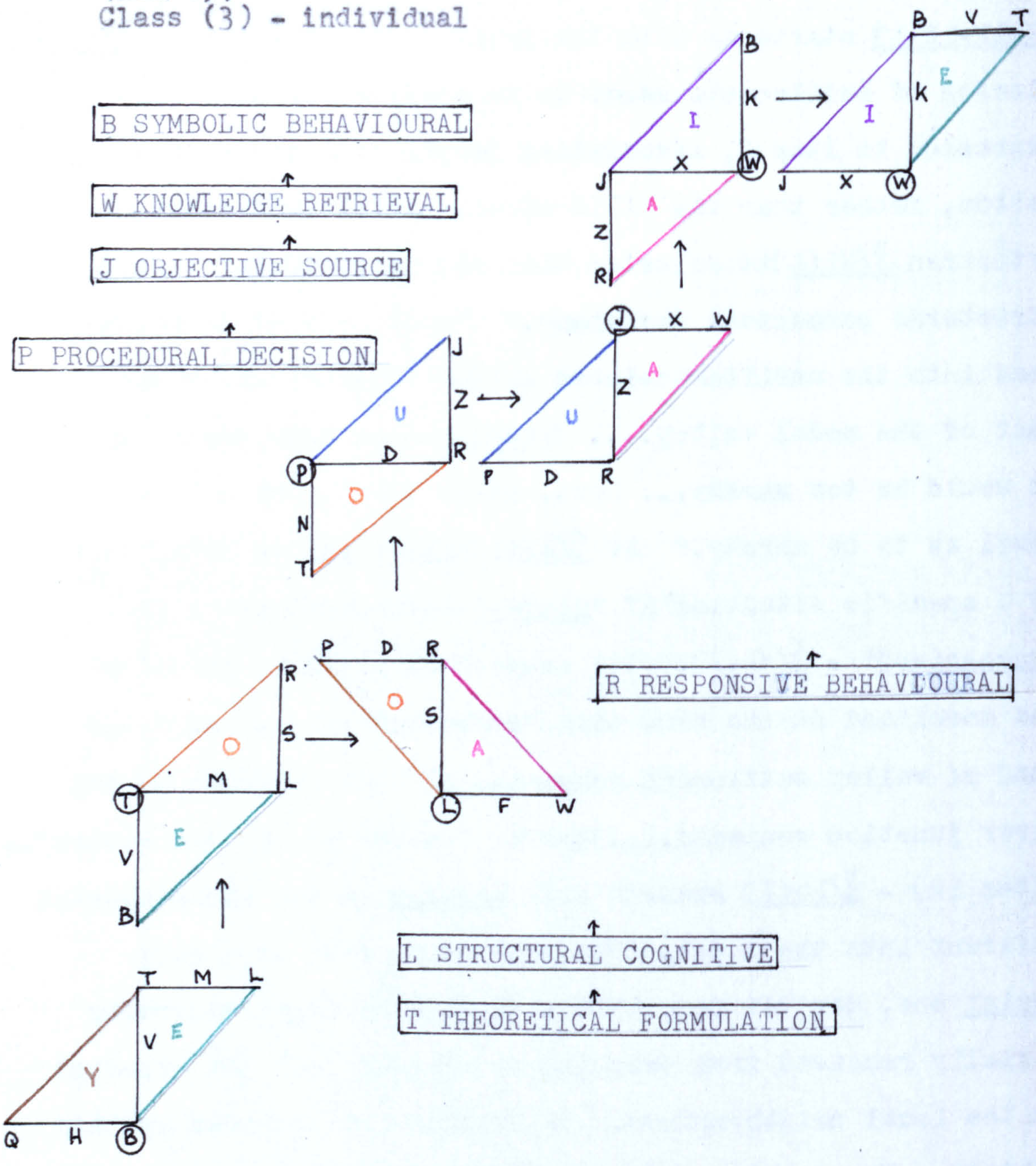
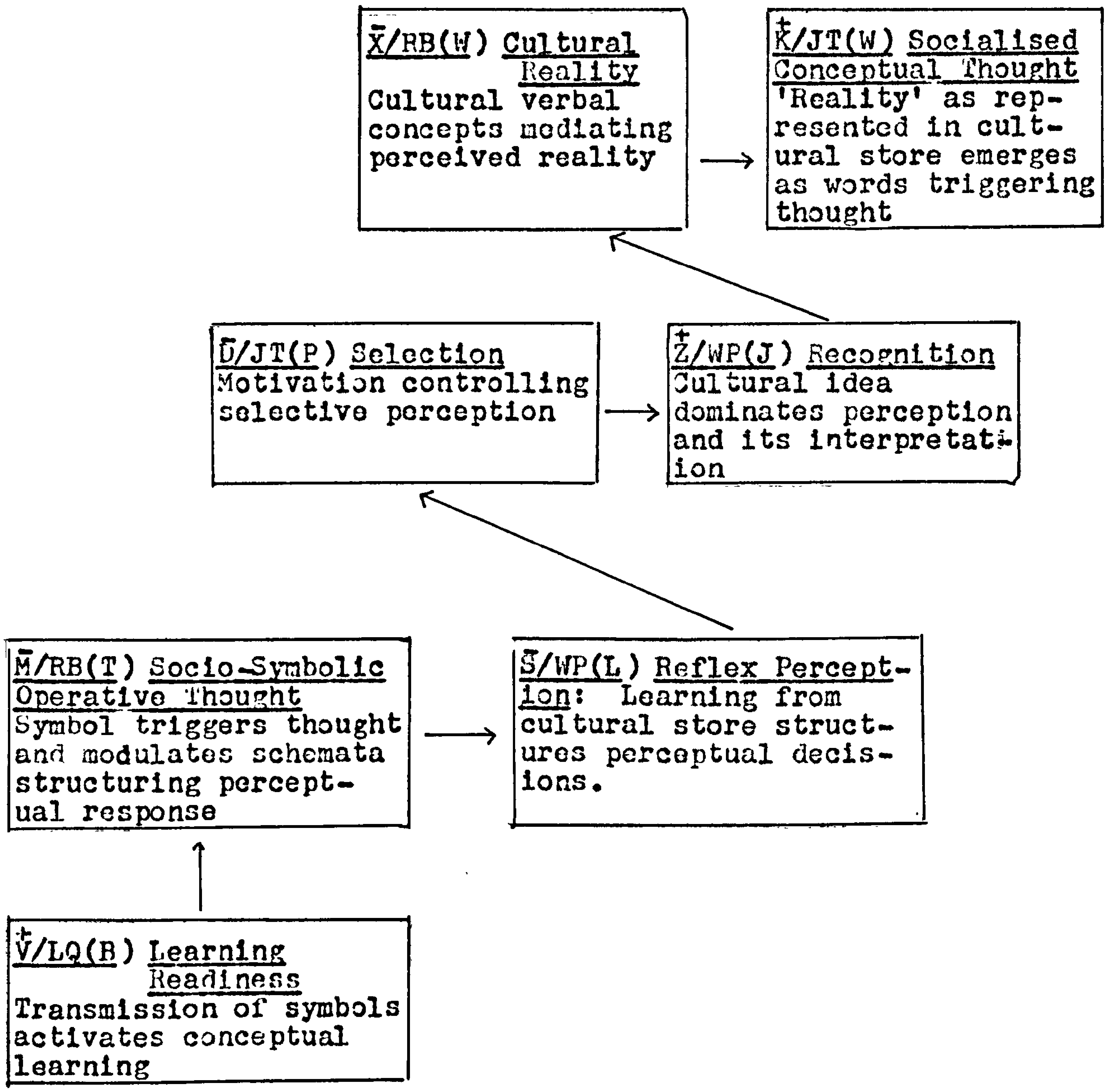


Fig. IX.6.


X̄/RB(W) Cultural Reality
Cultural verbal concepts mediating perceived reality
K̇/JT(W) Socialised Conceptual Thought
'Reality' as represented in cultural store emerges as words triggering thought
D̄/JT(P) Selection
Motivation controlling selective perception
Ż/WP(J) Recognition
Cultural idea dominates perception and its interpretation
M̄/RB(T) Socio-Symbolic Operative Thought
Symbol triggers thought and modulates schemata structuring perceptual response
S̄/WP(L) Reflex Perception: Learning from cultural store structures perceptual decisions.
V̇/LQ(B) Learning Readiness
Transmission of symbols activates conceptual learning

The following sequence dealing with the placing of roads linking the settlements appeared to follow much the same course; as the net built up, the pattern fed back finally led to a view of extension of landscape beyond the model... "from other towns".. (Item 14). When the scripts were typed out, they were split up into arbitrary items that served to identify stages of the interview, but in the subsequent orthotron analysis, the thought operation distribution did not necessarily coincide, since very rapid, virtually simultaneous mental operations might be occurring at one time, and slow deliberate thought at another.

To place settlements required the location of points, to place roads, the location of lines. As a follow-up to this, the subject's attention was directed to the areas surrounding the towns and roads. The same type of sequence is recorded as the social concept of farming appears, but there is deviation when the Mapping into the model, $\overset{+}{Z}$/WP(J) feeds back; conceptual scanning has alerted a schema that says internally - 'but land use changes"... so comes the question, "Do you want just now, or history"? This calls for the use of the other X Orthotron, $\bar{X}$/RB(W), as Meaning is sought in the Cultural Reality of history, chaining to $\overset{+}{K}$/JT(W) as the Socialised Conceptual Thought of transmitted knowledge is conveyed verbally in terms of vegetation changes. It stays in the Neighbourhood of W. This final part of the sequence was individual to this subject and represents a kind of development more often met with in the more mature part of the population interviewed. In fact this subject appears to be ahead of the other random selection made from his age group, but, as has already been indicated, this script was picked out as having a useful assemblage of characteristics for illustrative purposes, not because of any "average" character. It has the smallest number of sequences, yet contains examples of each of the four main types which were identified (see below); this was not ascertained when it was selected, but reflects the implicit recognition of its economical character which was explicated in its analysis.*

No. 34 will be referred back to later when a range of examples is referred to in less detail; for the time being it is deliberately left at the stage of judgments made to identify with the organising set of Orthotrons as operations within the framework of the Cube.

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* The conceptual quality score (29) was the highest recorded for his age group.

<u>The Charting, Classifying and Coding of Thought Sequences</u>

Scrutiny of the scored flow-charts on the scripts themselves suggested that there were a number of common sequences of varying lengths. Sequences of only two orthotrons were ignored, being only a matter of a single interaction between tester and subject, not significant conceptual thought. It was evident that three-orthotron sequences were covered by four classes and that in each class further stages up to a maximum of eight orthotrons were recurring. The first flow-charts were drawn out as curtailed nets as already illustrated for No. 34. This revealed two things, firstly that each class had a characteristic pattern, and secondly, that once the use of the curtailed nets had been proved in this way, it was more economical to overlap the matching chained vectors (Fig. IX.12. p. 201). This presentation makes a better Gestalt for each pattern and shows up a series of oblique and right-angle junctions. Before the problem of the significance of these could be tackled, however, it was necessary to find a method of numerically coding the sequence patterns.

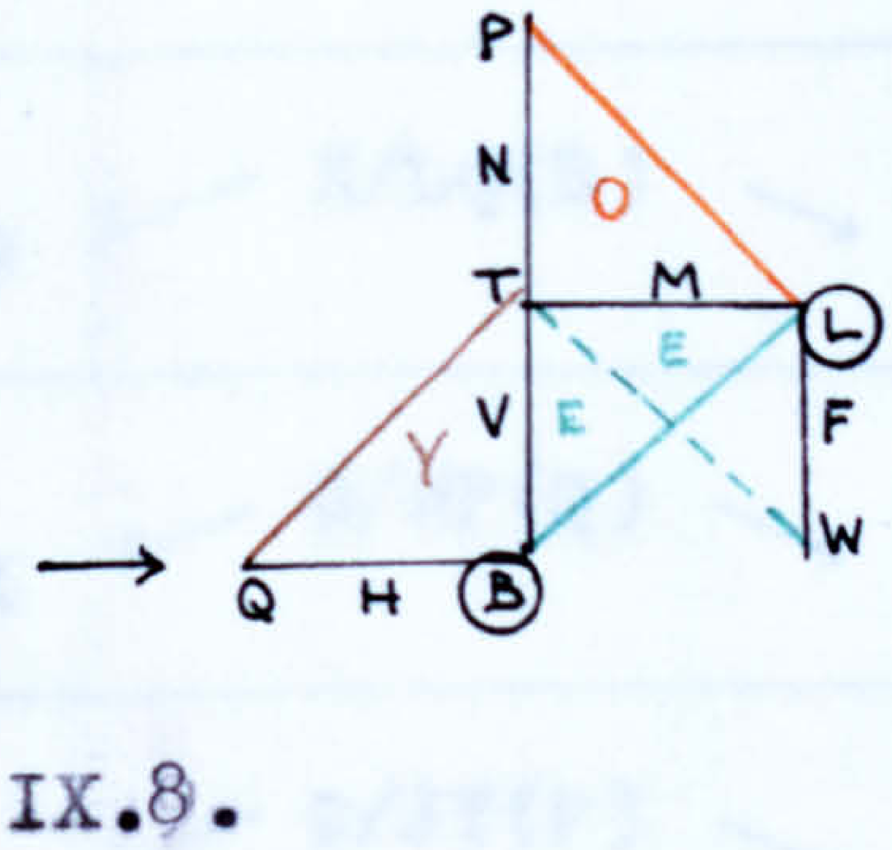
Attempts were made to find a way to use a binary notation which could be translated into a decimal code. Referring back to p. 181 the system of chosing the succeeding Orthotron in the chain was shown to have two steps, (1) selection of the minor vector in the first Orthotron, (2) selection of right-handed or lefthanded succeeding Orthotron. The combined possible choices could be coded by the binary numbers 0 to 3. <u>In choice</u> (1) the + vector means <u>positive</u> movement away from the Neighbourhood Constant, left in a lefthanded, right in a righthanded Orthotron; the - vector <u>negative</u> movement in the reverse direction, so <u>+ (1) implies "normal" positive movement</u>, <u>- (0) implies "reverse" negative movement</u>. In choice (2), + signifies the righthanded Orthotron, - the lefthanded one.*

First Orthotron	Second Orthotron left	Second Orthotron right
Reverse	00	01
Normal	10	11

Fig. IX.7.

For example, the first Orthotron in each sequence in <u>$\overset{+}{\text{V}}$/LQ(B)</u> in this case we have no choice (1), but we will assume a Reverse lead from <u>$\overset{-}{\text{H}}$/JT(B)</u> which the Orthotron Thesaurus suggests as most appropriate. Our Orthotron is righthanded, so lead-plus-orthotron is <u>01</u>. The beginning sequence illustrated in No. 34 was <u>$\overset{+}{\text{V}}$/LQ(B)</u> - <u>$\overset{+}{\text{M}}$/WP(L)</u>: the second lead-plus-orthotron will be <u>11</u>, i.e. Normal lead-plus-righthanded orthotron.

<u>Code</u> 01 11



-but this is implying a hypothetical lead, so better to read -

V/1 11

When the initial orthotron is known the sequence can then be decoded.

Fig. IX.8.

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* Fig. IX.9. (p. 198) summarises the links.

Figure. IX.9.

Table of Orthotron Chaining

-(0) Normal-Lefthanded-Reverse +(1) -(0)	+(1) Reverse-Righthanded-Normal -(0) +(1)
C ← N/LQ(T) → M	D ← N/RB(P) → V
D ← S/WP(L) → F	Z ← S/JT(R) → M
Z ← X/RB(W) → K	G ← X/LQ(J) → F
G ← H/JT(B) → V	C ← H/WP(Q) → K
K ← V/WP(T) → N	H ← V/LQ(B) → M
H ← C/RB(P) → D	G ← C/JT(Q) → N
G ← Z/LQ(R) → S	X ← Z/WP(J) → D
X ← F/JT(L) → M	K ← F/RB(W) → S
S ← M/RB(T) → V	F ← M/WP(L) → N
F ← K/LQ(B) → H	X ← K/JT(W) → V
X ← G/WP(Q) → C	Z ← G/RB(J) → H
Z ← D/JT(P) → N	S ← D/LQ(R) → C

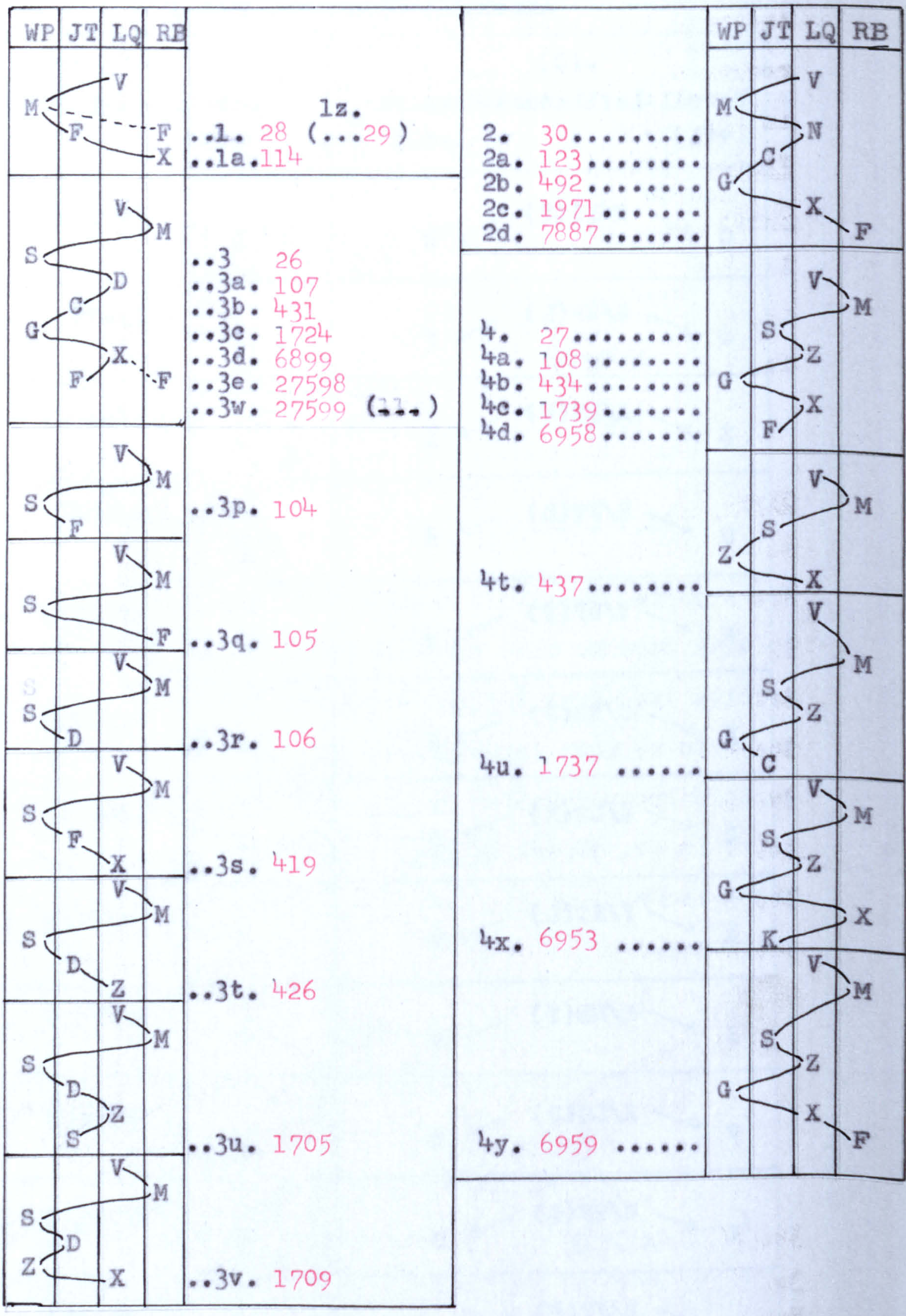

WP JT LQ RB
1z.
..1. 28 (...29)
..1a. 114
2. 30
2a. 123
2b. 492
2c. 1971
2d. 7887
..3 26
..3a. 107
..3b. 431
..3c. 1724
..3d. 6899
..3e. 27598
..3w. 27599
4. 27
4a. 108
4b. 434
4c. 1739
4d. 6958
..3p. 104
4t. 437
..3q. 105
..3r. 106
4u. 1737
..3s. 419
4x. 6953
..3t. 426
..3u. 1705
4y. 6959
..3v. 1709

Fig. IX.10.

Classification of Sequences

A summary table of coded sequences is given below to indicate the stages of the four classes of sequences which recurred, in binary and decimal form of coding. (Score charts in Fig. IX.10.)

Figure. IX.11.

Class (1)		
1.	1 11 00	28
1z.	1 11 01	29
1a.	1 11 00 10	114

Class (2)		
2.	1 11 10	30
2a.	1 11 00 11	123
2b.	1 11 10 11 00	492
2c.	1 11 10 11 00 11	1971
2d.	1 11 10 11 00 11 11	7887

Class (3)		
3.	1 10 10	26
3p.	1 10 10 00	104
3q.	1 10 10 01	105
3r.	1 10 10 10	106
3a.	1 10 10 11	107
3s.	1 10 10 00 11	419
3t.	1 10 10 10 10	426
3b.	1 10 10 11 11	431
3u.	1 10 10 10 10 01	1705
3v.	1 10 10 10 11 01	1709
3c.	1 10 10 11 11 00	1724
3d.	1 10 10 11 11 00 11	6899
3e.	1 10 10 11 11 00 11 10	27598
3w.	1 10 10 11 11 00 11 11	27599

Class (4)		
4.	1 10 11	27
4a.	1 10 11 00	108
4b.	1 10 11 00 10	434
4t.	1 10 11 01 01	437
4u.	1 10 11 00 10 01	1737
4c.	1 10 11 00 10 11	1739
4x.	1 10 11 00 10 10 01	6953
4d.	1 10 11 00 10 11 10	6958
4y.	1 10 11 00 10 11 11	6959

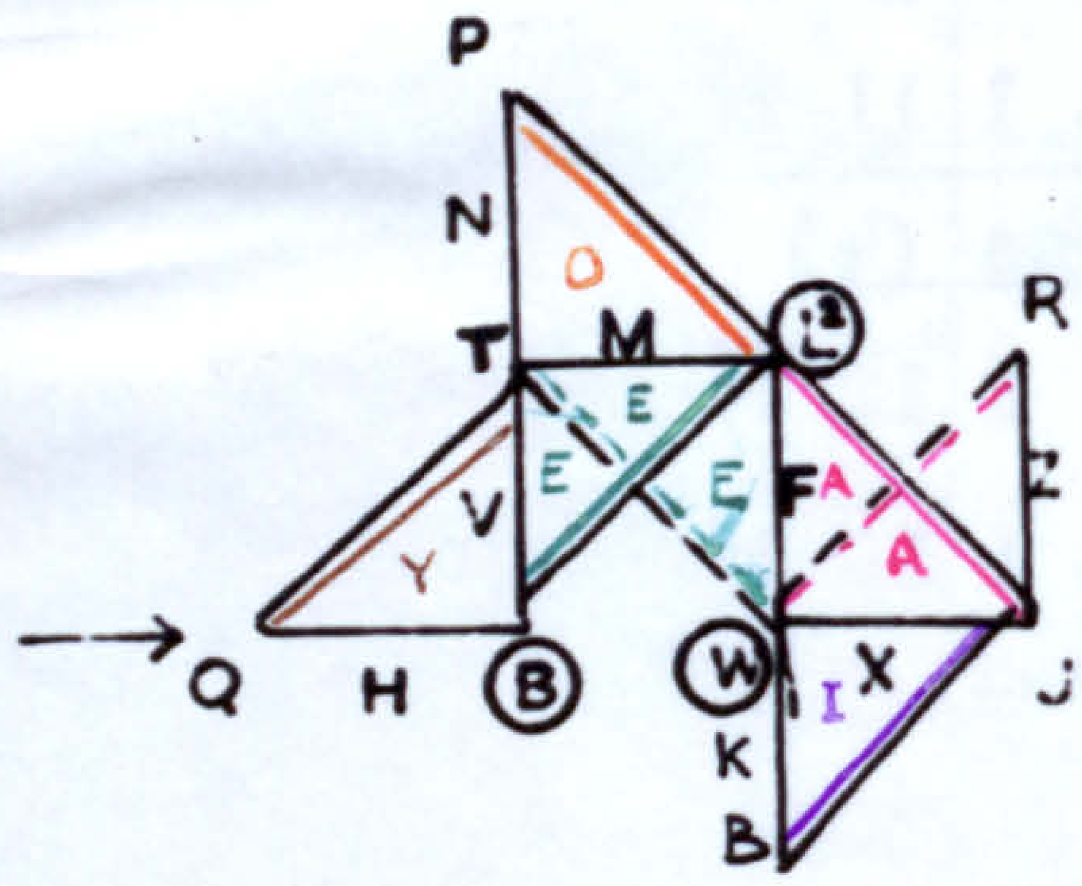
Notes. 1. Binary numbers have been spaced out to clarify chaining.
2. The apparently illogical sub-numbering by letters is clarified in the subsequent diagrams and comments.
3. V/1 is simplified to 1 since this does not vary.

Figure IX.12.

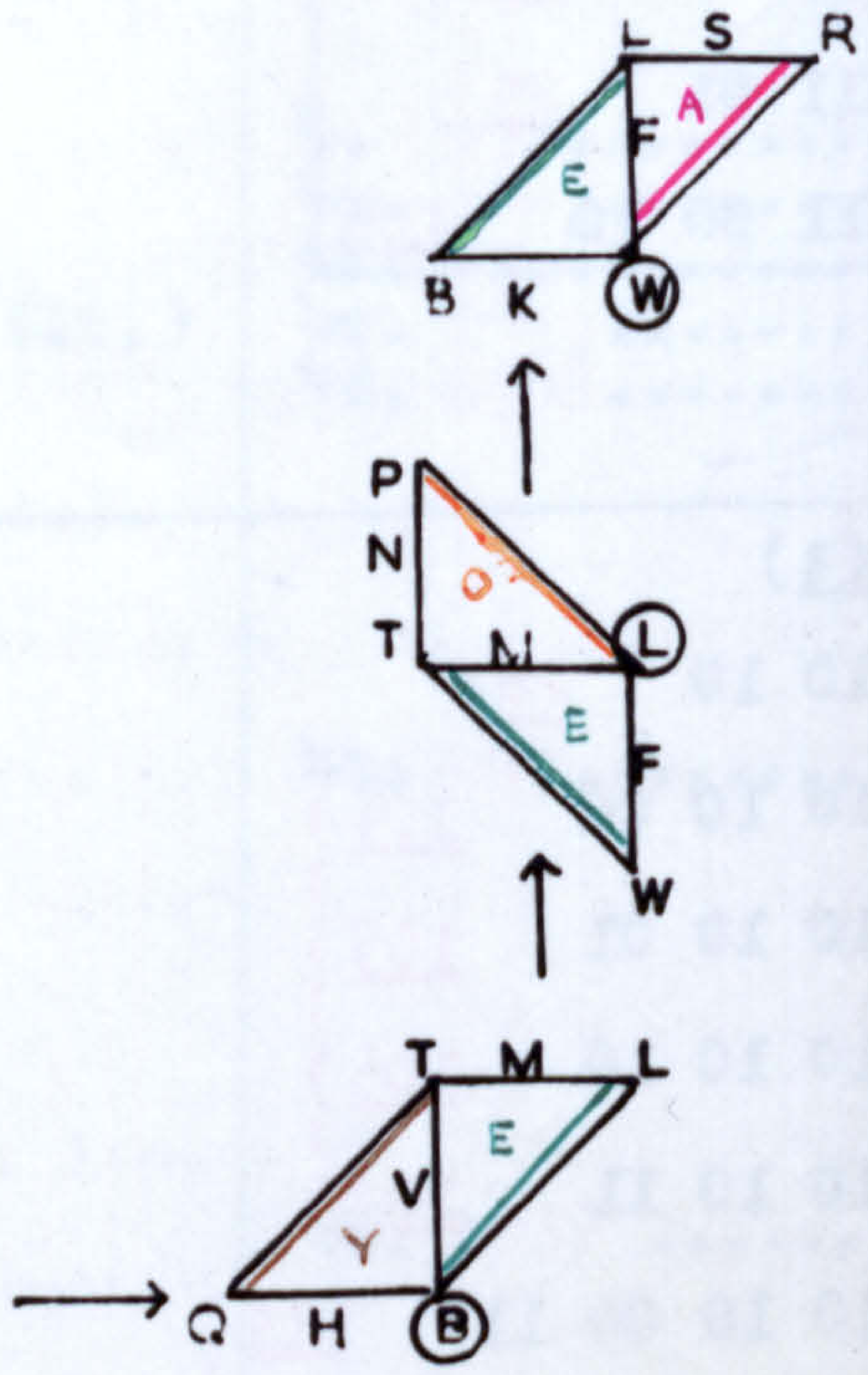
CLASS (1) Flow Chart

All the flow charts are presented working up from the bottom of the page.

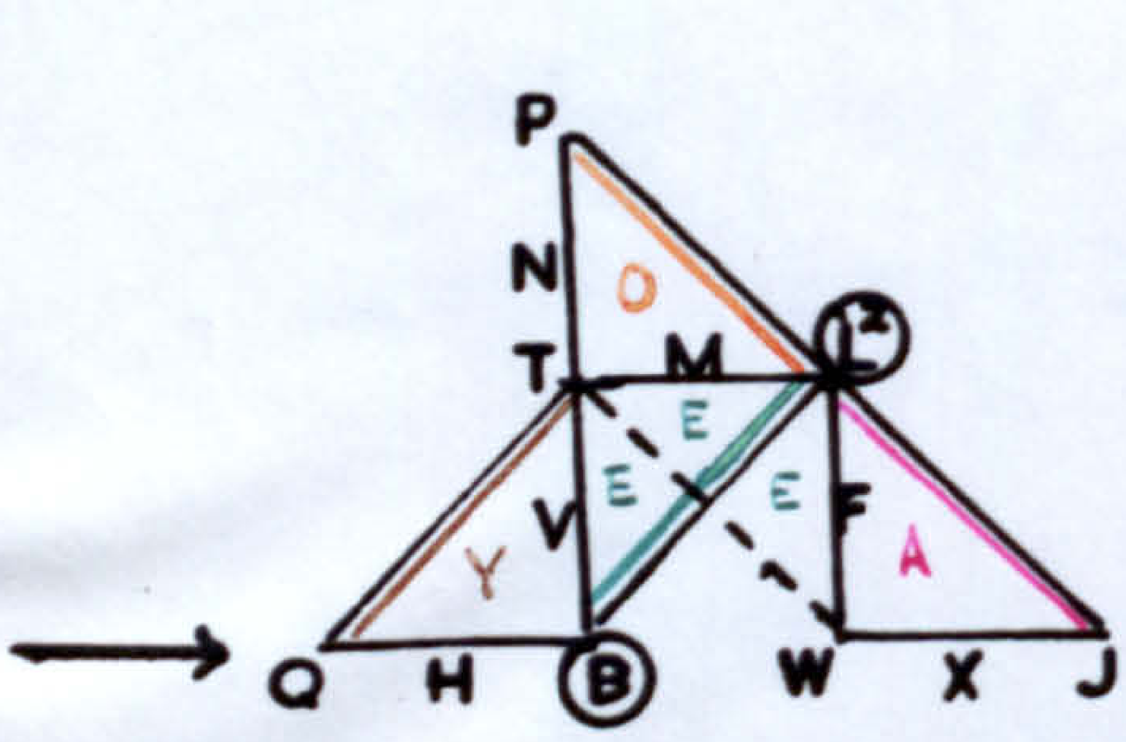
B represents Neighbourhood of Orthotron: L^2 referring to 2 Orthotrons.



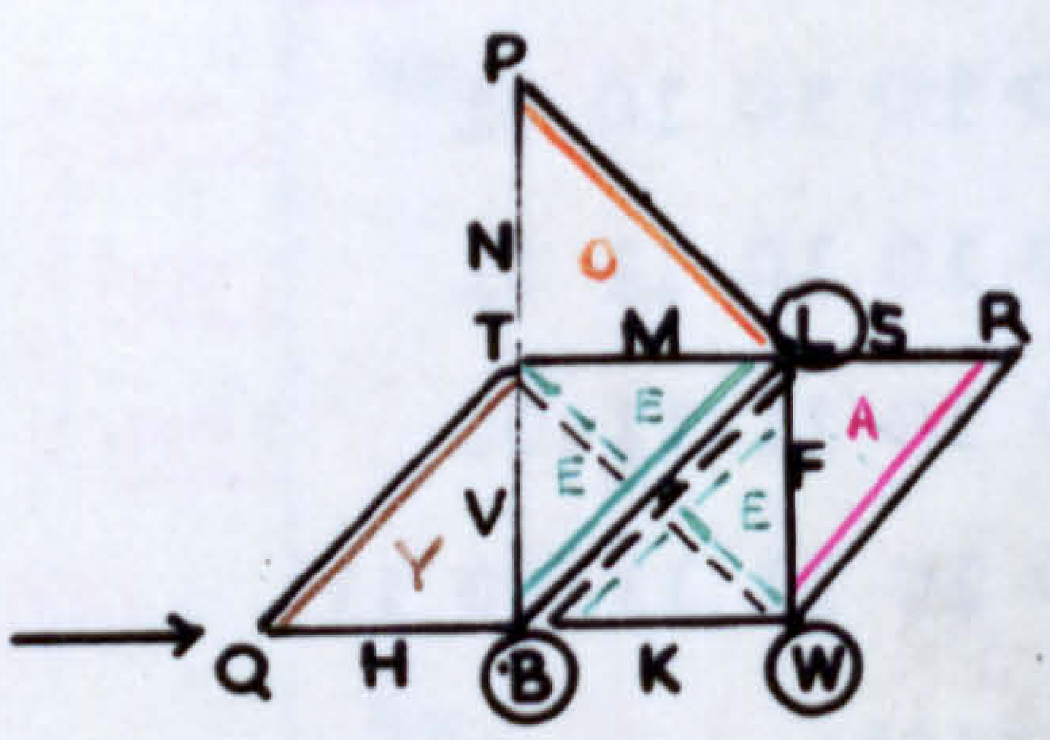
1a. 1 11 00 10 (11⁴)



Expansion of (29) to clarify the triple overlap occurring.



1. 1 11 00 (28)



1z. 1 11 01 (29)

Figure IX.12. Class(I) Flow Chart.

<u>Class (1)</u> (Fig. IX.12. opposite)

1.	$\overset{+}{V}$/LQ(B) →	$\overset{+}{M}$/WP(L) →	$\bar{F}$/JT(L).		28
1a.	→	→	→ $\bar{X}$/RB(W). . . .		114
1z.	$\overset{+}{V}$/LQ(B) →	$\overset{+}{M}$/WP(L) →	$\overset{+}{F}$/RB(W).		29

Learning Readiness → Socio-Symbolic Learning → Cultural Reaction → Cultural Reality.

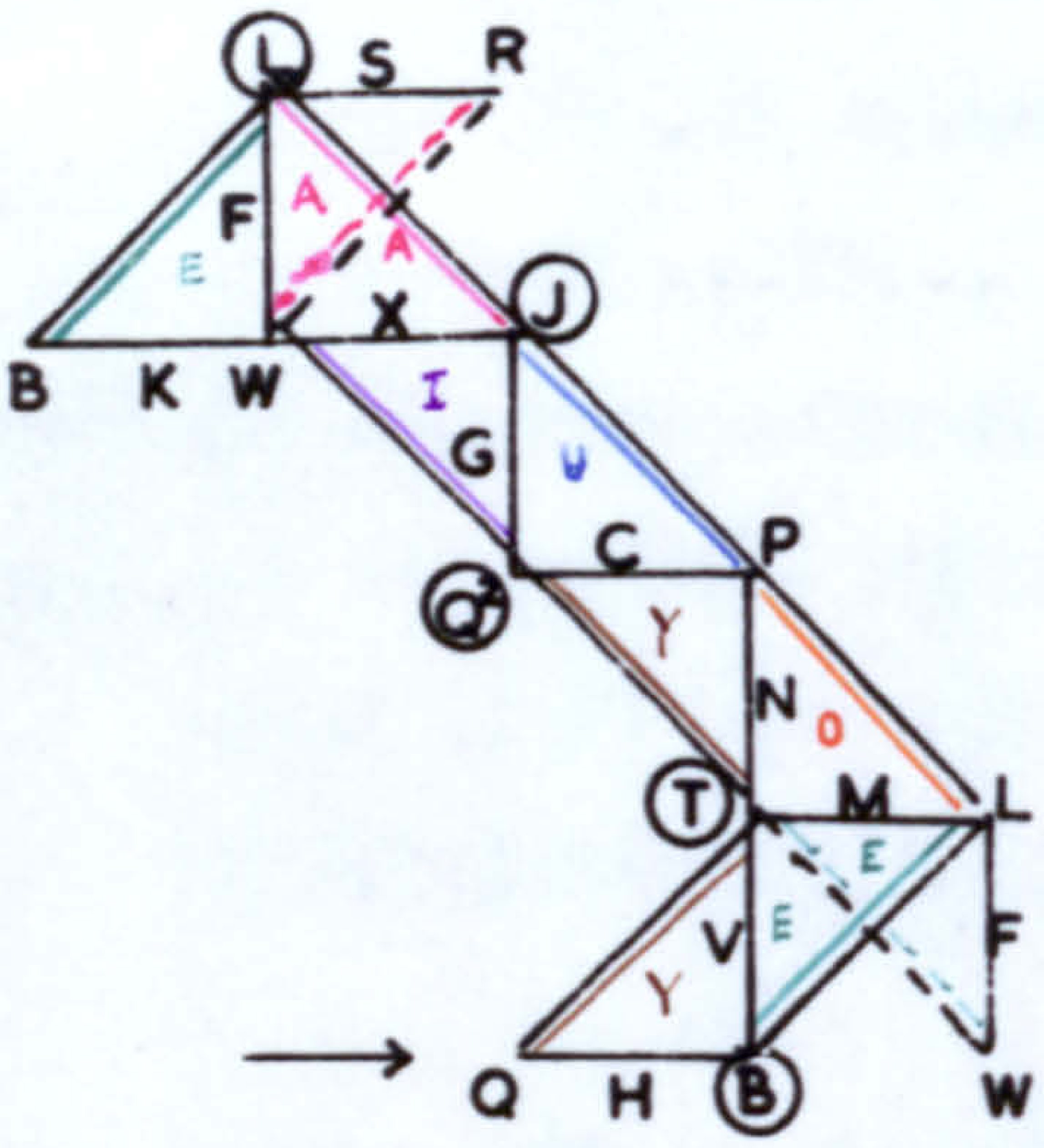
This class is taken first, because the usual context of this type of sequence was the response to the initial question, "What is a valley"? The analysis of script No. 34 gave an example of this, at the first stage of ...28... When there is further extension with information clearly acquired through the transmission of socialised concepts in teaching or reading, there is a chaining to the dominant X vector; it is there potentially as a minor vector in $\bar{F}$/JT(L). No. 42 (17.5), at ...114... says,

> "In an alpine area most settlements are in the valley, on lower slopes, on southfacing side to get the sun, and sheltered".

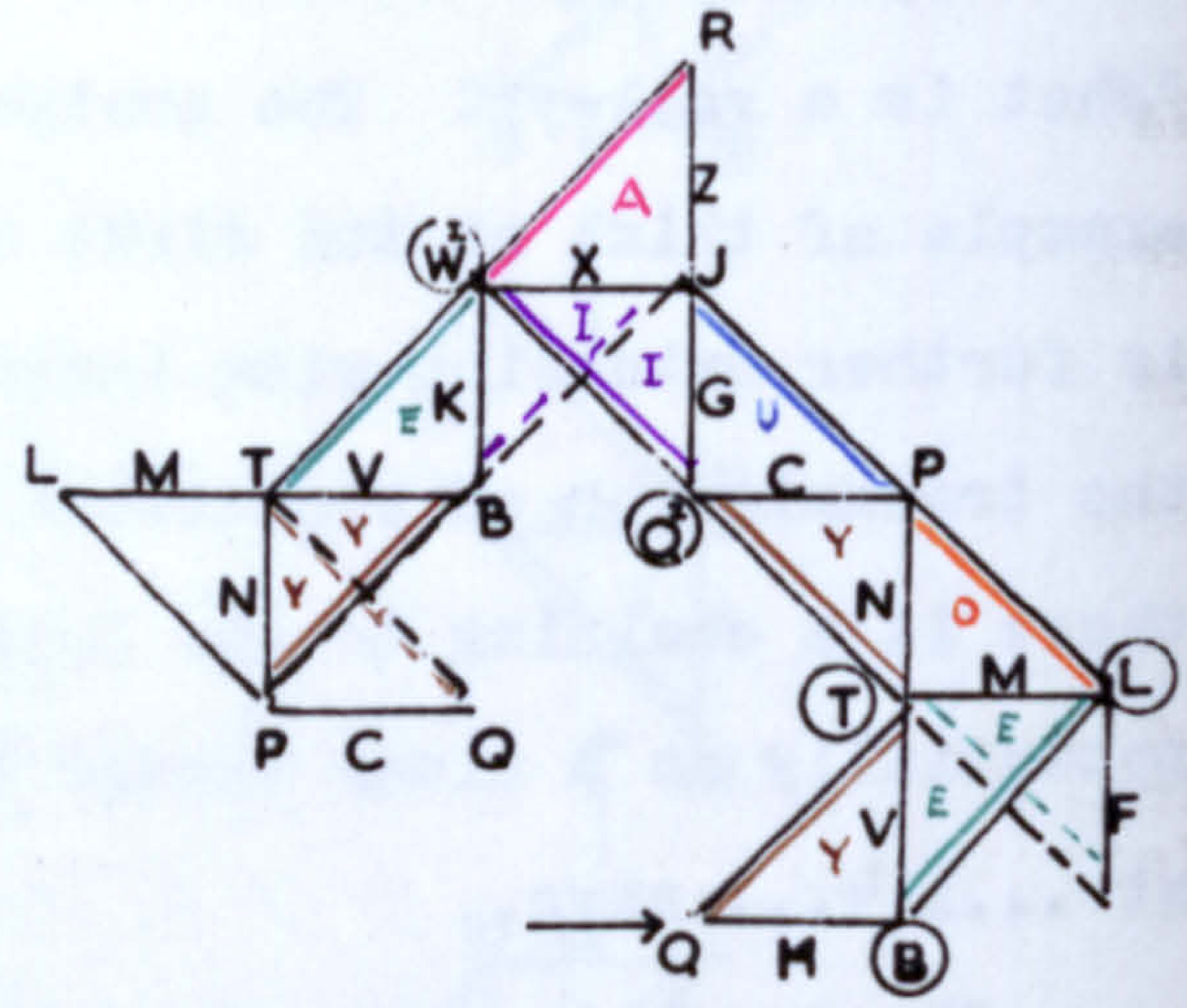
This was a sixth former who was currently studying the Alpine region, and had incorporated this "socialised concept" in his valley schema, but we have no check that it is more than verbal association.

Perhaps because this was the warming-up stage of the interview longer sequences did not develop from this beginning, unless they started from the alternative ...29... which signifies relation of the verbalised concept to some recall of landscape experience (K - F - S in $\overset{+}{F}$/BR(W). In this case the sequel was always peculiar to the individual, rather than a "standard type" of sequence. ...29... has been designated

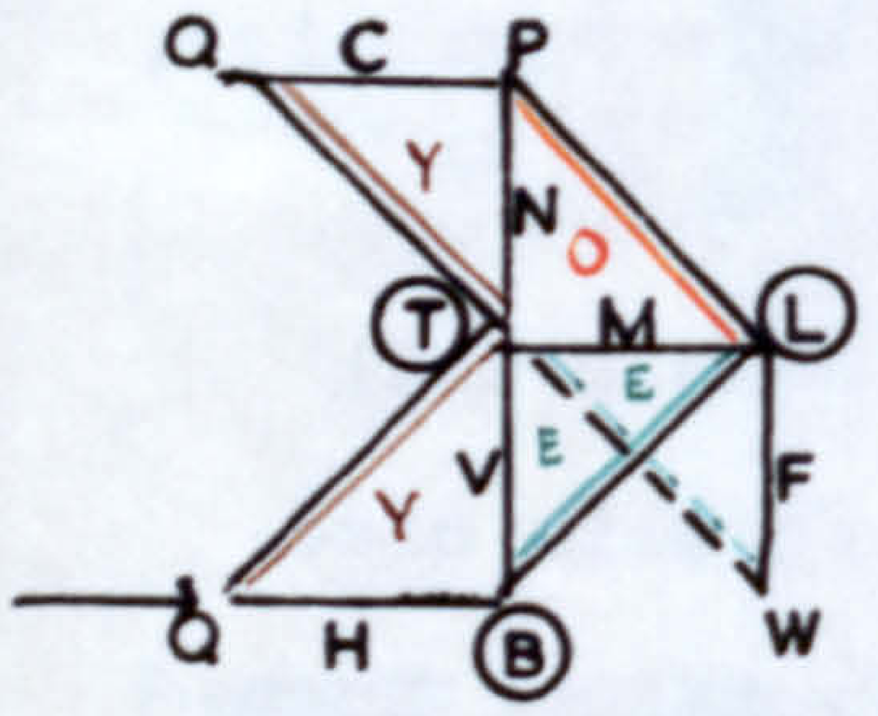
As there is such a simple diagonal progression from 2 through a - b - c, 2a and 2b have not been shown separately



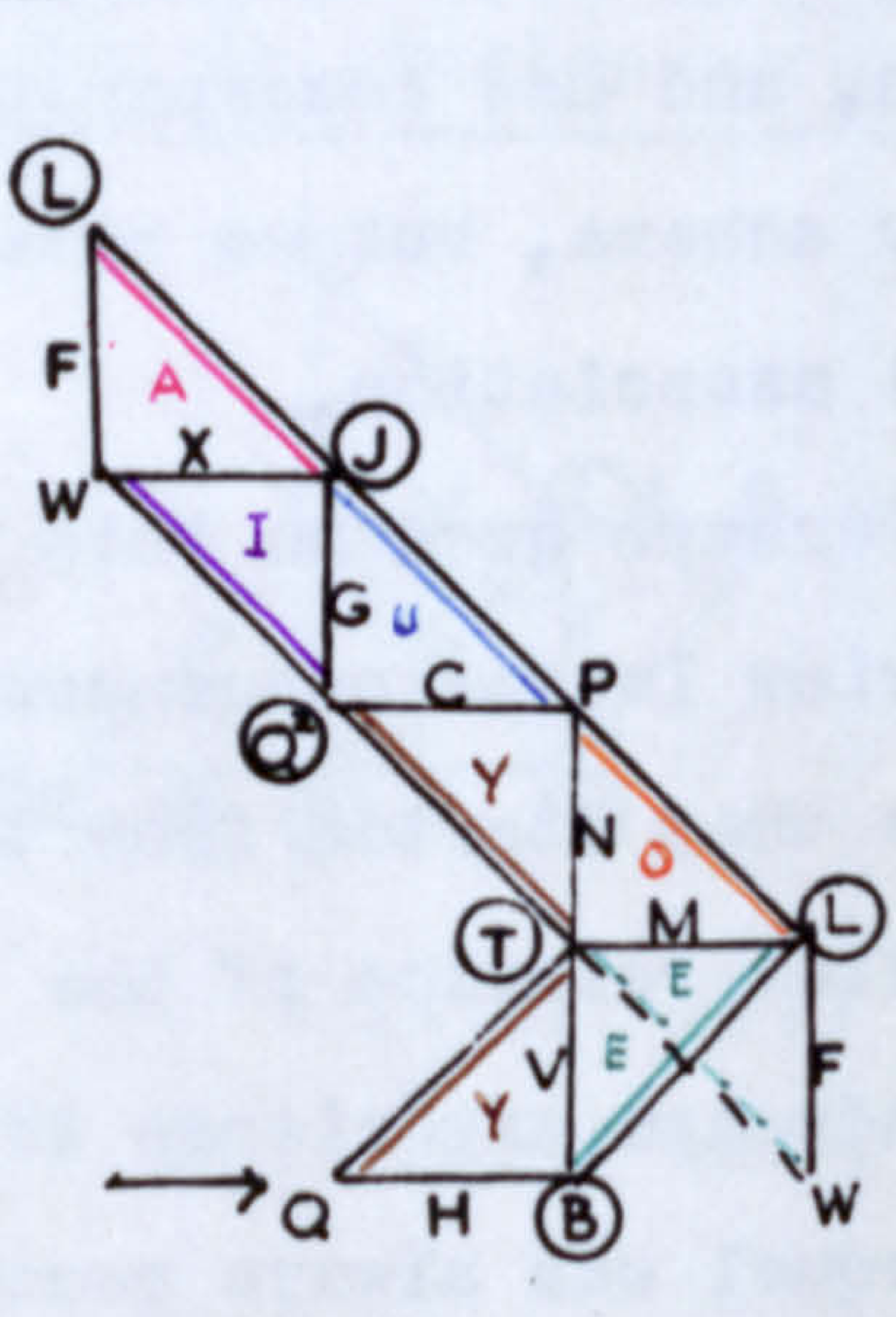
2d. 1 11 10 11 00 11 11
(7887)



2x 1 11 10 11 00 10 01 10 00
(492/152)



2. 1 11 10 (30)



2c. 1 11 10 11 0011
(1971)

Figure IX. 13. Class (2) Flow Chart.

(1z), since the letters a,b,c, etc. have been used to indicate stages in a "mainline" standard sequence of mental operations, and letters from the latter part of the alphabet used for variants (whose code number will differ slightly from the "mainline" sequence of similar length).

Class (2)

Fig. IX.13 opposite.

2.	$\overset{+}{V}$/LQ(B)	→ $\overset{+}{M}$/WP(L)	→ $\bar{N}$/LQ(T)	. . . .				30
2a.		→	→	→ $\overset{+}{C}$/JT(Q).				123
2b.		→	→	→	→ $\bar{G}$/WP(Q)			492
2c.		→	→	→	→	→ $\overset{+}{X}$/LQ(J)		1971
2d.		→	→	→	→	→	→ $\overset{+}{E}$/RB(W)	7887

Learning Readiness → Socio-Symbolic Learning → Practical Implementation → Technical Reaction → Transmission of Information → Cultural Reality

The usual context of this sequence was the demonstration of the concept in the sand tray. The sand is neutral at the beginning and its limitations for modelling in detail may frustrate the subject's attempt to show more detailed knowledge. At first the subject is demonstrating the version of his schema which was verbalised in an initial Class (1) sequence, but once a model is formed, it will feed back to the subject as well as informing the interviewer. The feedback begins to operate from 2b. onwards. In 2c. the schema is sufficiently strongly developed to set off a new train of thought with visualisation of referent phenomena which are related to the model already produced. At 2d. this is accompanied by integration with a verbalised concept, that is, the individual schema operating at 2c. appears as an accepted "geographical concept", reality viewed through the selective cultural sieve of this discipline (K-F-S in $\overset{+}{F}$/BR(W), as in ...29....

At ...30... there is usually the simple model of two hills and a space between for the valley, and no comment beyond "two hills and a valley between", at a stage where the concept was rudimentary and it practically disappeared in scripts beyond age 12+.[x] In Junior School scripts it usually refers to models of a hill since this concept appeared viable before that of a valley.

At ...123... the model is better, for at $\overset{+}{C}$/JT(Q) it conveys more information, as, for example, the convex-concave continuity of valley-slope-hill, a phenomenon which has now been "Minded". Comment is restricted to verbalisation of what can be seen on the model itself, e.g. No. 23 (12.6):

> It'll have a river running down it and breaking off round another hill here".

As demonstrated in the sand, this schema includes the erroneous idea of a river branching to go round two sides of a hill.

A sequence of the ...492... type was explicated for No. 34: the model was elaborated and transmitted more information. Watching a subject modelling and the adaptation of form as he proceeds suggests the interaction between his ideas and actions as the model helps in clarifying the general definition. The feedback at this stage first appears implicit in action rather than verbalisation, hence the importance of the Q Neighbourhood. At this point the interviewer has to be conscious of kinaesthetic feedback from

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[x] See above p. 111 for illustration of this concept quality

the action as well as visual scanning of the product appearing. But though action has been emphasised, it is important to note that most ...123... and all ...492... sequences were accompanied by verbalisation of the actions. This is significant in consideration of the subject's thought, but his model was efficient in conveying information about the referent phenomena.

...1971... No. 43. (17.6) says, while modelling,

> "Coming from the mountains down to the coast... it starts off... it gradually goes away at the bottom... fairly deep at top.. got side valleys and hanging valleys if it's been glaciated and the top bits are eroded off to make it round".

The additional orthotron $\overset{+}{X}$/LQ(J) includes the vectors G-X-F; there is interaction between the modelling and the Cultural Concept of a glaciated valley; but the expression is rather crude and the glaciation verbalisation is not clearly tied up with the modelling, so F appears as a minor vector, though the phenomenal referent in X is now dominant, not the modelled version, G.

...7887... No. 44 (17.9) says,

> "Goes steeply at first, steep V, truncated spurs, gradually gets narrower and then you start to get your meander plain towards the bottom. These are supposed to be interlocking spurs - where it's steep it's all rocky, then gradually flattens out... might get a river bluff, flood plain." ᵡ

This is a more fully formulated concept, better clothed in correct terminology. The previous orthotron $\overset{+}{X}$/LQ(J) is matching landform concept to model, and this was in continuation of the oblique pattern which is a feature of this sequence. At F/RB(W), alongside the Mapping there is much

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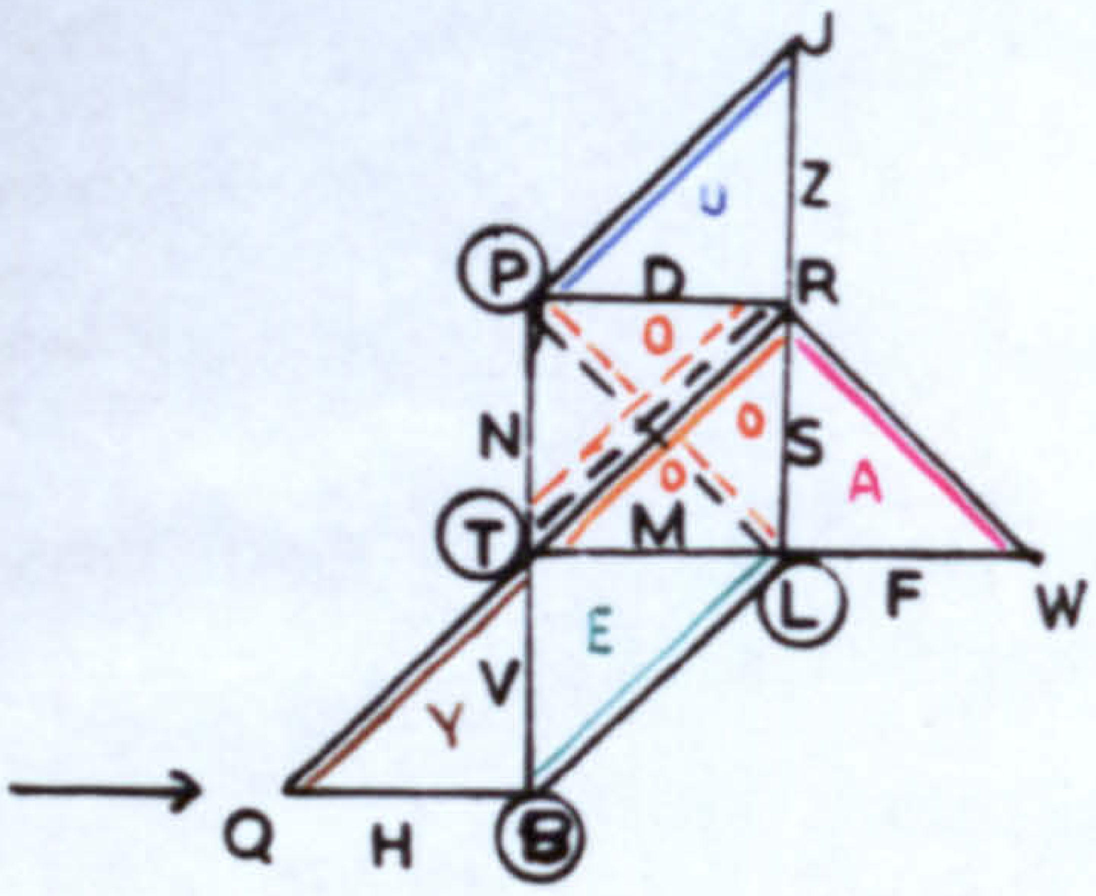
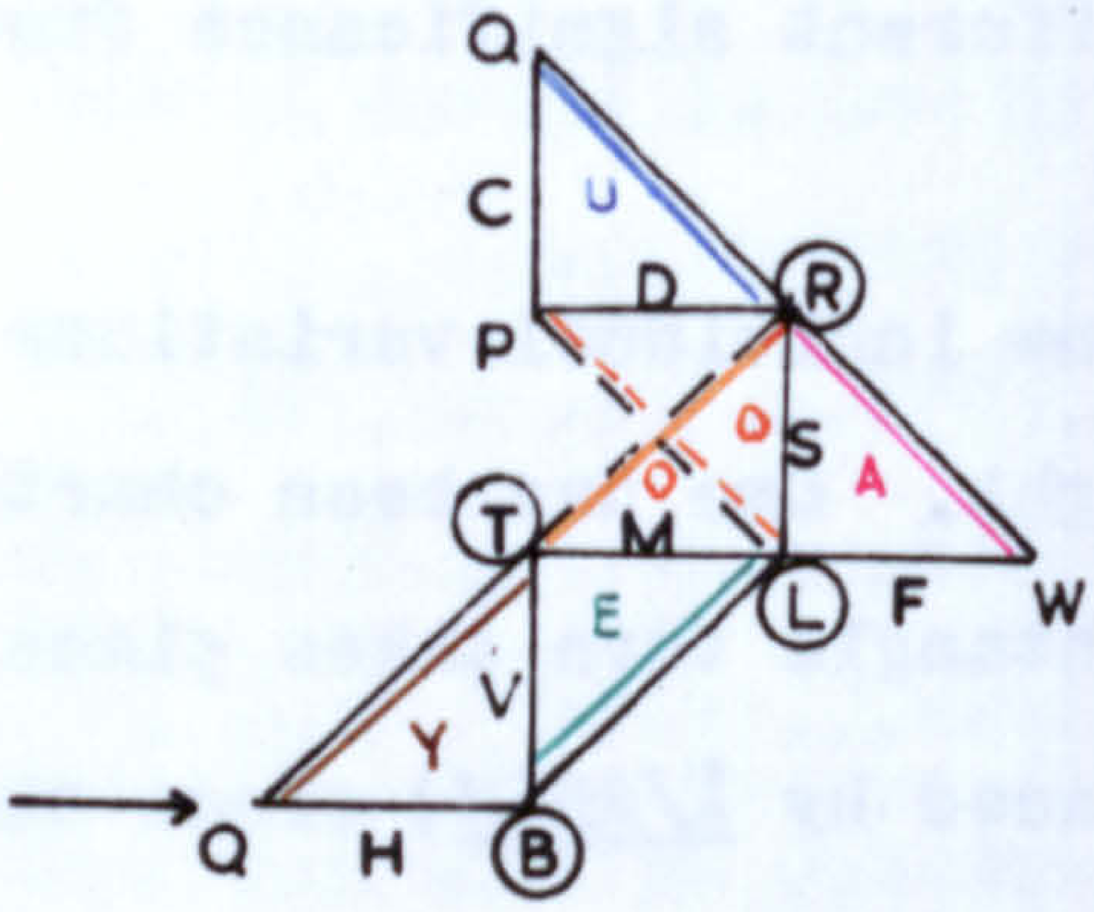
ᵡ The model is shown on p. 137 where this is quoted for Level 3 of the Long Profile Concept.

more elucidation of <u>Meaning</u> of the concept. The overlapping in the pattern is a reminder that some of these mental operations must be regarded as simultaneous. The rightangled junction of the last orthotron also poses questions. Has it a different significance from the continuous oblique series?

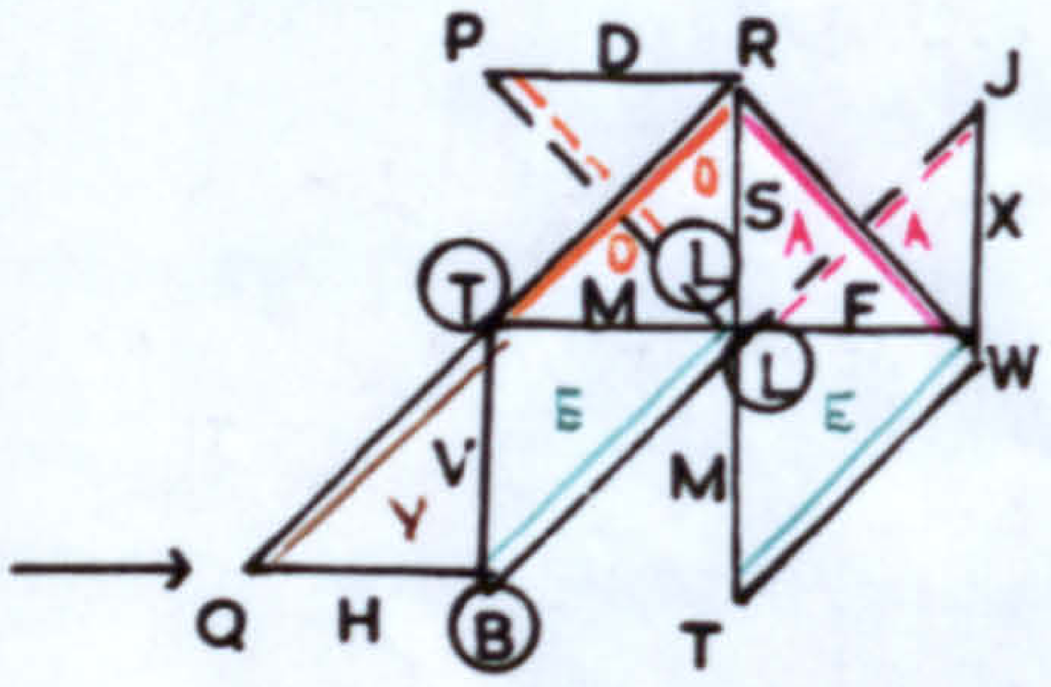
Some individual variations give alternative developments of thought. One has been charted as 2x. in Fig. IX.13. The rightangle turn takes place a stage earlier; $\underline{\overset{+}{X}/LQ(J})$ is replaced by $\underline{\bar{X}/RB(W})$ since the environmental referent feedback switches on a piece of verbal learning "parallel retreat", i.e. of the valley sides (Compare ...114..., in Class (1). This is demonstrated by pushing back and smoothing out her sand model valley sides. She has switched from a river-eroding-valley concept to one of broader landscape erosion through recall of a key phrase, the sort of thing that might be rote-learned, but at least its implication in visual landform can be demonstrated. In doing so the elements of the first "phrase" of this sequence recur, as she translates her own internal verbalisation into action. Variation of this type and renewal of thought sequence is more typical in the student population (this is No. 58 (34 yrs.), a married woman), and will be discussed more appropriately farther on.



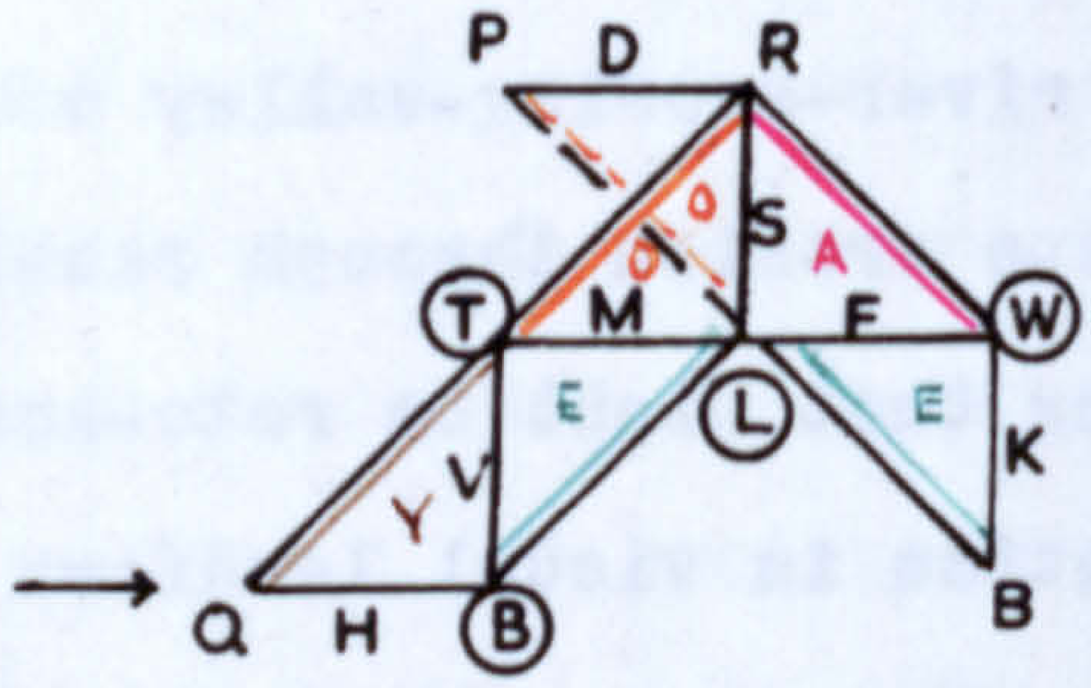
3r. 1 10 10 10 (<u>106</u>)



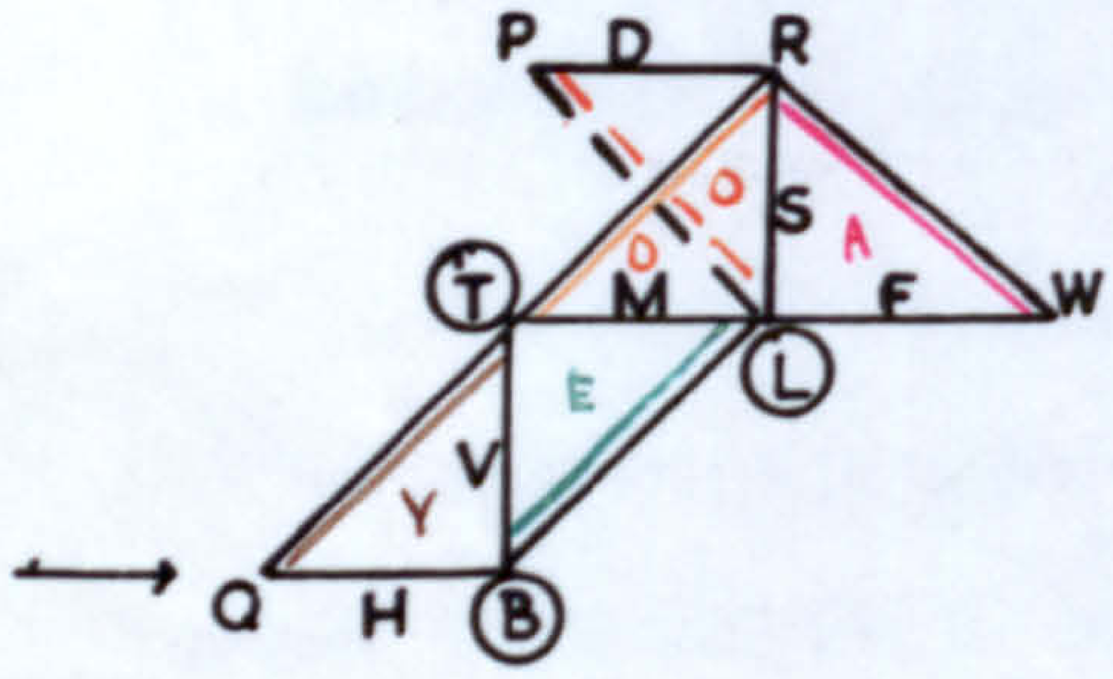
3a. 1 10 10 11 (<u>107</u>)



3p. 1 10 10 00 (<u>104</u>)



3q. 1 10 10 01 (<u>105</u>)



3. 1 10 10 (<u>26</u>)

At the second stage all four possible sequences occurred in this class and their patterns have been grouped together for comparison.

Figure IX.14. Class (3) Flow Chart (i)

Class (3)

Fig. IX.14 opposite

3.	$\overset{+}{V}$/LQ(B) →	$\bar{M}$/RB(T) →	$\bar{S}$/WP/(L)	26	
3p.	→	→	→ $\bar{F}$/JT(L)	. 104	→ X/LQ(J)...419...
3q.	→	→	→ $\overset{+}{F}$/RB(W)	. 105	
3r.	→	→	→ $\bar{D}$/JT(P)	. 106	→ $\bar{Z}$/LQ(R)...426...
3a.	→	→	→ $\overset{+}{D}$/LQ(R)	. 107	→ $\overset{+}{C}$/JT(Q)...431...

Learning Readiness → Socio-Symbolic Learning → Cultural Reaction → Selection

Placing of settlements, roads, or type of land use on the given model, or the drawing of valley patterns on the Aloplast dome involved the meaning of a perceptual response - $\bar{M}$/BR(T) - and might all arouse either a Class (3) sequence in which an acquired geographical concept seemed to be guiding the initial response - $\bar{S}$/WP(L) - or a Class (4) sequence in which recall of personal landscape experience - $\overset{+}{S}$/JT(R) - was dominant. At the second stage of the Class (3) type all the four possible leads from $\bar{S}$/WP(L) recurred. This gives an opportunity to review the differences between them with examples.

3a ...107..., though given last because of numerical order above, was the first to appear amongst the younger subjects, was the most frequent at all ages, and continued the main line of the series. In land use questions, for instance, the Junior High School children employed simple farming concepts which were sufficiently integrated to guide their perception of the model, on which they Selected - $\overset{+}{D}$/LQ(R) - areas to map in their ideas. No. 27 (12.10), says,

"This flat bit could be used for ploughing...

> I mean doing things (i.e. on plateau)... can't do much on that (lower slope)... ordinary countryside."

"Ordinary countryside" turned out to mean "green fields". This orthotron - $\overset{+}{D}$/LQ(R) - is in the Neighbourhood of R and would seem to have the natural continuity from Reflex Perception that its "main line" frequent occurrence suggests. The lefthand orthotron $\bar{D}$/JT(P) represents more positive organisation of the Selection, a more explicit Minding of the environmental referent. No. 22 (11.11) had plateau settlements on both sides of the valley, but no connecting road, and did not seem to think that a bridge was likely to be built. Asked why, he said,

> "Well, I don't think you'd need a bridge if there was another village".

His road pattern included a road (leading off the model) which he had already said was going to another village; he had not accepted the limits of the model but extended his own mental map beyond. This ... 106... sequence was more frequent in the older age groups; this 11+ example was its first appearance.

The "Cultural Reaction" i.e. to a 'socialised' or 'Cultural' concept, orthotrons $\overset{+}{\bar{F}}$ did not appear till a later stage; they appeared as alternatives to the $\overset{+}{D}$ orthotrons, as acquired cultural concepts became more operative in the later school years. No. 38 (15.6) says,

> "If you have sheep they could use the river in connection with the sheep, for processing... wool washing"

This was in the context of land use at the bottom of the valley; $\bar{F}$/JT(L) suggests the operation of an acquired concept in the schema, but not with Selection; The D element is more practical, the F element more theoretical in the initial stages of sequences of this class.

The ... 105... sequence emphasises this. With $\overset{+}{F}$/RB(W) it involved a clear acquired concept related to perception, but abstractly, not with Selection on the model or in recalled landscape. No. 39 (15.9) says about his valley modelled in sand, that it did not represent a particular part of the valley,

> "but have to be flowing slowly because it is not V-shaped"

(a confused statement since he starts with a comment on the river character and finishes it with reference to valley shape). The deduction is not a valid one, the concept being derived from over-simplified textbook geomorphology. This was one of only two instances in which this sequence appeared without an individual continuation.[*]

...104... continues to ...419... with Mapping of the phenomenal referent into the model in $\overset{+}{X}$/LQ(J). These $\overset{+}{F}$ cases were concentrated markedly in a particular part of the population interviewed; the tendency to emphasize a verbalised geographical concept, with or without clarity of landscape reference occurred among the normal age (18-20) men students. The women students inclined to $\overset{+}{D}$ in ...106... and ...107..., in which practical selective relation to the model was more dominant at this length of sequence.

	419) 104) -F	+105	426) 106) -D	+431) 107)
Junior/Junior High (28)	2	0	4	24
Grammar sch. (17)	8	1	12	22
All Students (16)	10	1	7	23
All subjects (61)	20	2	23	69
Students, 18-20yrs. Men(4)	(9)	1	0	2
" " Women(5)	1	0	1	(14)

[*] See p. 202 The same orthotron introduces individual variations, starting with sequence (1)z ...29...

The sequel to ...106... adding $\bar{Z}$/LQ(R) in ... 426... is mapping the recalled phenomenon into the model - No. 55 (30 yrs.) says,

> "... I'd build an M1 here and if this town was big enough to warrant it."

The main line sequel to ...107... adding $\overset{+}{C}$/JT(Q) at ...431... shows more activity with the model related to the train of thought. No. 47 (18 yrs, woman student), says while modelling on the Aloplast dome,

> "If it was like that it would probably be radial drainage coming from the centre... they'd be running fairly fast at the top, and the flow would get less fast as it came down. Probably start to meander as it goes down on to this low bit".

This is running commentary on action; she is Minding her rivers as she draws them.

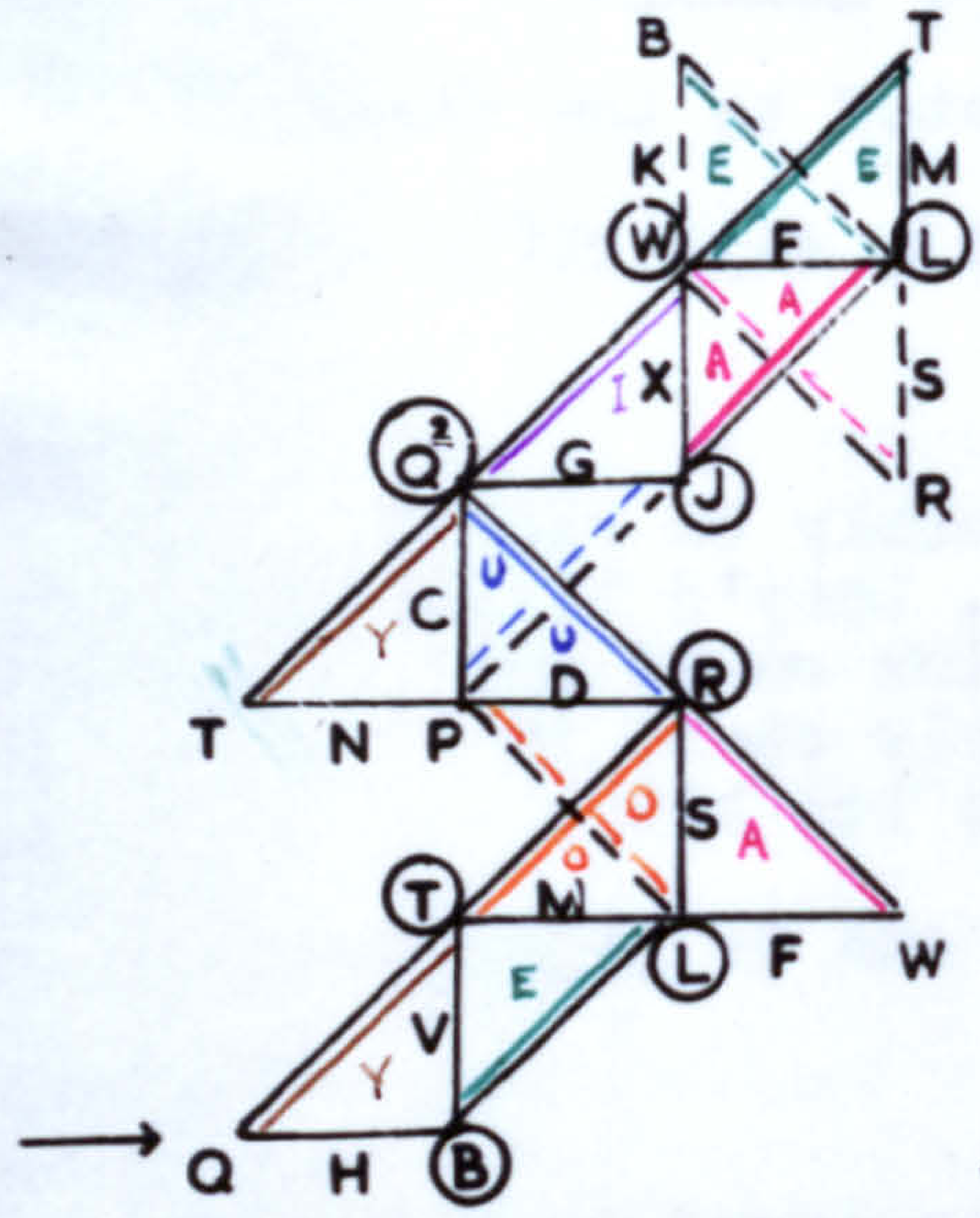
A good example of the ...104... continued in 419 with $\overset{\pm}{X}$/LQ(J) is No. 51 (19 yrs, male student), in the same context,

> "I suppose in this situation where you get a dome shape you get radial drainage something like the Lake District... They'd have to flow down the steepest slope"

The radial drainage concept appears in both, but in No. 47's case the slope of the modelling clay and her action then dominate. With No. 51, there is a statement on "Minded" landscape along with the concept (the Lake District being the most usual textbook example), and this is "Mapped" on to the model. It is possible that two different roles of language are being picked out here, its use as an aid in working out an idea with No. 47, and with No. 51 retrieval of a verbally stored concept.

(27598)

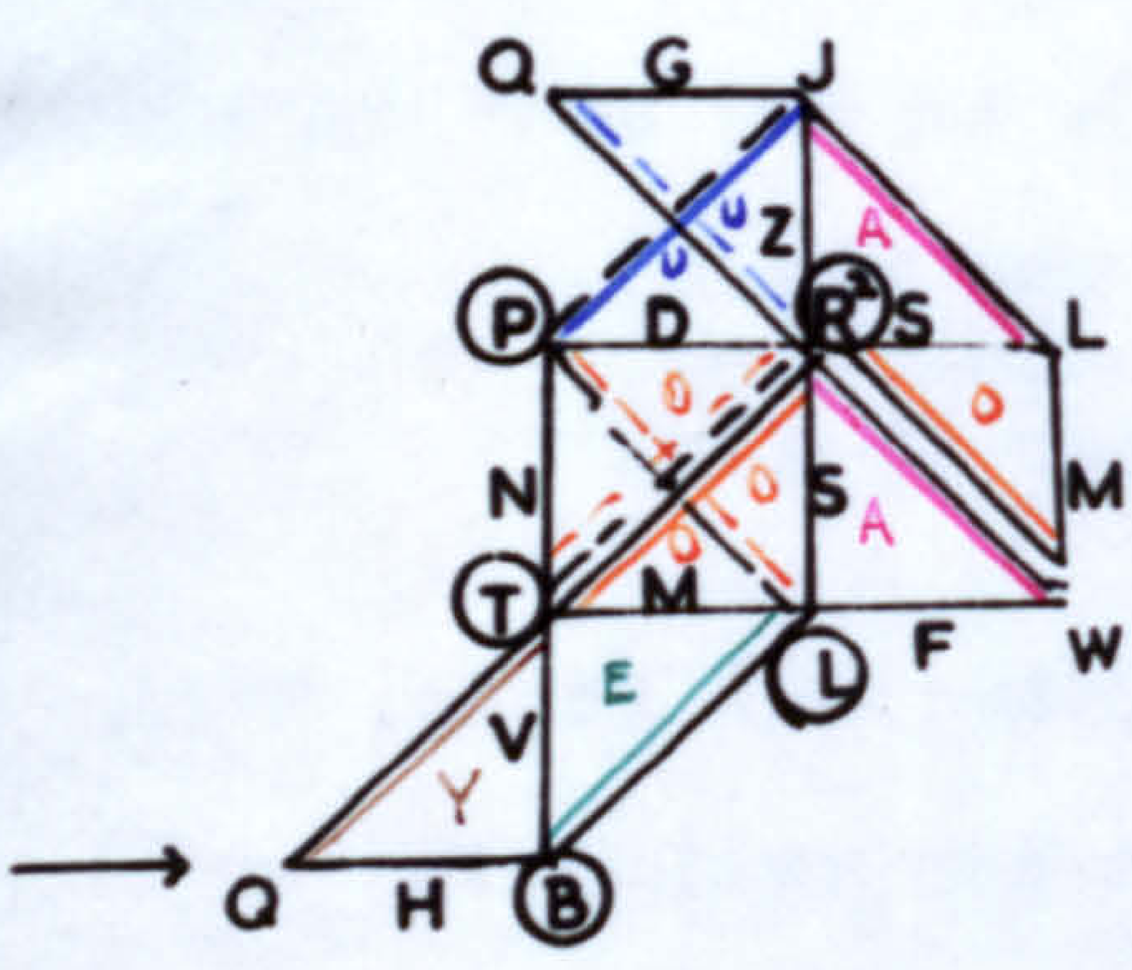
3e. 1 10 10 11 11 00 11 10



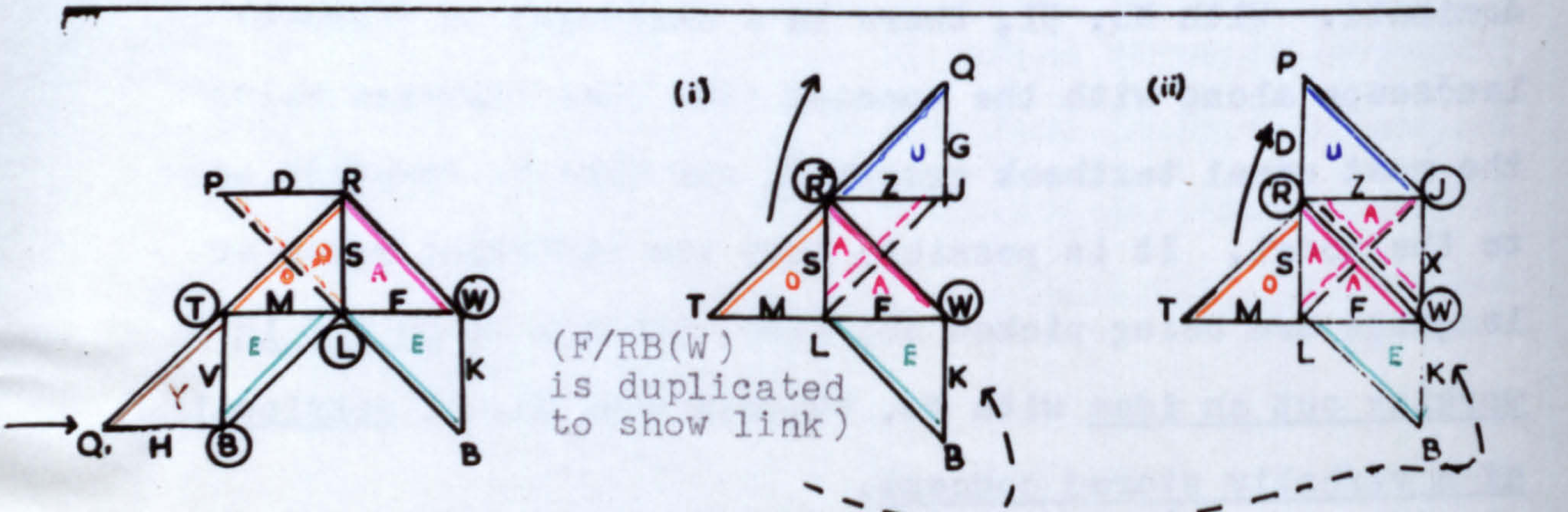
(27599)

3w. 1 10 10 11 11 00 11 11

(Last Orthotron shown in broken lines)



3u. 1 10 10 10 10 01 (1705)



1 10 10 01/11 00 (105/12)

1 10 10 01/11 01 (105/13)

The break in continuity results from the limitation of presenting a 3-dimensional rotation in 2 dimensions.

Figure IX.15. Class(3) Flow Chart (ii).

Class (3) (ii)

Fig. IX.15 opposite

Main line								
3a.	$\overset{+}{V}$/LQ(B) →	$\bar{M}$/RB(T) →	$\bar{S}$/WP(L) →	$\overset{+}{D}$/LQ(R).				107
3b.	→	→	→	→	$\overset{+}{C}$/JT(Q) . .			431
3c.	→	→	→	→	→	$\bar{G}$/WP(Q)		1724
3d.	→	→	→	→	→	→	$\overset{+}{X}$/LQ(J)	6899
3e.	→	→	→	→	→	→	→ F/JT(L)	27598

Learning Readiness → Socio-Symbolic Learning → Reflex Perception→ Selection → Technical Reaction → Transmission of Information → Cultural Reality → Cultural Reaction

Before continuing with the main line it is worth looking at two variations following from those just discussed. No exactly recurrent longer sequence was recorded leading from ...105... but there are two which are very similar (see flow chart opposite) equivalent to a 3c. sequence length. They also bring up a presentation problem; the recurrent sequences just fell within the limits of showing their rotations in two dimensions, the individual sequences often involved overlaps which would have made it impossible to read through the chart. In these cases one orthotron has been repeated and arrows added to show the direction of sequence. The development in this case was caused by a return to perceptual scanning. No. 44 (17.9) in ...105/13... showed strong landscape recall after the dominance of a farming concept on the initial scan,

> "The valley bottom would be meadows, but with the danger of flooding they would be hay meadows,* but you would get cows in the lower slopes, and

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* Quoted also on p. 136-137 above for Level 3 of "Extent" element in location Concept.

> sheep on top, and trees on the steep slopes, and here it looks to be a bit flat, perhaps oats, here quite flat, you could have cultivated that, but on top it would be too windy for trees just moorland".[*]

No. 55 (30 yrs) in ... 105/13... showed dominance of the motorway concept, social experience of communications being translated into the model landscape,

> "You could even say, Bradford trying to link up with the M1., so vital for communications - if you can't get the goods or raw materials in you don't stand a chance.[@] If this place had any potential at all they'd need the road link. The motorways don't come to the towns anymore, we've got to go to them.

[@] Marks the shift from cultural concept to "Minding" from the scanned model (the second S orthotron is $\bar{S}$/JT(R).

...106...426... had a continuation in ...1705..., a minor recurrence; From the <u>$\bar{D}$/JT(P</u>) ending or ...106..., then <u>$\bar{Z}$/LQ(R) - $\overset{+}{S}$/JT(R</u>). Minding-Mapping-Minding - is working back from a conceptually selected landscape to recalled landscape as an instrument of thought. It occurred in special circumstances, i.e. with mature students,[**] either in developing their own sand model or in their initial comment on the character of the given model valley. No. 60 (39 yrs) developed his sand model:-

> "If you had something hard and solid here (he made a gorge) you could have something like the Strid, forced through something small, or flat out into a march (demonstrates). Actually if I do think of valleys and streams I think of those flowing down from Ilkley Moor, where you take the kiddies on a Sunday".

The flow chart for this sequence curls up into a tight pattern, (Fig.IX.15) a characteristic of the individual

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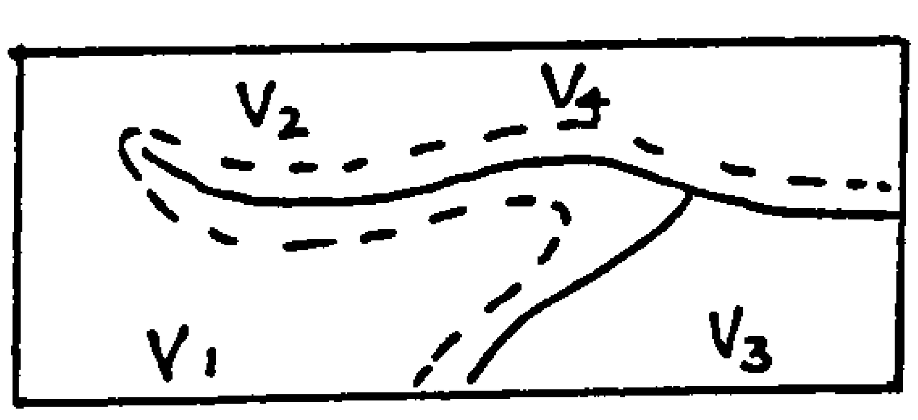
[*] Quoted also on p. 136-137 above for Level 3 of "Extent" element in location Concept.

[**] See comment on p.139 above on the use of recalled landscape experience by these students.

sequences of the student group especially in their final phase and at points of re-orientation of thought on a different conceptual basis.

The Main Line sequence was last quoted at ... 431... where activity with a model is dominant related to Minding the environmental referent; at ... 1724... further feedback from the model is activating ideas; at ...6899... they are related back to landscape reference. Finally at ...27598... another concept has been activated. The operational thought characteristics of this long sequence will be discussed more appropriately when its elements are simplified in analysis based on the Oppositionals, and after comparison with the patterns of theoretical abstract thought derived directly from the Cube in contrast to empirical testing. To illustrate the development of sequences the following series of examples have all been taken from the settlement and road-placing context to facilitate comparison.

...1724... No. 30 (13.10)



"I think up here (V_1) because this is flat land for a farm... might be a town or a village (V_2) ... there might be some houses (V_3) and near the town (V_4)".[x]

-finishing on $\bar{G}$/WP(Q), dominated by information transmitted by the model form. This makes it essential to quote the diagram summary of the pattern as well as the verbalisation.

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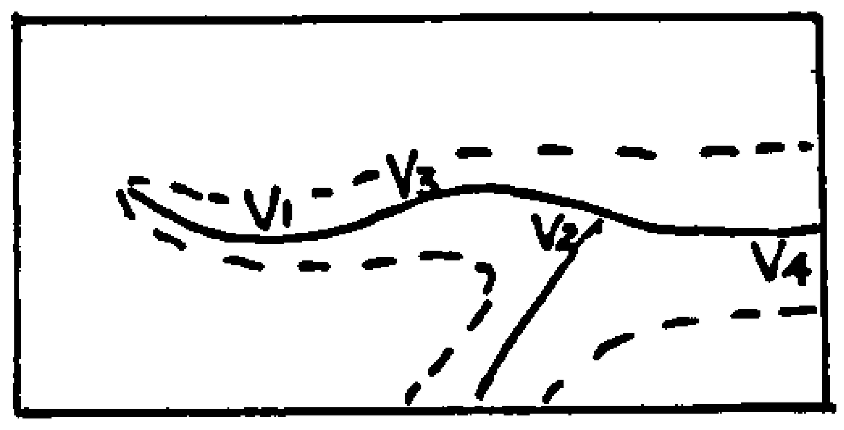
[x]Also quoted for Level 2 of Ranking element of Settlement concept - p. 131 above. The model to the instrument for working out the ranking concept.

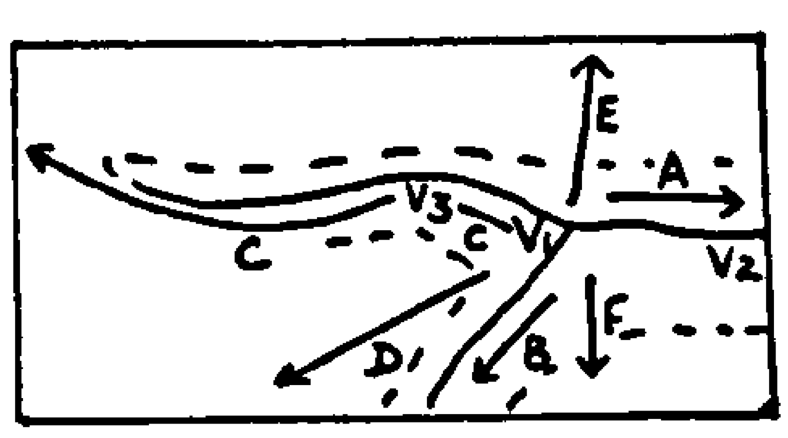
...6899... No. 37 (15.2)



"They are all well sheltered because of the steep slopes and here (V_2) you've got the joining of two streams or rivers, and you get different ways, and if you've got a boat you could go to different places... and here (V_4) the land isn't so steep so if you've got a car you've made a track up here and go to various towns."

- finishing on $\bar{X}$/LQ(J), mapping in phenomenal referents based on communications. The modelling was done first, then the comment given. It is perhaps better to think of this, not so much as a sequence but as simultaneous mental operations sorted out linearly by the analysis.

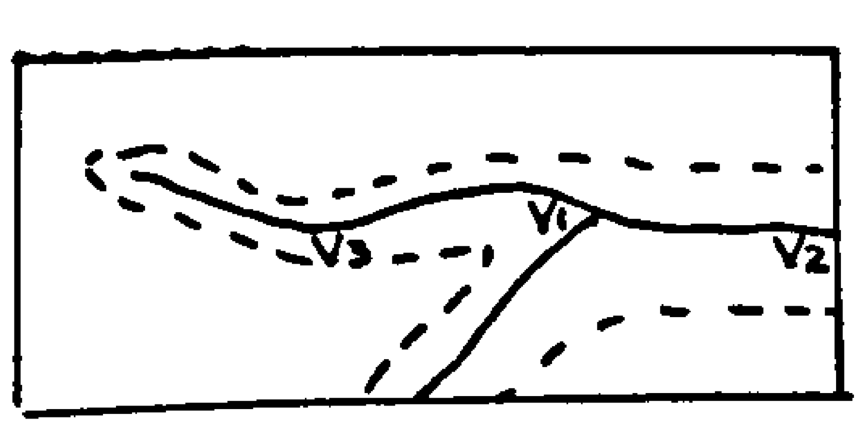
...27598... No. 40 (16.0)



"I should think this (V_1) would be the main village at the junction of the two rivers and therefore most trade will be done here, and therefore people from this village (V_3) will come to this village (V_1) and of course there will be little roads connecting with the big roads. Most villages have roads splitting over the country, and possibly have them in the valleys because it is the most flat ground, and going over the hills if there's somewhere to go to and that's the quickest way."

- finishing on $\bar{F}$/JT(L) as the concept of a road pattern going beyond the model takes over. This followed a ...6899... sequence of placing the settlements, and a ...108... (Class 4) sequence on actual road placing it seemed likely that the conceptual basis was implicit during the action, and that the subject made it explicit to herself as well as to the tester by the comment afterwards.

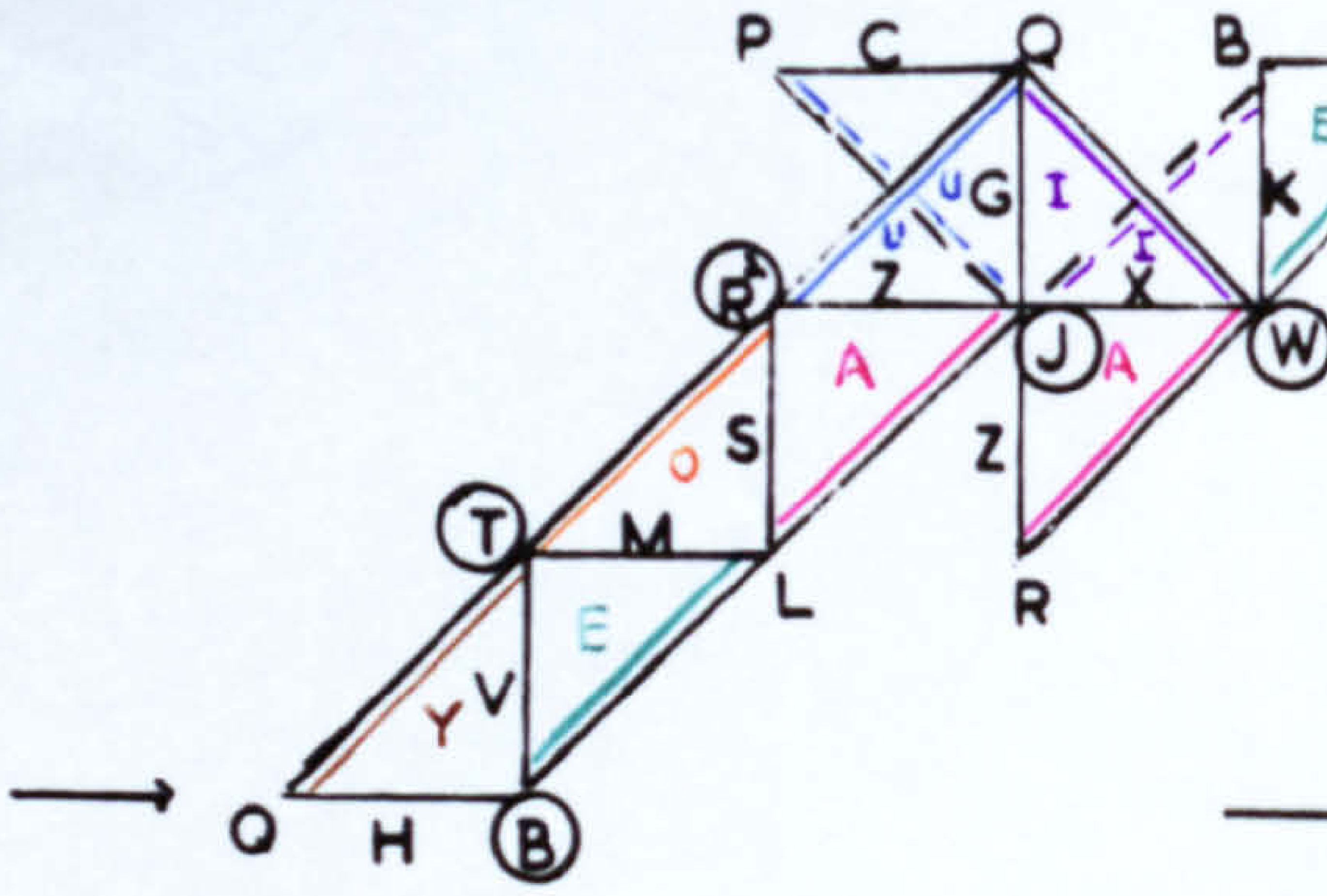
...27599... No. 45 (17.9)



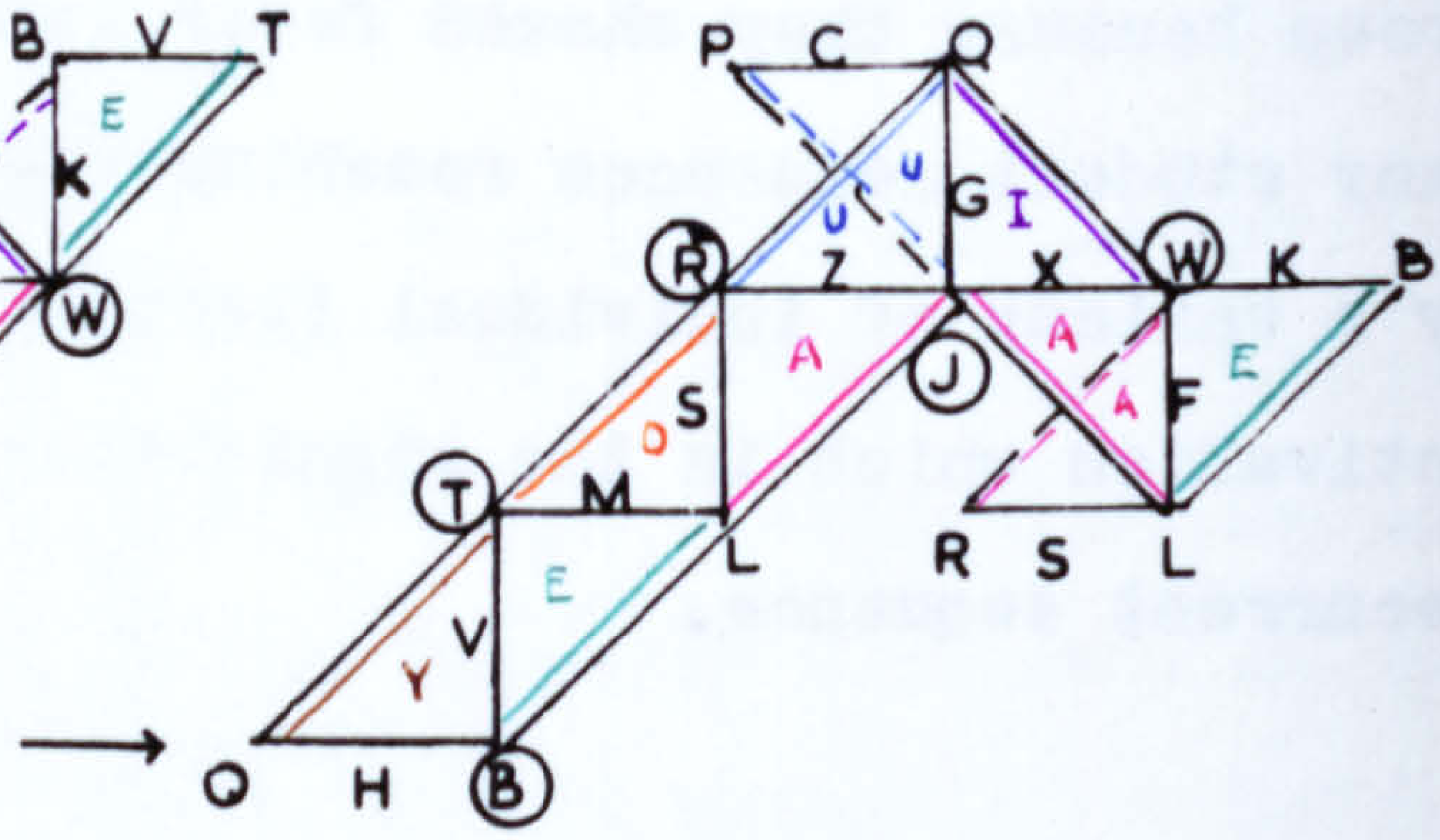
"I was thinking of towns, (V_1) market centre for routes, then when it flattened out, farming perhaps, (V_2), and if it was an Alpine country, in this narrow valley there might be one here (V_3) on a narrow plain, and farms up the hillside.

- finishing on $\overset{+}{F}$/RB(W) this time because instead of continuing with Minded landscape, a learned concept of Alpine landscape is switched on (from current European regional studies in class),

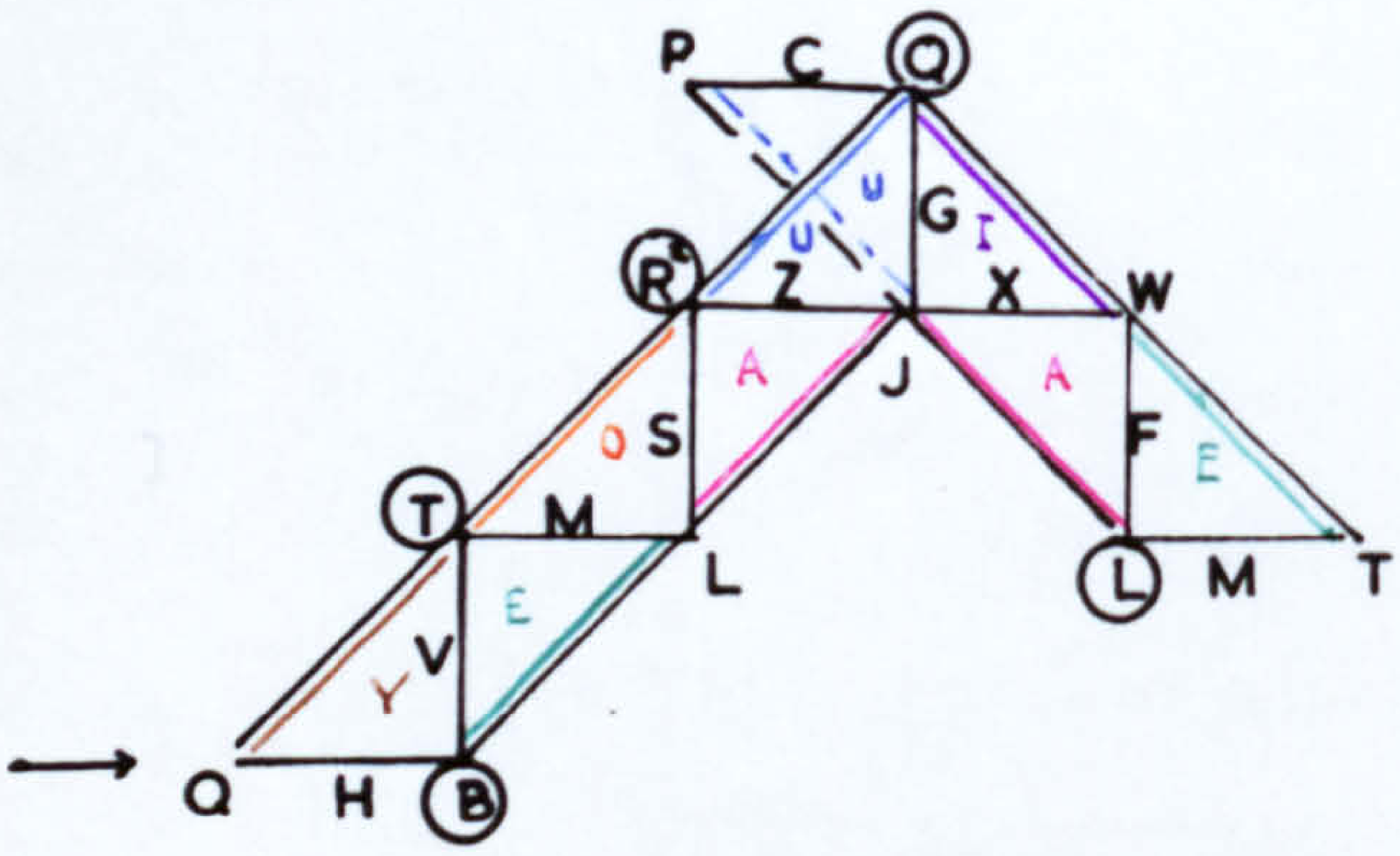
These examples have been taken from the Grammar School group because they showed fewer individual continuations; many student sequences reaching this stage were complicated by a variety of individual finishes enlarging on the conceptual activation which is the significant final stage of the recurrent sequence.



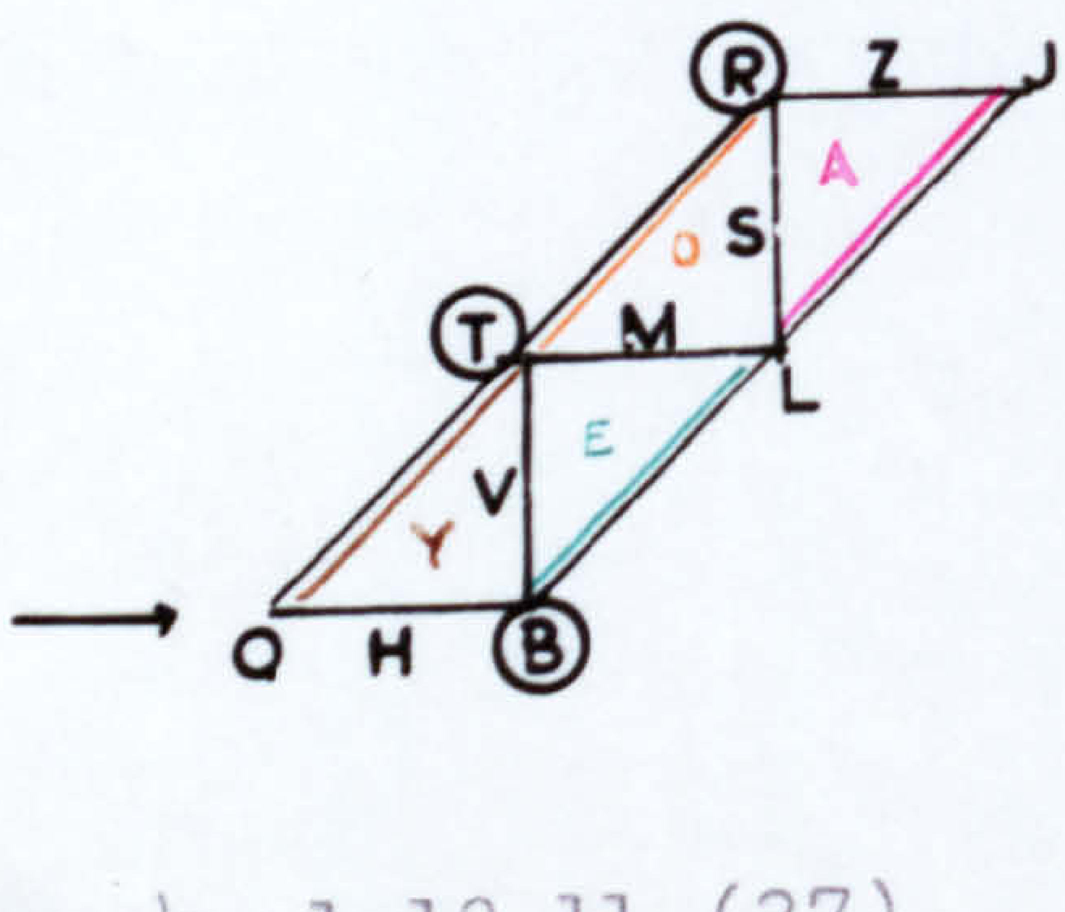
(6953)
4x. 1 10 11 00 10 10 01



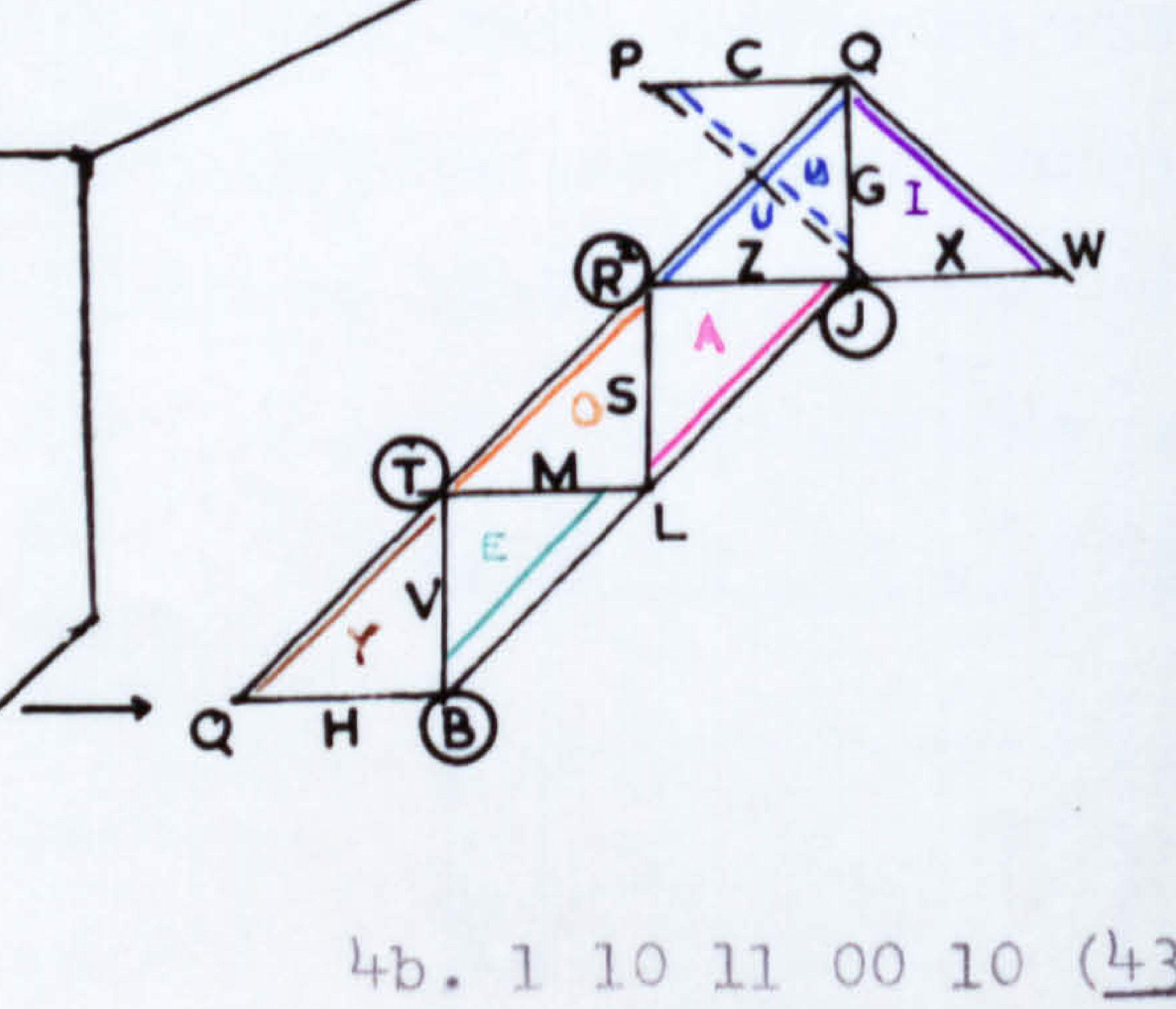
(6959)
4y. 1 10 11 00 10 11 11



(6958)
4d. 1 10 11 00 10 11 10



4. 1 10 11 (27)



4b. 1 10 11 00 10 (434)

Figure IX.16. Class(4) Flow Chart.

Class (4)

Fig. IX.16 opposite

4.	$\overset{+}{V}$/LQ(B) → $\bar{M}$/RB(T) → $\overset{+}{S}$/JT(R).	27
4a.	→ → → $\bar{Z}$/LQ(R)	108
4b.	→ → → → $\bar{G}$/WP(Q)	404
4c.	→ → → → → $\overset{+}{X}$/LQ(J).	
4d.	→ → → → → → $\bar{F}$/JT(L)	6958
Learning Readiness → Socio-Symbolic Learning → Reflex Perception → Recognition → Transmission of Information → Cultural Reality -		
4t.	→ → → $\overset{+}{Z}$/WP(J) → $\overset{+}{X}$/LQ(J)	437
4u.	→ → → $\bar{Z}$/LQ(R) → $\bar{G}$/WP(Q) → $\overset{+}{C}$/JT(Q).	1737
4x.	→ → → → → X/RB(W) → $\overset{+}{K}$/JT(W) . .	6953
4y.	→ → → → → $\overset{+}{X}$/LQ(J) → $\overset{+}{F}$/RB(W) . .	6959

Class (4) represents situations in which recall of personal landscape experience appeared dominant, and the first two stages of ...27... and ...108... accounted for about half of the total number of sequences recorded. This comes about because for the younger children who lacked acquired geographical concepts this was their most usual mode of operation, and their sequences were short but more numerous since the interviewer had to ask more supplementary questions. About three-quarters of these early stage sequences occurred with the Junior and Junior High School children.

$\overset{+}{S}$/JT(R) replaces $\bar{S}$/WP(L) as schemata based on recall of past perceptual responses are used to match with present perceptual responses to the model: $\bar{Z}$/LQ(R) is so closely related and may be taken as simultaneous with $\overset{+}{S}$/JT(R), so that ...108... is by far the most frequent sequence, and ...27... is more usually in reply to a supplementary question. The oblique pattern may be compared with a similar occurrence in Class (2) sequences, where it occurred in the context of modelling in the sand. (Fig. IX.16). ...108... (all oblique) has not been illustrated separately in Fig. IX.16 as it is so easy to read from 4b ...434...

...27... in the simplest cases, occurs, for instance when Junior children were asked if they knew a stream or could say what one was - No. 8 (8.4) says,

> "just right little stream about that big and the water flowed down".

i.e. the idea is meaningful and can be matched with recalled perception. No. 17 (11.4), responded to the initial question, "What is a valley?" -

> "is it a different town with lots of trees in, like woods?",

and asked if she was thinking of a place, went on,

> "no, I just thought when I heard the word, like wood, with bushes and trees".

This child lives almost on the boundary of Bradford, and the woods on the opposite side of the valley are in Calverley; the response suggests a possible phonetic confusion between "valley" and "Calverley", especially as the latter is pronounced locally "Calv'ley". In general in this study it was felt that chronological age was appropriate as background because of the influence of acquired concepts in school classes, but in an extreme case such at No. 17 her low verbal I.Q. (75) must be mentioned when an eleven-year-old gives a response similar to an 8-year old child. It is the verbal lack, that is similar; this child is really being much more explicit about her own thought than was the eight-year-old.

No. 5 (8.3) provides a good example of valley explanation by matching environmental experience,

> "It's a.... something... where you go down like at stream... you have some big mountains, like hills and all that, and you have bridges.. and we've got a stream at home.. you go down that big hill."

This boy (a West Indian) contributed to the large total of ...108... responses - and in longer ones - he had a vivid mental map of his own locality.

Many settlement and road patterns of the younger children were classified at ...108... as they seemed a clear mapping in of local characteristics of their environment. Questions asking directly whether they had a particular place in mind naturally also produced this sequence if the answer was positive - No. 24 (12.6) ...

> "down on the estate, that's like in the valley... there's the aerodrome and there's this (he gestures) going down between".

This suggests quite an extensive local mental map, much more extensive than that of the Junior child referred to above.

At ...434... feedback from this relating of model with recalled phenomenal referent begins to open up possibilities, though as yet only potential - $\bar{G}$/WP(Q) appears at right-angles. This sequence appeared in all age groups, the quality of the ideas improving with age.

No. 21 (11.9) gives reasons for her settlement placing,

> "so there's more people around, then they can communicate easier, if there was only one up there, if there was a fire that spread all over, they'd have to go across the valley".

She is dominated by the model valley form, but the potential real landscape is being mapped into it. Later on she arrived at the idea of a bridge across the valley. In a. ...107... sequence. Sometimes the phenomenal referent was developed further at $\overset{+}{X}$/LQ(J), which continued the mainline sequence. No. 32 (14.0) makes the bridge connection in a single sequence at ...1739...,

> "(placing roads) here, for these two, connected, down to that village, and round the end (of the valley): To connect these two one could have one going up there, and to get across here there'd have to be a bridge."

$\overset{+}{X}$/LQ(J) brings in the cultural concept in the minor vector F, in this case, building bridges. No. 21 brought this element in later in a ...107... sequence when she "built" her bridge.

Further development of this type of sequence did not occur except on individual lines with the Grammar School population, who tended to go further on their acquired cultural concepts i.e. Class (3) rather than start from a perceptual basis. The mainline did continue with the students; the older ones resorted to landscape experience in which they might be richer, and in any case, the character of the first year College course which is based on fieldwork may have biassed them towards interpretation in terms of known landscape. No. 55 (30 yrs) when asked if his motorway would run in the valley, says,

...6958...
> "no, above, say up here, just find the best course

regardless of all this (i.e. the settlement), and if it's good for building one they'd build it, taking into consideration other factors. I don't think they'd build a road in here, it seemed too contained and liable to landslides, but if it's stable this would be a good idea to get out of the valley here, so depending on its degree of slope and its stability you could use it, they'd probably straighten it out".

The dominance of the model form and its interpretation in terms of landscape is finally influenced by the cultural concept of modification of relief in road engineering in the final phase of this sequence, $\bar{\bar{F}}$/JT(L).

A small number of variations appeared in the course of this sequence. For instance, sometimes the "recognition" of a real recalled landscape seemed more dominated by interpretation in cultural terms, which was classified as $\overset{+}{Z}$/WP(J) and this led directly to $\overset{+}{X}$/LQ(J); the influence of the model (G) as mediator was minimal. No. 25 (12.9), when asked about land use, spoke in terms of farming, then, when asked to differentiate between the top and bottom of the slopes, enterpreted this in terms of colour and light in the landscape. He was asked to explain:-

...437...

"light down in the valley, but dark on top...yes it's the sunlight as well, it doesn't always get down to every part of the valley"... and it would be shortish in the bottom because all the cattle had it".

He worked through mediation of the model in the previous sequences and in this one goes straight to the referent landscape, the elements of selection of landscape (D), of the mediation of the model(G), recalled perception and cultural concept (F) still appearing as minor vectors.

On the other hand occasionally the model form was so dominant that transmission of information from the model at $\bar{G}$/WP(Q) led to a Minding of the environment still dominated by the model form. No. 20 (11.7) in placing settlements was overwhelmed by information about steepness of slope,

...1737...

> "That one because the place where people are living, there, the house wouldn't be secure because it's such a slope (i.e. above the site chosen)... and put that on top, because if it was there (on edge of slope) the house would be tumbling about ... and that one, if it was there, when the bad weather came, the house would be knocked over, the rain would run down the side... put that one there, the house would be all right there because not so steep."

In the Mainline sequence (4)d the transmission of information at $\bar{G}$/WP(Q) had operated towards recalled landscape. The final Cultural Reaction might be more distinctly acquired cultural knowledge being read into the percept – $\overset{+}{F}$/RB(W) – related to perception without being as well integrated into the personal schema as in $\bar{F}$/JT(L). This seems true of No. 53 (20 yrs) –

...6959...

> "(Settlements) I think on the high land up there, away from the river, slightly sheltered by the outcropping rock, but not on the valley floor – on the bottom slopes. You may have them along the course of the river, on the high land... quite a number of towns along the course of the river in the sheltered part of the valley... at the source of the river there'd probably be a town... also in the lowlands, on perhaps a more raised part above the vale, least danger of flooding." *

This last part of this example suggests a need for further working out of its implications, and in fact this sequence did in other cases lead on to individual variations – indeed

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* Quoted on p. above for Level 3 of the Site Scatter element of the settlement concept.

this occurred with the same subject in his next sequence on the road network.

The other differentiation occurred a stage earlier, $\bar{X}$/RB(W) replacing $\overset{+}{X}$/LQ(J) , and leading to $\bar{K}$/JT(W). It is clear that the cultural concept is dominant here. This is well shown when No.47 (18 yrs) is commenting on landscape. The first part of the sequence suggests concepts based on perception; then there is a feedback that activates quite a different phenomenal referent in terms of economic geography,

...6953...

> "sides of the valley mainly grass, and grazing in the bottom, cattle perhaps and on the sides, mainly sheep. It depends how high it is, up on the top, if it's very high it wouldn't have lush vegetation, that would be lower down... if it were lower you'd have farming. But it might be an industrial area, if it's in an area where there's minerals and the settlements would grow up from the mining, and the emphasis would be on the minerals rather than the vegetation and farming".

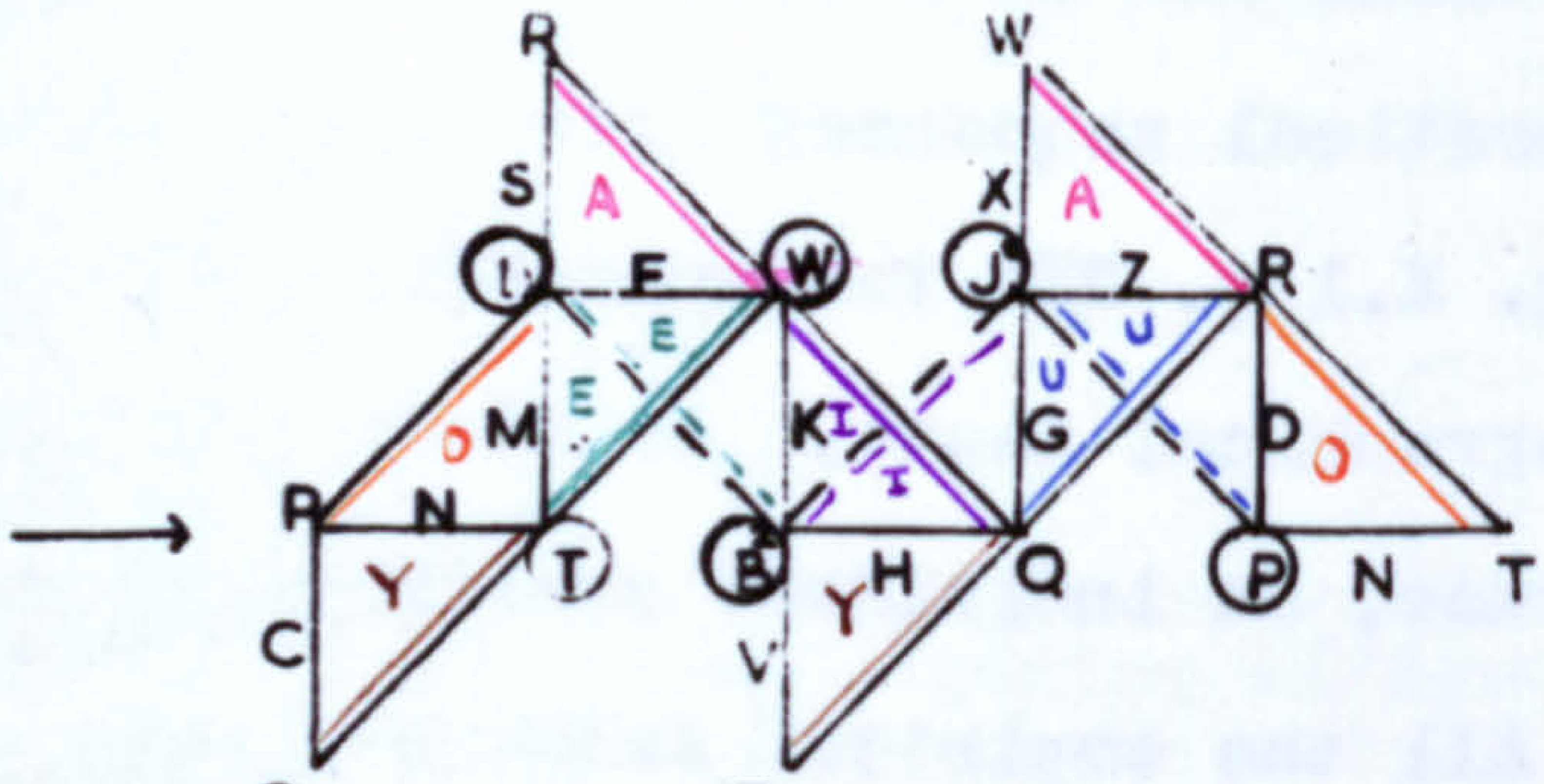
The end of developed Class (2), (3) and (4) sequences all leave the subject poised on some concept activated by feedback. Older students tended more often to carry on from this, producing individual sequences. Others could no doubt have been stirred up further by the interviewer, but spontaneous conceptual thought had petered out. Of course in teaching as opposed to testing encouragement of the activated concept would be vital.

CHAPTER X

PATTERNS OF THOUGHT

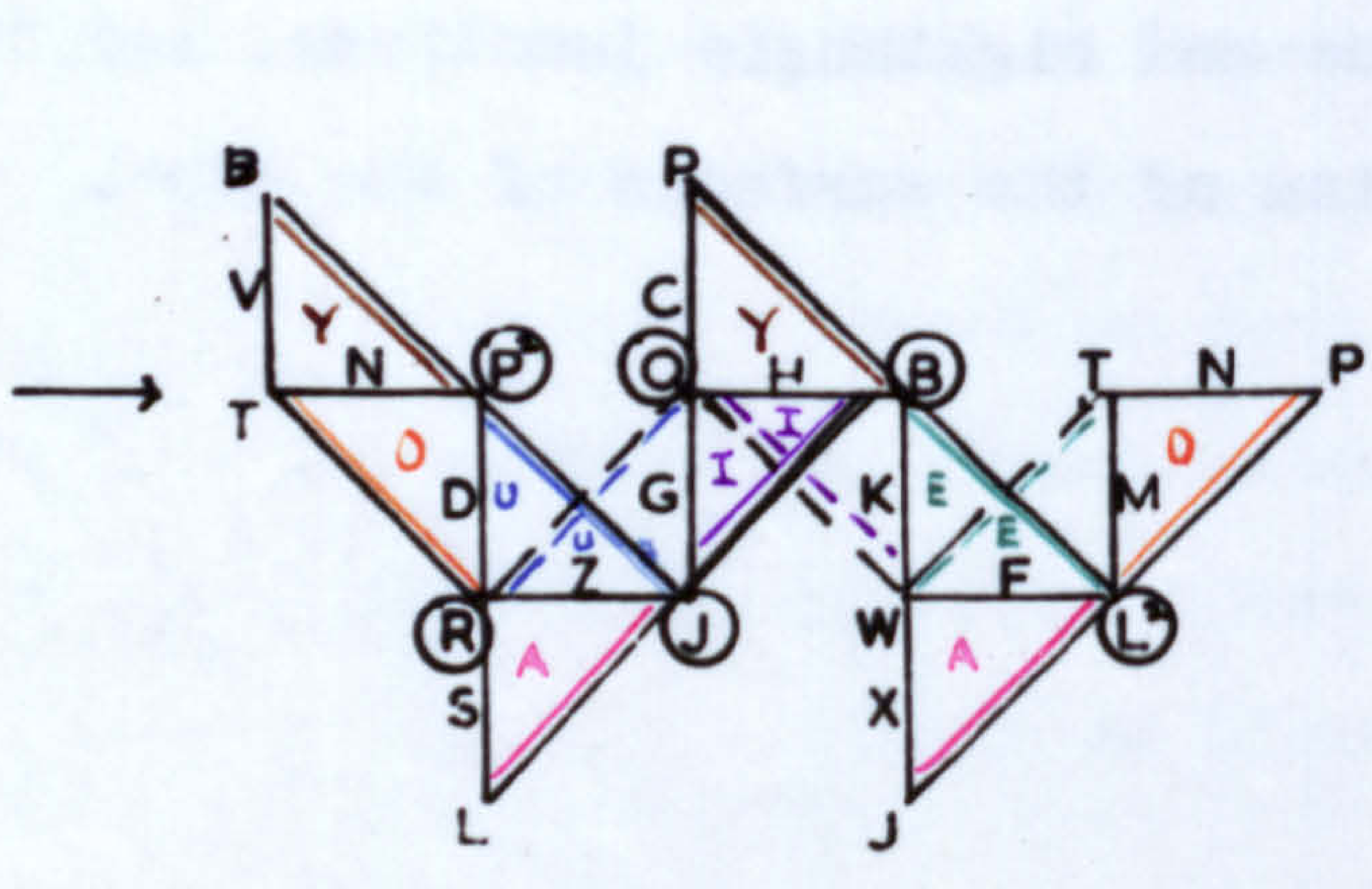
The Orthotron flow charts have provided a means of recording the extracted elements of the thought sequences and storing them in a visual form for comparison. The information about the judgments made in analysis is retained in its temporal relations and in a precise framework.

Meredith's theoretical sequences (see p.163 above) are displayed in Fig. X.1 p. 228 for comparison with the full sequences in the geographical tests. As Class (1) has no long recurrent sequence, an individual continuation of (1)a. has been included. All the empirical sequences have been re-orientated in this presentation to facilitate comparison with the theoretical sequences and it has been convenient to arrange them to read from left to right instead of from the bottom of the page upwards. The patterns are now treated divorced from their context, to emphasize the general relationships apparent, in particular the directions dictated by the occurrence of oblique and rightangle junctions, and the overlap and dispersion of the surfaces of the Cube.



(A) 10 01 01 00 00 11 01 10

Theory- Proof



(B) 01 00 10 11 11 10 10 01

Experiment- Theory

Figure X.1. Flow Chart of Theoretical Sequences.

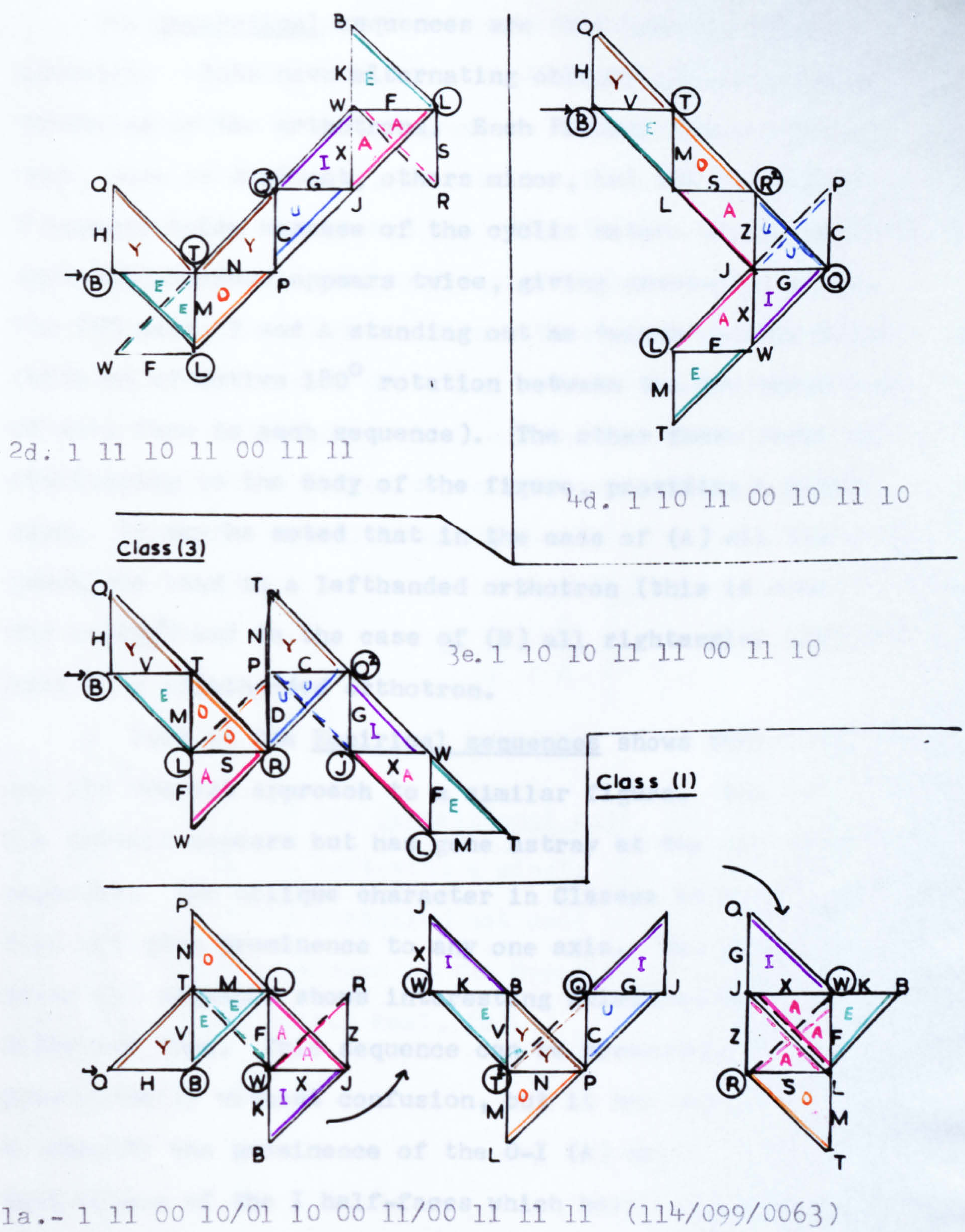


Figure X.2. Flow Chart of Empirical Sequences from test interviews.

The theoretical sequences are distinguished by their symmetry. Both have alternating oblique and rightangled junctions of the orthotrons. Each Process Vector appears once, some as dominant, others minor, but all are present. N appears twice because of the cyclic nature of the sequence. Each half-surface appears twice, giving prominence to the Y-A (Y) axis, Y and A standing out as "wings" in the figure (with an effective 180° rotation between the two occurrences of this face in each sequence). The other faces occur neatly overlapping in the body of the figure, providing a central core. It may be noted that in the case of (A) all rightangled junctions lead to a lefthanded orthotron (this is recorded in the coding*) and in the case of (B) all rightangled junctions lead to a righthanded orthotron.

A look at the Empirical sequences shows that Class(3) has the nearest approach to a similar figure. The same Y-A pattern appears but has gone astray at the end of the sequence. The oblique character in Classes (2) and (4) does not give prominence to any one axis. The selected Class (1) sequence shows interesting relationships of a different type. This sequence can be presented two-dimensionally without confusion, but it has been split here to clarify the prominence of the O-I (δ) axis. There is duplication of the I half-faces which have been rotated by 90° in this presentation.

If we wish to pause to reflect on the Organism-Environment relation, or the Cause-Effect Relation, or the Intensive-Extensive relation, of particular parts of the sequences, these flow charts will serve us well. But in

* Fig. X.5

contemplating these surfacial aspects there is an emphasis on static relations as in the earlier Orthochoric presentations (Ch. IV.). To progress on the dynamic Mathetic analysis another aspect, present in these charts but not emphasised, must be looked at. This is the succession of Oppositional relations, so frequently referred to in the preceding analytical discussion. These Orthotron flow charts were based on a curtailed orthotron net omitting the faces of the tetrahedron which are bounded on one side by the Oppositional. So let us re-draw our net, but this time centre it on the Oppositional. (a)

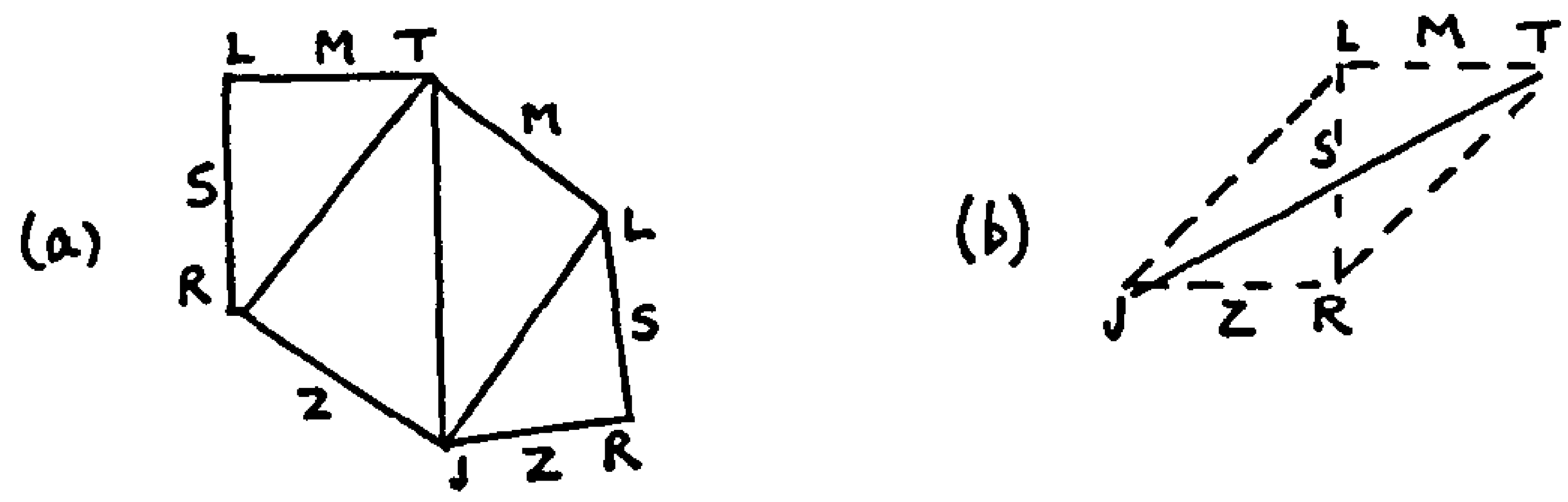
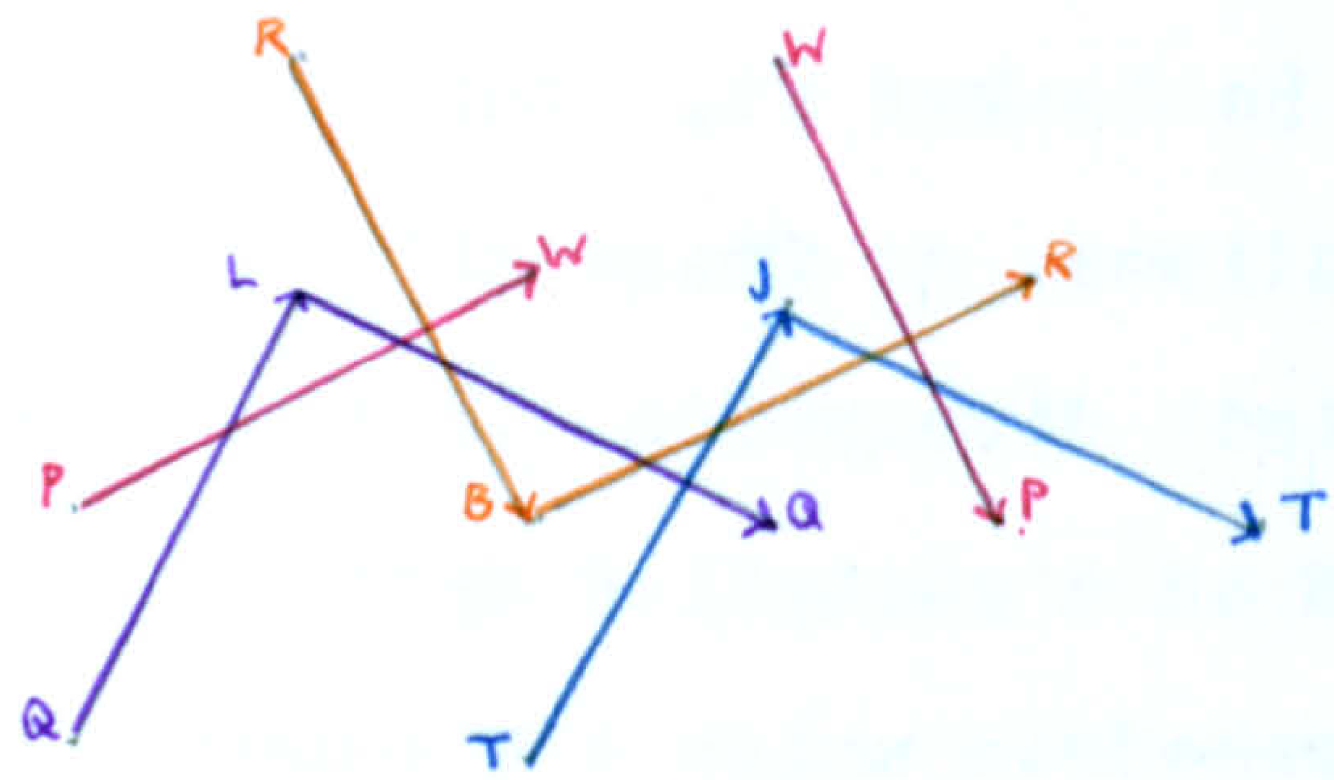


Fig. X.3.

Let us now abstract the Oppositional only, and omit the rest of the net. We are left with a single line which we can orientate as if the curtailed net used previously represented a solid orthotron perched on the Oppositional as a boat might be perched on its keel. (b).

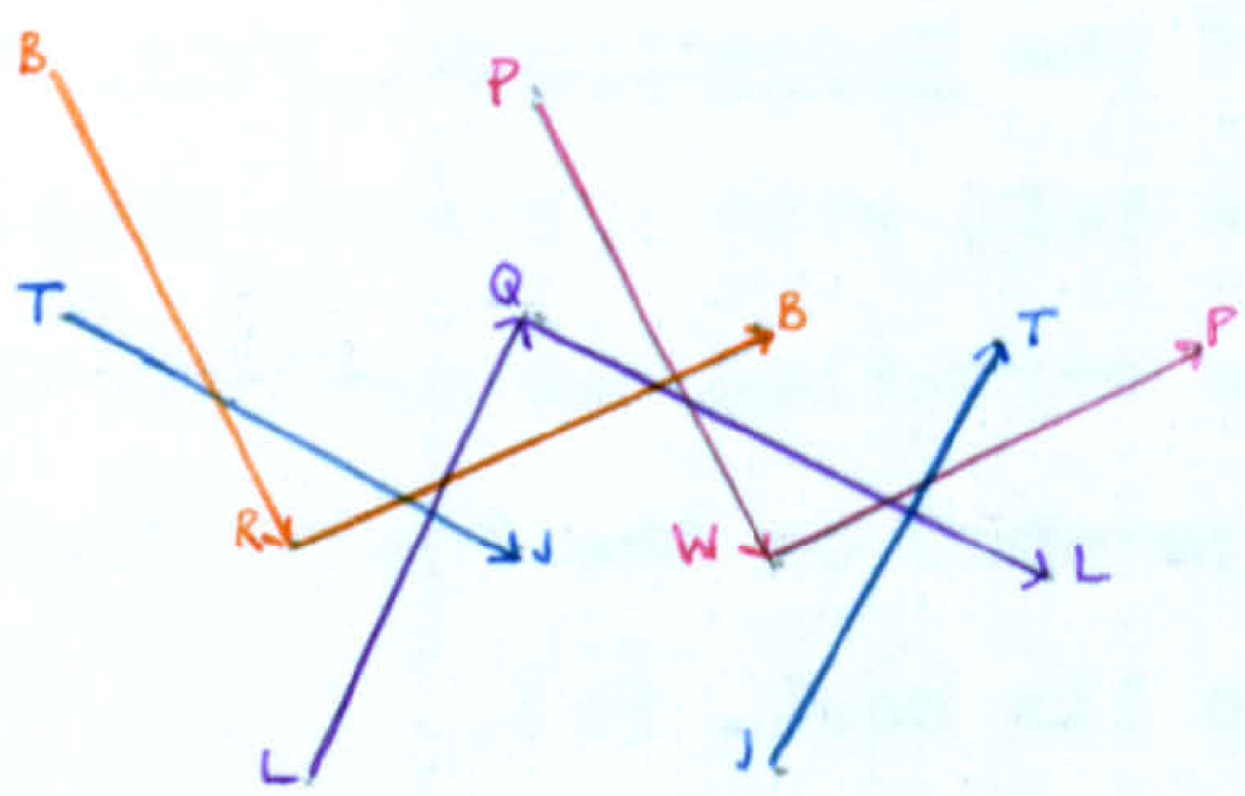
Oppositional Flow Chart of Theoretical Sequences

Note. Use of distinguishing colours has no connection with colour code for Cube surfaces



(A) $\bar{O}\ \bar{R}\ \bar{O}\ \bar{R}\ \overset{+}{O}\ \bar{R}\ \overset{+}{O}$

Theory - Proof

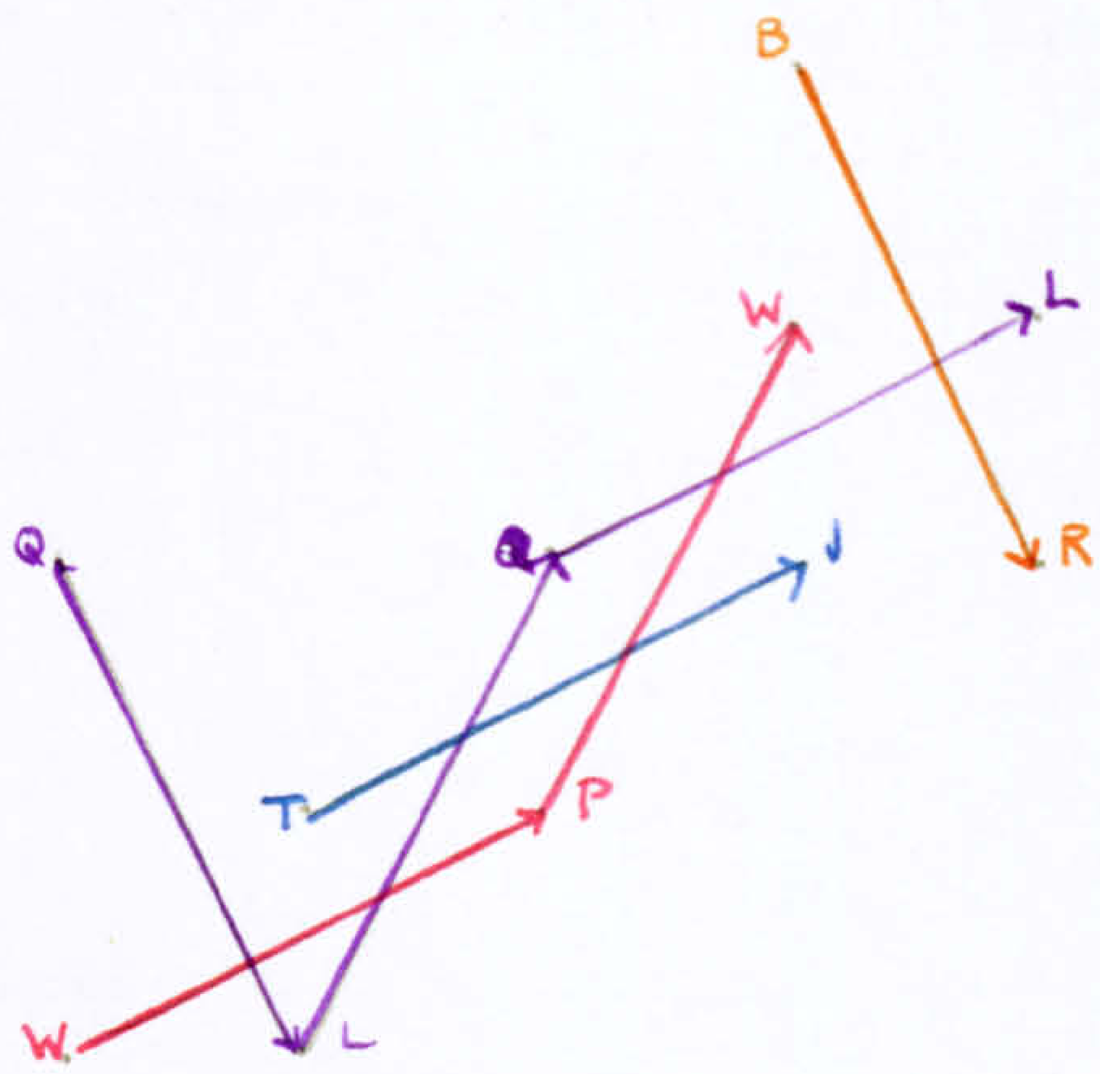


(B) $\overset{-}{O}\ \overset{+}{R}\ \overset{+}{O}\ \overset{+}{R}\ \overset{+}{O}\ \overset{+}{R}\ \overset{+}{O}$

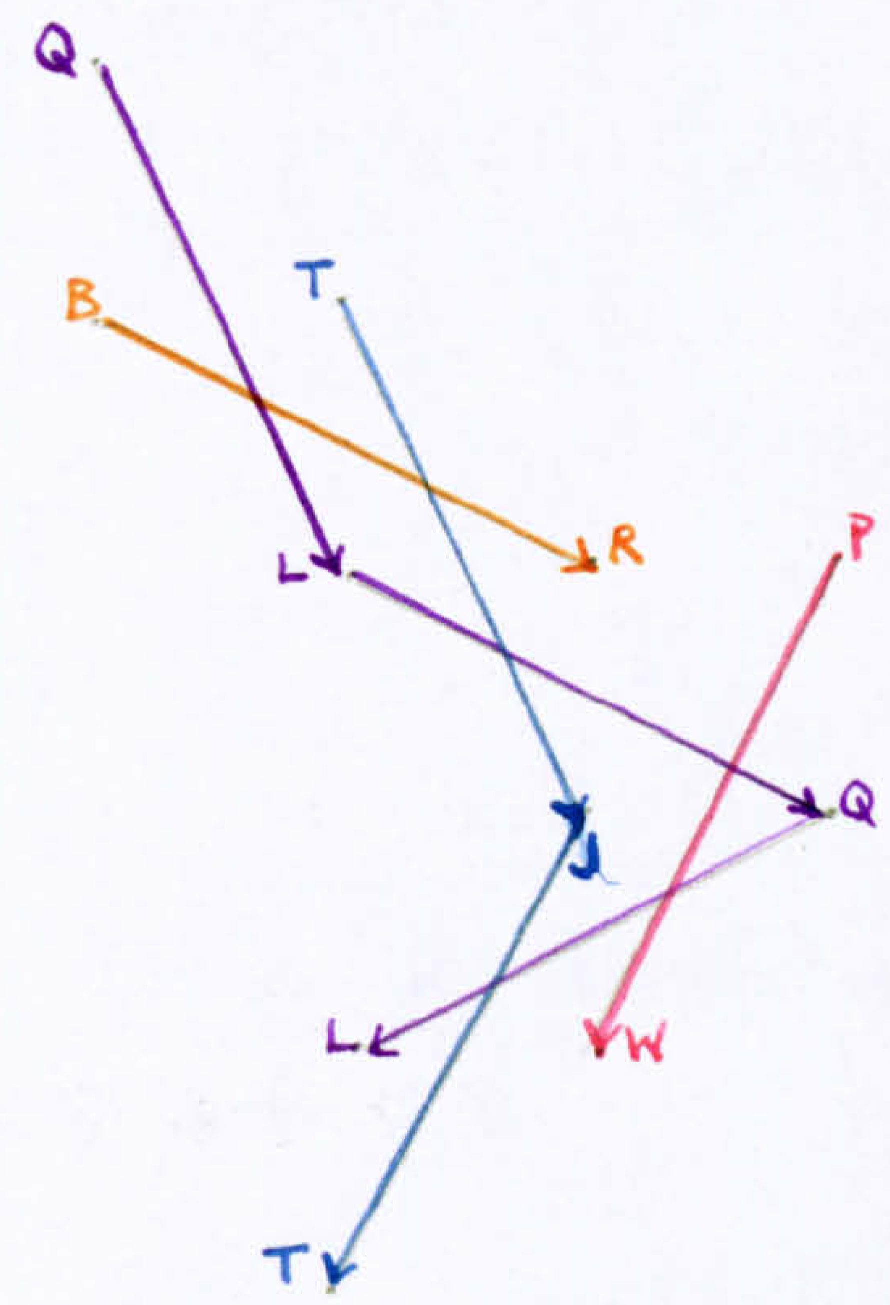
Experiment - Theory

Figure X.4.

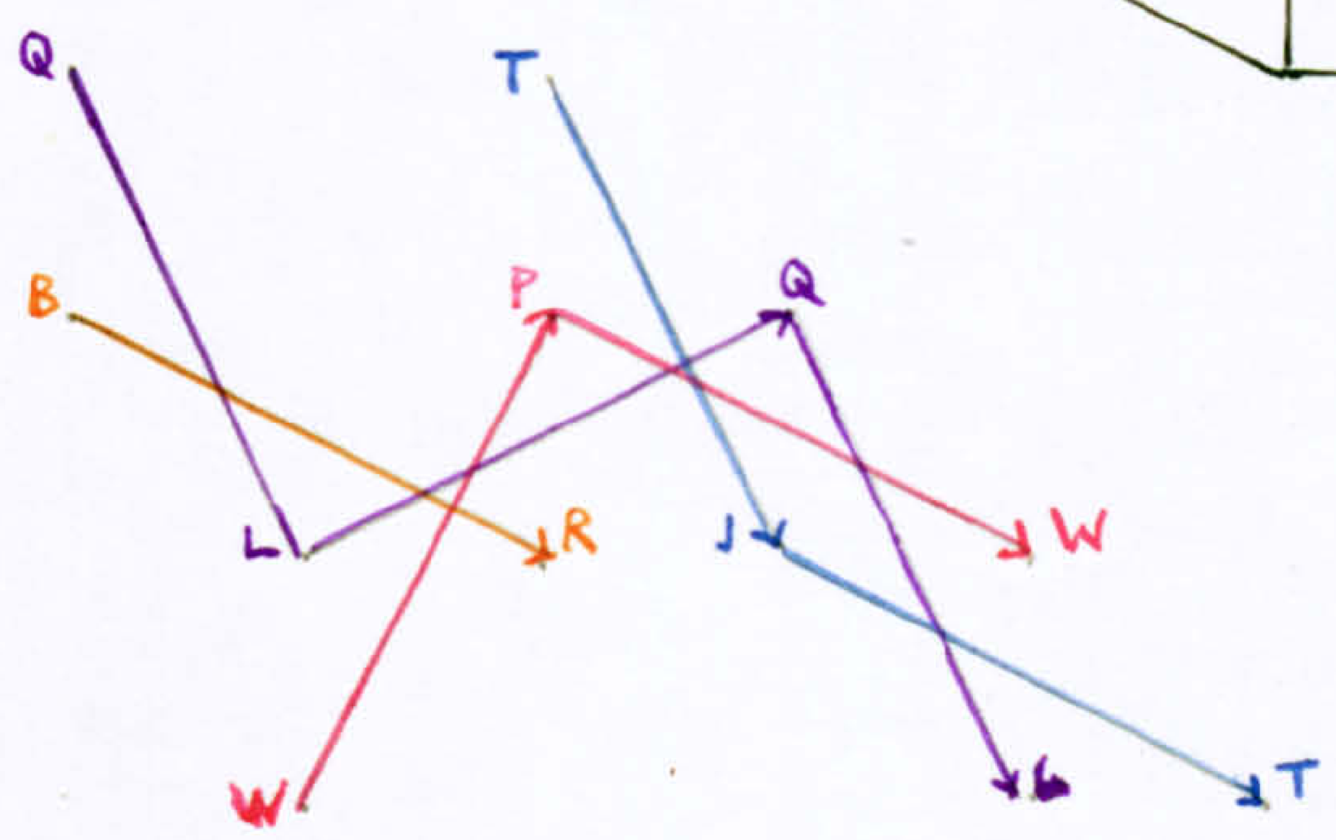
Oppositional Flow Chart of Full Sequences
(re-oriented as in Fig. X.2.)



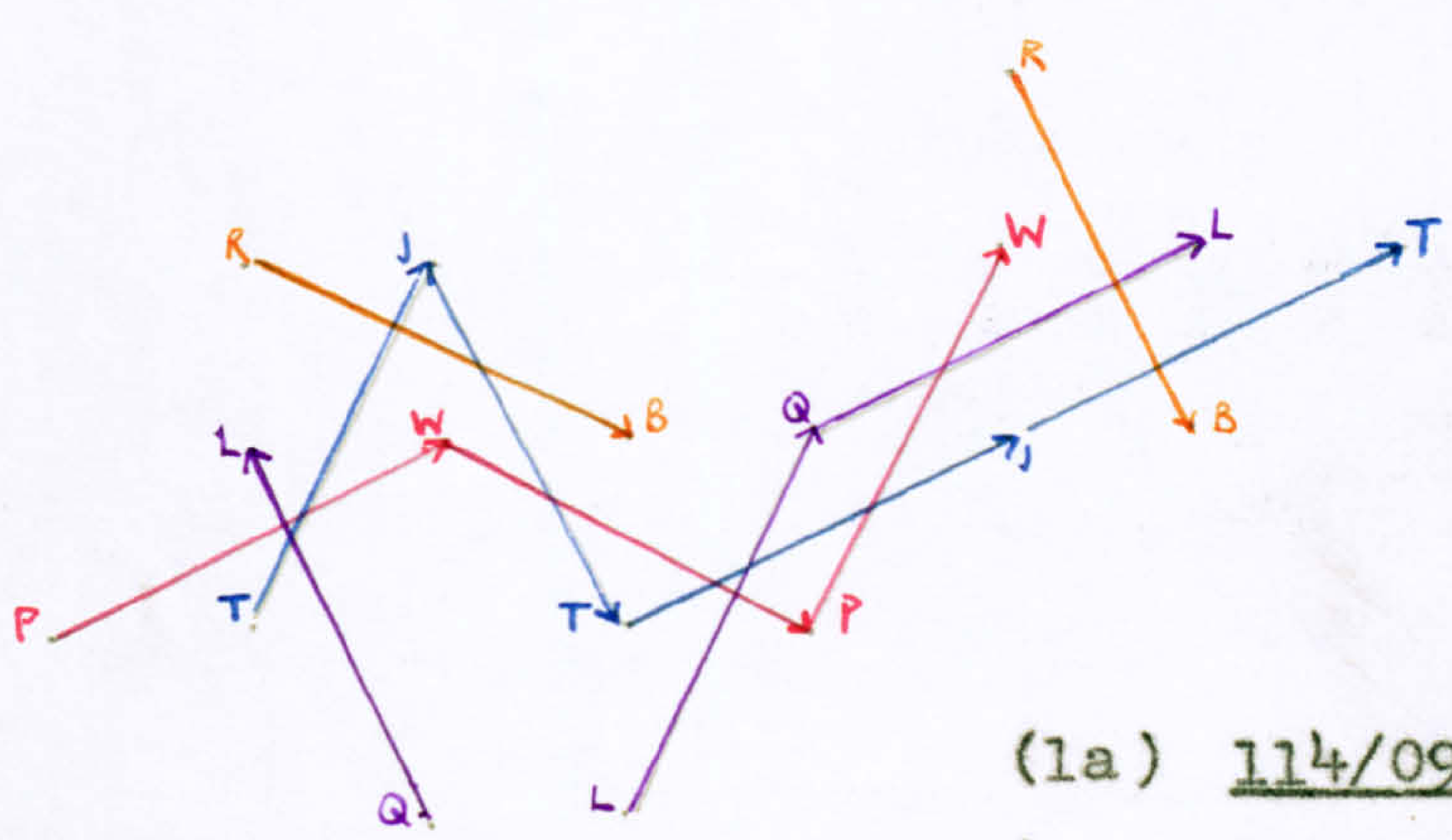
2d. $\overset{+}{R}$ $\overset{+}{O}$ $\overset{+}{O}$ $\overset{-}{O}$ $\overset{+}{O}$ $\overset{+}{R}$



4d. $\overset{+}{O}$ $\overset{+}{O}$ $\overset{-}{O}$ $\overset{+}{R}$ $\overset{+}{O}$ $\overset{+}{O}$



3e. $\overset{+}{O}$ $\overset{+}{R}$ $\overset{+}{O}$ $\overset{+}{R}$ $\overset{-}{O}$ $\overset{+}{O}$ $\overset{+}{O}$



(1a) 114/099/0063

$\overset{+}{R}$ $\overset{-}{O}$ $\overset{+}{R}$ $\overset{-}{O}$ $\overset{+}{O}$ $\overset{-}{R}$ $\overset{+}{O}$ $\overset{-}{O}$ $\overset{+}{O}$ $\overset{+}{R}$ $\overset{+}{R}$

Figure X.5.

Now instead of maintaining contact with the different series of sets into which the 24 Orthotrons can be grouped, i.e.

8 Neighbourhood sets
6 Surfacial sets
4 Oppositional sets
3 Axial sets

we deal with a single Oppositional set containing 4 types of operations,

PW "Making"
JT "Minding"
LQ "Mapping"
RB "Meaning"

Each of the four operational subsets will build a Cube (p.150 above)

The comparative flow charts of Fig. X.1,2 can be replaced by Oppositional Flow Charts as in Fig. X.3,4. The same orientation is maintained except in the case of the Class (1) individual sequence which has been joined up again to preserve the essential continuity. Oblique and rightangle junctions are now clarified, and certain Oppositionals reveal a continuity, for example LQ in Classes (2), (3), and (4), and TJ in the Class (1) individual sequence. Before going on to discuss the semantic significance it is appropriate to complete the formal presentation by summarising the relationship between the binary coding and the angles of junction. When first used the code was seen simply as an aid to recording the classification of sequences but because initially it was based on the strict structural Cube relations it proved of fundamental value.

Orthodron Junctions

The binary coding of the Orthotron sequences was tabulated in Fig. IX.11, p. 200 The two-dimensional presentation showed two angles of junction, oblique and rectangular, which are more clearly seen when the Oppositional axes are abstracted. The relationship of this to the binary coding was explored and the resulting matrix is shown below.

Fig. X.6.

2nd → / 1st ↓	00	01	10	11
00	− R 0 0000	− O 1 0001	+ R 2 0010	+ O 3 0011
01	Ō 4 0100	− R 5 0101	+ O 6 0110	+ R 7 0111
10	− R 8 1000	− O 9 1001	+ R 10 1010	+ O 11 1011
11	Ō 12 1100	− R 13 1101	+ O 14 1110	+ R 15 1111

Red - Orthogonal
Black - Oblique

Plus and Minus signs governed by direction of lead to second Orthotron.

Since the lefthand binary places indicates the lead from the preceding to the first orthotron of the pair, a simpler but significant matrix can be compiled by omitting this.

Fig. X.7.

	00	01	10	11
0	− R 000	− 0 001	+ R 010	+ 0 011
1	− 0 100	− R 101	+ 0 110	+ R 111

Two other forms of this show up this matrix pattern:-

+ R 010 111	− R 000 101	+ 0 011 110	− 0 001 100

0. 000 R
1. 001 0
2. 010 R
3. 011 0
4. 100 0
5. 101 R
6. 110 0
7. 111 R

The symmetry of the rightangle junction coding makes it easy to distinguish the types in the code as well as on the flow charts.

The distribution of the junctions between the four Oppositionals occurring in the sequences was tabulated, (Fig. X.8.) and their occurrence in each individual interview. The summary tables in Fig.X.9. were then drawn up giving the percentage occurrences. The large number of LQ/RB junctions is partly accounted for by the fact that it was the first junction in all the Class (3) and Class (4) sequences. It is also evident that the high figure for RB/JT junctions in the lower age groups is accounted for by its occurrence as the second junction in the Class (4) sequences; short sequences of this type predominated with the younger children. More significant are (1) the changes in percentage of leads from PW and JT, the former increasing, the latter decreasing through the school population, but increasing again amongst the students, and (2) the much higher percentage of leads to JT, maintained throughout the age range. The coding matrices were then co-ordinated with the Oppositional junctions in the matrix in Fig. X.10.

Fig. X.8.

Junctions of Oppositionals in Recurring Sequences

Sequence No.	Code	PW/JT	PW/LQ	PW/RB	JT/LQ	JT/RB	JT/PW	LQ/RB	LQ/PW	LQ/JT	RB/PW	RB/JT	RB/LQ
1.	28	1							1				
1a	114	1				1			1				
2.	30		1						1				
2a.	123		1						1	1			
2b.	492		1				1		1	1			
2c.	1971		2				1		1	1			
2d.	7887		2				1	1	1	1			
3.	26							1			1		
3a.	107		1					1			1		
3p.	104	1						1			1		
3q.	105			1				1			1		
3r.	106		1					1			1		
3b.	431		1					1		1	1		
3t.	426	1			1			1			1		
3s.	419	1			1			1			1		
3u.	1705	1			1			1		1	1		
3c.	1724		1				1	1		1	1		
3v.	1709	1	1				1	1			1		
3d.	6899		2				1	1		1	1		
3e.	27598		2				1	1		2	1		
3y.	27599		2				1	2		1	1		
4.	27							1				1	
4a.	108				1			1				1	
4b.	434				1			1	1			1	
4t.	437			1			1	1				1	
4c.	1739			1	1			1	1			1	
4w.	1737	1			1			1	1			1	
4d.	6958		1		1			1	1			1	
4x.	6953			1	1			1	1			2	
4y.	6959		1		1			2	1			1	

Fig. X.9.

Percentage of Oppositional Junctions occurring in Age Groups

	PW/JT	PW/LQ	PW/RB	JT/LQ	JT/RB	JT/PW	LQ/RB	LQ/PW	LQ/JT	RB/PW	RB/JT	RB/LQ
Juniors	0.5	3	-	26	-	0.25	34	3.5	0.25	2	30.5	
Junior High	5	6	0.5	16	-	0.75	32	7.5	1	10.25	21	-
Grammar 3-4	7	8.5	1.5	11	1.5	3	26	10	4	11.5	16	-
Grammar 5-6	9.5	13.5	2	7	1.5	5	23	8.5	6.5	13	10	0.5
Normal Students	5.5	12.5	2	13	3	4.5	22	9	6	10	12	0.5
Mature Students	7	11.75	4	11	1.5	5.5	21	10.25	5.75	10.25	12.25	0.25

Summary Table

	→ PW →		→ JT →		→ LQ →		→ RB →	
Juniors	5.75	3.5	31.25	26.25	29	37.75	34	32.5
Junior High	18.5	11.5	27	16.75	22	40.5	32.5	31.25
Grammar 3-4	24.5	17	27	15.5	19.5	40	29	27.5
Grammar 5-6	26.5	25	26	13.5	21	38	26	23.5
Normal students	23.5	20	23	20.5	26	37	27	22.5
Mature Students	26.	22.75	25	18	23	37	26.5	22.75

Fig. X.10

Table of Orthotron Junctions relating Oppositionals and Orthogonal Axes

2nd / 1st		PW			JT			LQ			RB	
	α	β	γ	α	β	γ	α	β	γ	α	β	γ
α					0$\bar{0}$0 101	0$\overset{+}{1}$0 111			0$\overset{+}{1}$1 110		0$\bar{0}$1 100	
PW β						0$\overset{+}{1}$1 110	0$\bar{0}$0 101		0$\overset{+}{1}$0 111	0$\bar{0}$1 100		
γ					0$\bar{0}$1 100		0$\overset{+}{1}$1 110			0$\overset{+}{1}$0 111	0$\bar{0}$0 101	
α		0$\bar{0}$0 101	0$\overset{+}{1}$0 111					0$\bar{0}$1 100				0$\overset{+}{1}$1 110
JT β			0$\bar{0}$1 100				0$\overset{+}{1}$1 110			0$\overset{+}{1}$0 111		0$\bar{0}$0 101
γ		0$\overset{+}{1}$1 110					0$\bar{0}$0 101	0$\overset{+}{1}$0 111			0$\bar{0}$1 100	
α			0$\bar{0}$1 100		0$\overset{+}{1}$1 110						0$\overset{+}{1}$0 111	0$\bar{0}$0 101
LQ β	0$\bar{0}$0 101		0$\overset{+}{1}$0 111	0$\bar{0}$1 100								0$\overset{+}{1}$1 110
γ	0$\bar{0}$1 100			0$\bar{0}$0 101	0$\overset{+}{1}$0 111					0$\overset{+}{1}$1 110		
α		0$\overset{+}{1}$1 110				0$\bar{0}$1 100		0$\overset{+}{1}$0 111	0$\bar{0}$0 101			
RB β	0$\overset{+}{1}$1 110			0$\overset{+}{1}$0 111		0$\bar{0}$0 101			0$\bar{0}$1 100			
γ	0$\overset{+}{1}$0 111	0$\bar{0}$0 101		0$\overset{+}{1}$1 110				0$\bar{0}$1 100				

PW. Making Topic Analysis Proposal for Work

Purpose/Knowledge. Performance/Feedback.

α	$\bar{S}$ **Reflex Perception** Learning from cultural store structures perceptual decisions	$\overset{+}{H}$ **Use of Categories** Measurement or Categorization into verbal concepts
β	$\bar{V}$ **Learning Readiness** In a stage of readiness (motivated) towards acceptance of verbal concept	$\overset{+}{Z}$ **Recognition** Cultural idea dominates perception and its interpretation
γ	$\bar{G}$ **Transmission of Information** Operation of equipment transmitting information filed in cultural store	$\overset{+}{M}$ **Socio-Symbolic Learning** Cultural concepts assembled in new array relevant to context, i.e. operational

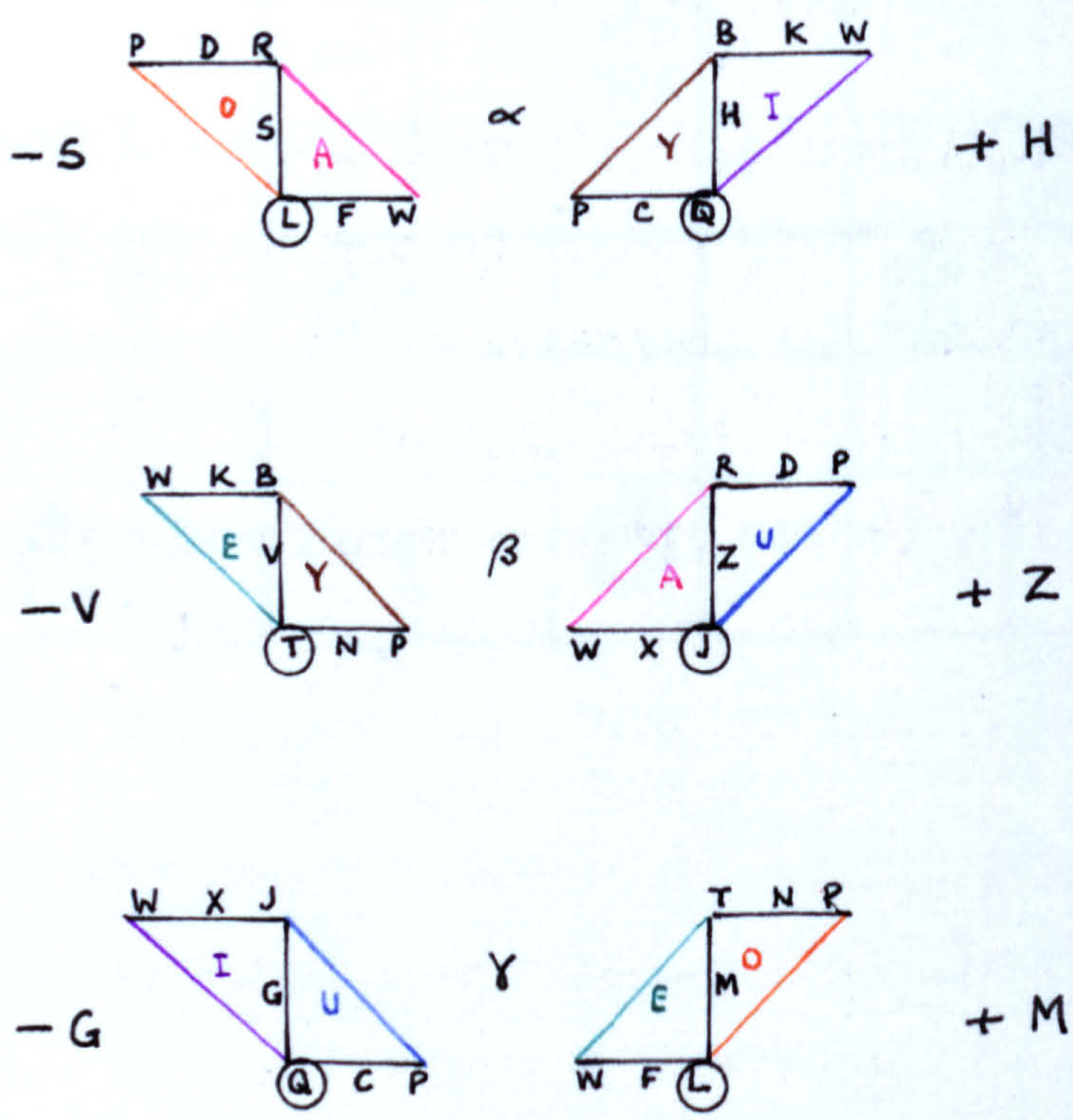


Fig. X.11

To clarify further the significance of the aspects of thought represented by the Oppositionals the orthotrons are now reviewed assembled in the relevant sets, each of which completes a Cube structure.

I. PW. "Making".

Also identified with "Proposal for Work"
"performance/feedback"

and in the total Epistemic context with "Topic Analysis".
It may be regarded as the decision-making element in thought.

On the α Axis*

The orthotrons contain bundles of information concerned with implicit operations, implicit concepts operating in perception, concepts which are implicit in material equipment because they have been designed into it.

$\underline{S}$ Reflex Perception: concepts are so well integrated into schemata that their action in decision following on perception is automatic. The inclusion of the F vector implies that the concept is communicable, part of the common store of knowledge, whether in everyday terms or more specifically geographical in the present context. It is possible that the subject is not aware of any operative concept, he is simply "looking".

$\underline{\overset{+}{H}}$ Categorization: "Proposal for Work" is appropriate here - purposive use of equipment which embodies symbols carrying information this might be consultation of the Orthotron Thesaurus as an instrument of analysis, or use of an oscilloscope. Geographically a raingauge implicitly categorises rainfall in inches or millimetres, a contour map categorises

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* Refer to Fig. X.11 for the Orthotrons.

landforms into height intervals. These are not definable without the instrument. This orthotron is not characteristic of the present experiment as the equipment did not categorise information in a way which would automatically draw it out in such categories; the intention was to avoid this so that as little as possible should be imposed on the individual's line of thought.

On the β Axis

The orthotrons are storing information about the state of the subject, his readiness for mental action, his response to environmental stimuli.

$\bar{V}$ Learning Readiness or Motivation an attitude, a mental set embodying "proposal for work"; it becomes operative through the agency of a symbolised concept, in which the task is stored.

$\overset{+}{Z}$ Re-cognition: Meredith has "objective impact on observer" for the Z vector alone; in the orthotron it is bound up with X, the cultural bit of information in which is stored the "object", and by which the individual operates in selecting (D) from the environmental noise that particular object.

On the γ Axis

The orthotrons are carrying information about communication, either instrumentally or verbally, in effective operation.

$\bar{G}$ Transmission of Information: positively it relates to the filing of phenomenal information in the cultural bit, X; a feedback of information from the operation of the equipment.

$\overset{+}{M}$ Socio-Symbolic Learning: the climax of the "Making" aspect as a verbal concept becomes operational, and its

Associations achieve some Intended Yield. It rarely appeared with the Junior School children when asked about a "valley" since they had not achieved a viable concept. It represents the vital link in communication in teaching. The positive lead from this is towards action in N; the negative lead is to F which might be regarded as signifying that the stored cultural concept is taken out and purred over, as a miser might gloat over his hoard, but it is put away again without having been used.

Apart from the important items stored in the gamma orthotrons of this Oppositional, because of the socialised implications of W and the operational implications of P it has other strong gamma associations; the positive leads from the alpha and beta orthotrons lead to gamma orthotrons in other sets. "Negative" leads are not necessarily negative in a pejorative sense, although the comment above under $\overset{+}{M}$ might suggest it in that particular context.

Impression/Expression.

α	$\bar{H}$ **Categorization** Verbal or other symbols guide (or serve as) instrumentation	$\overset{+}{S}$ **Reflex Perception** Perceived reality matches structure of thought
β	$\bar{F}$ **Cultural Reaction** Triggering of Schema referring to cultural interpretation of reality	$\overset{+}{C}$ **Technical Reaction** Information transmitted to organism triggers motivation
γ	$\bar{D}$ **Selection** Motivation controlling selective perception	$\overset{+}{K}$ **Socialised Conceptual Thought** Reality as filed in cultural store emerges as words (or symbols) triggering thought

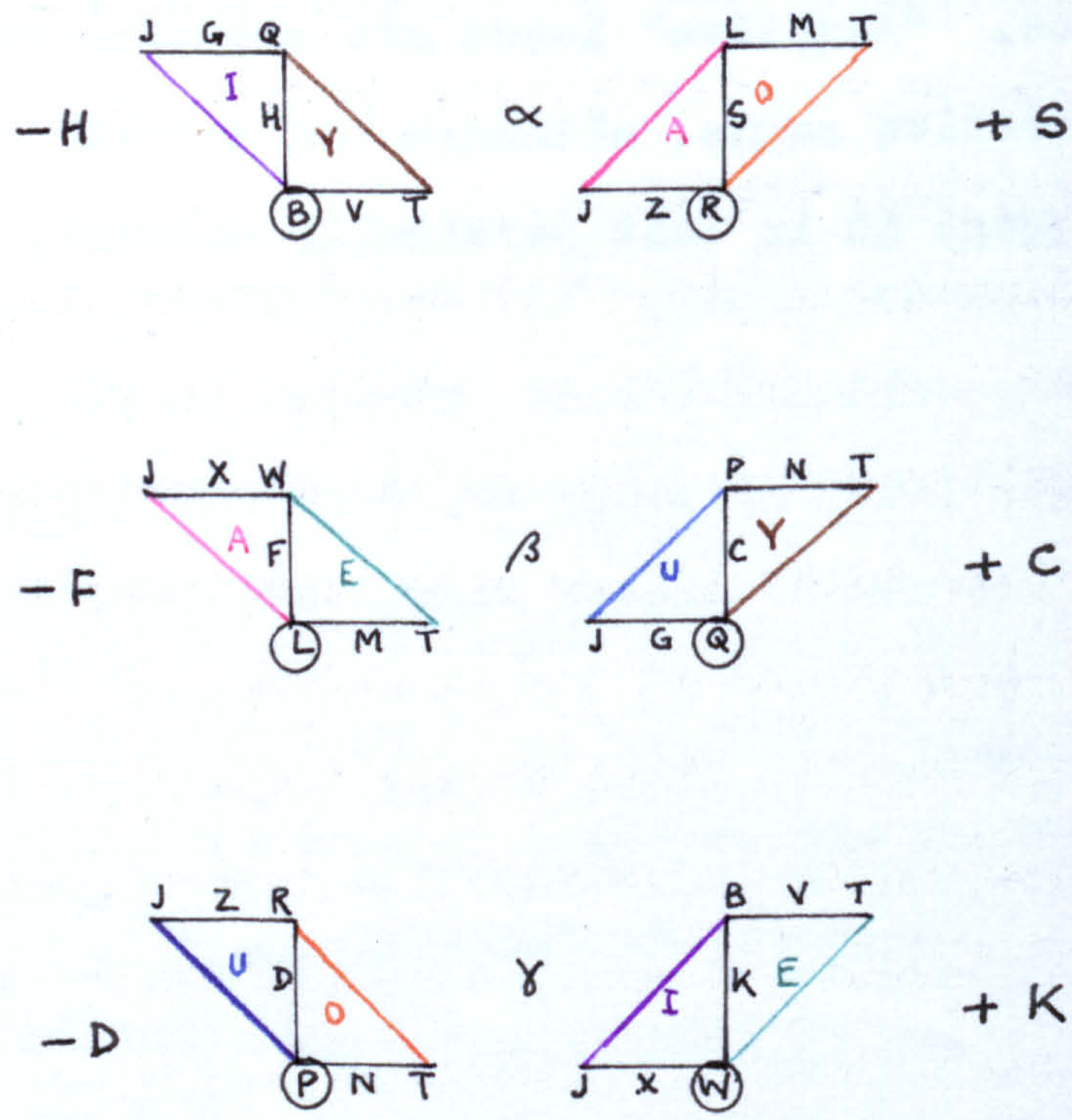

Fig. X.12.

II. JT. "Minding"

Also identified with "Thought about Object"
"Impression/Expression"

and in the total Epistemic context as "Orthochorics"

It may be regarded as the achievement of concepts. It appears closest to embodying the "equilibrium" concept of Piaget as the organism is constantly adjusting the balance between impressions received from the environment which have to be assimilated to the individual's version of the concept, and the expression of the adjusted concept which is in turn projected into the individual's view of the environment.

On the α Axis -*

The orthotrons are storing information about implicit schemata - the "accommodated" concept - structuring perception, or about the concept as an intermediary "model" interpreting evidence about the environment.

$\bar{H}$ Categorization: Meredith has "specification of necessary equipment" - but "symbolism embodied in the instrumentation"; in the Orthotron Thesaurus is not essentially different. In the orthotron it is linked with verbalised motivated thought and the "generation" of the phenomenon by the equipment. In relation to Thought about Object there is a "Model", hardware or software, which is outside the personal schema and the object, is indeed mediating between them by some documentation or instrumentation. As already commented on in dealing with $\overset{+}{H}$/PW this orthotron is not relevant with the neutral equipment used in this investigation, it is a vital element in the "new geography" (vide Chorley & Haggett 1966).

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* Refer to Fig. X.12 for the Orthotrons.

$\overset{+}{S}$ <u>Reflex Perception</u>;- this embodies what is referred to on p. 188 above as a "recognition schema"; there is a mental programme implicit, so well integrated (accommodated, in equilibrium), that it automatically switches on with the perceptual response. This is going to arise <u>positively</u> from BR (Meaning) or <u>negatively</u> it comes from LQ when implicit thought (some private "mapping") continues rather than some socially communicable thought, i.e. the equilibrium is not established; some assimilation is still going on.

<u>On the β Axis</u> -

The orthotrons are carrying information about the kind of reaction between the organism and the event attended at.
$\bar{F}$ <u>Cultural Reaction</u>:- Meredith calls this "set determining logical implication", which appears to be the "Minded", i.e. conceptualised environment in cultural terms actually determining the bit of information which is picked out referring to the environment. Positive leads to this will come from QL where an effective schema has been identified. Negative leads come from PW where the "operator" has turned to his "hoarded" concept without using it immediately. In that case, if he goes forward <u>positively</u> to J in this orthotron his hoarded concept may progress towards clearer identity (back to LQ) or clearer meaning (on to BR). Continued <u>negative</u> movement would return to PW γ from which some motivated meaningful application of the implicit concept might produce clarification on a second trial, or to PW α where it would remain implicit but become more effective in operation. If we refer back to the presentation of Class (3) ...104... sequences (p. 201-211 above) we find it concludes

on this orthotron having come from PW, and that where there was progression to ...419... this was the positive continuation to LQ. If we take this situation with its various possibilities as representing uncertainty of equilibrium in the Piagetian terms it may explain why this was a point when all possible leads from S/PW occurred in the sequences. Where equilibrium existed the subject was able to map back the concept effectively (D/LQ), hence the continuation of the "mainline" sequence from this. With D/JT (see below) equilibrium was sought in the perceptual response. $\bar{F}$/JT and $\overset{+}{F}$/RB seem to present two kinds of disequilibrium. Were the men students who tended to stop in disequilibrium at this point more ambitious in their selection of complex concepts while the women tended to select simpler concepts and to fall back deliberately towards concrete operations? The ending of the full "mainline" sequences of Class (2) and Class (3) types on the F orthotrons may represent a natural pause at a point of disequilibrium from which the older subjects were more likely to embark spontaneously on a new search for equilibrium.

$\overset{+}{C}$ Technical Reaction:- Environmental information is here transmitted by equipment; there is no element of direct perception (or recalled perception) of the environmental phenomena. Consequently the nature of the equipment governs the "Minding" in this episode of thought. One might say this of the present activity of the investigator when the Orthotron Thesaurus is the dominant instrument for writing this chapter and the personal investigation of the subjects has been laid aside (except in the preceding paragraph).

Relative to the complexity of the task in hand it might be taken as regression towards more concrete handling of the data in order to facilitate progression towards equilibrium in the multi-dimensional concept of the four Oppositionals.

On the Y Axis:-

The orthotrons carry information about the way in which the Associations embodied in the concept are connected to some yield.

$\bar{D}$ Selection:- decision leads to perceptual responding in Z, which infers decisive selection from the environmental noise; equilibrium is established in a "recognition schema" - or at least is approached, for there is no check without proceeding to $\overset{+}{\bar{Z}}$ where purposeful activity or mapping will occur.

$\overset{+}{K}$ Socialised Conceptual Thought:- Meredith calls it "empirical identification of physical implications". This seems to emphasise the I/E surfaces of Individuation/Experience which are adjacent in K. In terms of the orthotron the environmental referent is embodied in a verbalised concept triggering thought - again it would seem that equilibrium is approached but a further thought event would be needed to check this.

The need for further information to check achievement of the concept reminds us of the basic problem of conceptual investigation; we cannot dissect the concept to examine it; we can only hope to identify its functioning which is more likely to be evident in LQ mapping.

LQ. Mapping Mathetics Learning From Equipment

Storage/Retrieval

α	$\bar{N}$ **Practical Implementation** A schema is put into action meaningfully	$\overset{+}{X}$ **Cultural Reality** Equipment mediating phenomena to cultural store & functioning as schema
β	$\bar{Z}$ **Recognition** Structured perception brings reality into focus as an instrument of thought	$\overset{+}{V}$ **Learning Readiness** Transmission of symbols activates conceptual learning
γ	$\bar{K}$ **Socialised Conceptual Thought** Transmitted symbol filed in cultural store is assimilated to individual schema	$\overset{+}{D}$ **Selection** Conceptual structuring of perception leads to purposeful activity with equipment

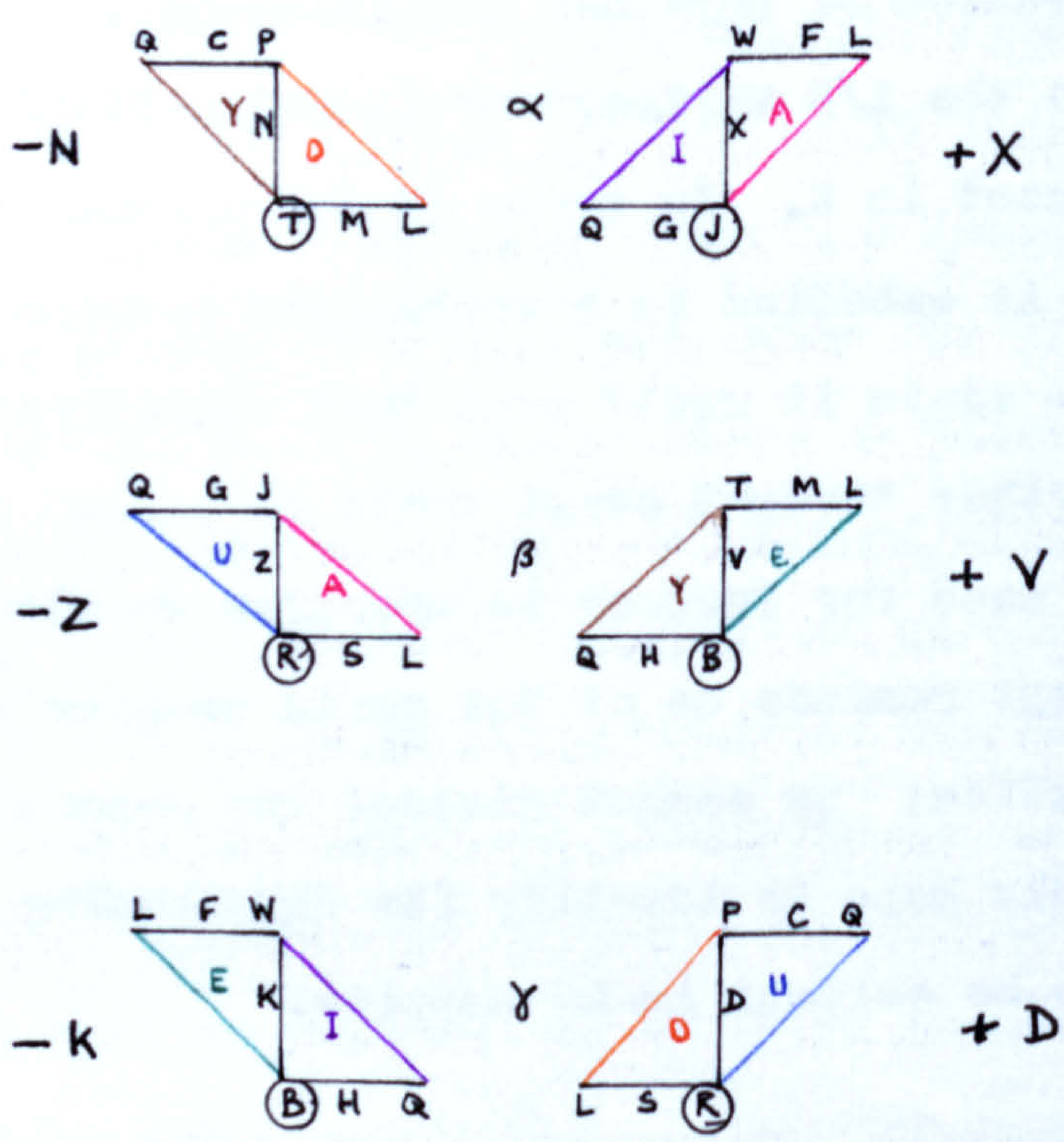

Fig. X.13

III. LQ. "Mapping"

Also identified with "Learning From Equipment"
"Storage /Retrieval"

and in the total Epistemic context as "Mathetics"

It may be regarded as the using of concepts. For this reason it may provide the vital evidence as to whether the concept is viable, i.e. whether its existent can be "proved" in the behaviour of the subject.

On the α Axis -[x]

The orthotrons are carrying information about the practical application of the concept and about the mental storage of cultural concepts. Four out of the eight possible continuations will lead to BR (Meaning) episodes. This axis "proves" the operation of the concept but we may need further information to evaluate its quality.

$\bar{N}$ Practical Implementation:- Meredith has "decision to investigate". One might also say, "To perform", in other contexts. The "Motivated thought triggers action" of the Thesaurus seemed a fair generalisation of this idea. In action either our own bodily tools, (i.e. our eyes to look, our vocal chords in speech,) or other tools as extended body-equipment are used in the Mapping (L-Q).

$\overset{+}{X}$ Cultural Reality:- The phenomenon is filed in the Cultural Store (not specifically verbally at this juncture); it is coming from some equipment, and through this socialised "model" is being mapped into the individual schema, or negatively the schema is registering this socialised concept in the equipment, e.g. a triangular marker serves as a "village" in the interviews.

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[x] Refer to Fig. X.13 for the orthotrons.

<u>On the β Axis</u>:- There is inter-action of schemata with phenomena transmitted by equipment or stored in symbols. Four out of the eight possible continuations lead to PW (Making) episodes which suggests the more usual form of "proving" in process will be in some operational form.

$\bar{Z}$ <u>Re-cognition</u>:- Meredith has, "Motor adjustment of objective material"; this seems most likely to arise from a positive lead from $\bar{D}$ (Selection). The negative lead from $\overset{+}{S}$ (Reflex Perception) frequently occurred in the sequence ...108... and often did involve motor adjustment of the model, but the mapping into the model did not always involve manipulation, sometimes it involved pointing, by gesture or verbal indication as the re-cognised detail from landscape experience was used. Both these leads are from the decisive PW.

$\overset{+}{V}$ <u>Learning Readiness</u>:- Here the symbol from the instrument "maps" the idea into the learner's mind and activates a schema. "Learning from equipment" is very relevant here, and also the concept of retrieval of a schema from mental storage and putting it ready for use. This "Mapping" appears to be the more purely cognitive aspect of readiness for a task. The more affective motivational readiness is expressed in V/PW, which has already been suggested as a "mental set".

<u>On the γ Axis</u> -

As a common denominator for the two orthotrons, the Association-Intended Yield aspect of this axis is more significant than its social implications, which are at a minimum in $\overset{+}{D}$. The decisive aspect ansures more thorough "próving" of the concept in use than occurs on α and β .

$\bar{K}$ <u>Socialised Conceptual Thought</u>:- For vector K Meredith has, "Reference to stored knowledge"; the orthotron fills out the implications of this, i.e. that it must be stored in some equipment such as words in a book, exposures on a film, signs on a map, and that for the individual using it, it must be sufficiently assimilated to the individual schema.

$\overset{+}{D}$ <u>Selection</u>:- The well integrated schemata which have structured perception, whether they originate in transmitted cultural concepts ($\bar{S}$) or are derived from personal experience ($\overset{+}{S}$), are mapped into action as equipment is used (or possibly constructed).

It should be noted that as with the α axis, the positive leads are all to β "Reactions" (C and F), but four out of the eight possibilities lead to PW, as with the β axis, suggesting further operational "proving" more likely to occur. Leads to α are all negative; comments above on S and H orthotrons suggest that the implicit nature of the concept operation represented in these orthotrons would not be helpful to the observer in "proving"the concept.

BR. Meaning. | Semalogistics | Bearing or Reference

Symbol/Response | Extrusion/Incorporation

α	$\bar{X}$ **Cultural Reality** Cultural verbal concepts mediating perceived reality	$\overset{+}{N}$ **Practical Expression** A percept is expressed in meaningful symbols
β	$\bar{C}$ **Technical Reaction** Physical response triggering action to produce symbolic form of idea	$\overset{+}{F}$ **Cultural Reaction** Symbol of cultural concept used in schema to view a percept
γ	$\bar{M}$ **Socio-Symbolic Learning** Symbol triggers thought behaviour & modulates schema structuring perceptual response	$\overset{+}{G}$ **Transmission of Information** Perceptual response to phenomena is registered by instrument and immediately symbolised.

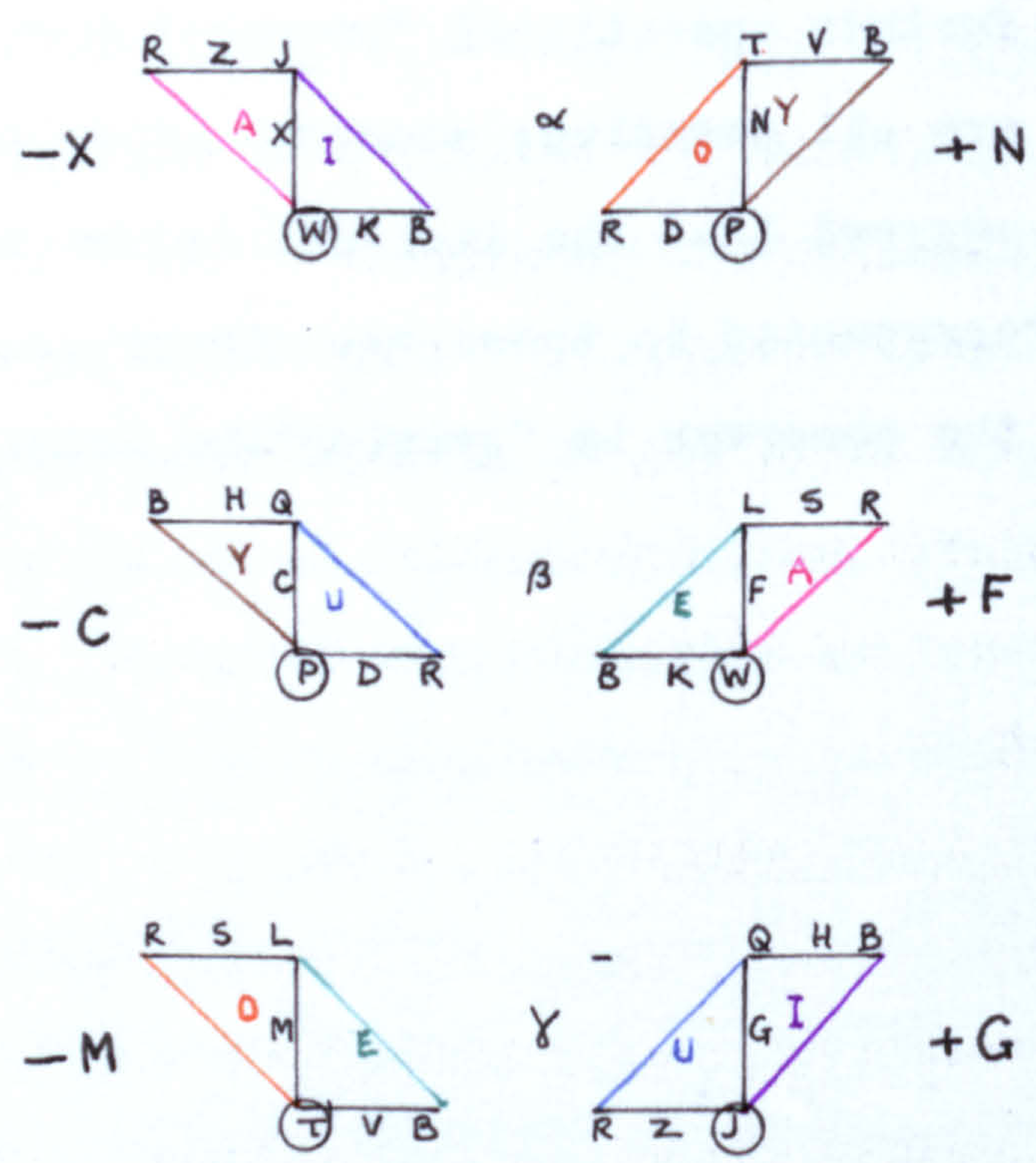

Fig. X.14.

IV. RB. "Meaning"

Also identified with "Bearing or Reference"
and "Symbol/Response"
and "Extrusion/Incorporation"

and in the total context of Epistemics with "Semalogistics"

It might be regarded as the switch operator which facilitates the use of stored information in mental activity. The relaxed scanning thought, externally perceptive, internally conceptual, behind operative thought, seems a necessary concept if we are to think in some manageable way of the infinite number of possible perceptions and possible recalled associations that might arise. At some point "Meaning" appears as a catalyst among the Minding, Mapping and Making activities of cognitive thought.

On the α Axis - *

The physical 'Symbol', however expressed, dominates.

$\bar{X}$ Cultural Reality:- the meaning of the "cultural bit" of phenomenal information involves the relating of the symbolised concept to the actuality in perceptual response. The orthotron stores such information as might be present in that dramatic moment when Helen Keller realised the meaning of the word "water".

$\overset{+}{N}$ Practical Expression:- the meaning of the perceptual response is translated into a symbolic form by the organism. Meredith summarises it as "Theoretical information". In the positive direction there is a selection of symbol which is in a sense an evaluation. "Practical" and "Theoretical" might appear to be in opposition at first sight, but "Practical" is used in the sense that once the symbolic form has been

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* Refer to Fig. X.14 for the orthotrons.

selected it is <u>active</u>; an effect is inevitable; thought will not follow the same track as it would have done if the symbol had not been used for expression.

<u>On the β Axis</u> -

The emphasis is on stimulus-response meaningful reactions

$\bar{C}$ <u>Technical Reaction</u>:- the meaning of the perceptual response is translated into a symbolic form by means of an instrument, i.e. pressing the button for the answer frame on a teaching machine, or putting pen to paper. It does not appear in the present analysis of the investigation because the apparatus did not of itself generate any symbols.

$\overset{+}{F}$ <u>Cultural Reaction</u>:- A stored symbol, in the present context likely to be a word, assimilated into the individual schema, organising perceptual response. Meredith has "Logical identification of implicit sets"; this is negative in movement and so in opposition to the description above, as the implications of the response are found in the symbolic information. The "switch operator" character has been illustrated on p. 214-5 above in discussing continuations from sequence ...105... and the 'translation of a concept into the model valley' (positive continuation to JT).

<u>On the γ Axis</u> -

The orthotrons are carrying information about symbolic information which is functioning internally in $\bar{M}$ and externally in $\overset{+}{G}$.

$\bar{M}$ <u>Socio-Symbolic Learning</u> or <u>Operative Thought</u>:- positively, there is a symbol-induced mental set activating the schema which is organising perceptual response. Response to the command "Look at the model" in the interview might be taken as a simple example.

Ĝ <u>Transmission of Information</u>:- An example will serve best here: to measure a day's rainfall by a raingauge, would, in the calibrated measuring cylinder generate the symbolised information of, say, one inch. This whole operation could fit very well into the Theoretical sequence (B),* in which the stored knowledge and interpretation involved in "an inch of rainfall" would be expressed. The relevance of Meredith's "action of material on equipment" then appears in context. This orthotron was not relevant with the valley model which did not embody any symbols.

Since the Meaning is expressed operatively in this Oppositional it is to be expected that there would be a different relationship with the continuations to α orthotrons S and H ; whereas from LQ these were negative, here they are all positive, as the established meaning remains <u>implicit</u> in the next episode of thought. Strong negative relations towards the γ orthotrons K and D suggest that more purposive operation has to follow up to make the switch-on as effective.

Prolonged consideration of lines and points although with reference to the sequences tends to loss of continuity of impression. As the longer sequences revealed the pattern of continuity most forcibly the individual script in which this continuity was most marked has been analysed in detail as it serves to reveal examples of the connections suggested above while retaining them in the flow of thought.

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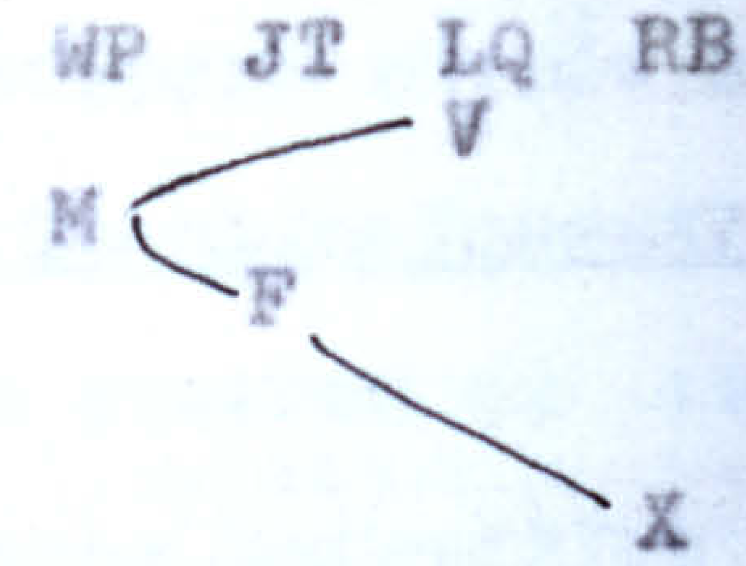
* see p. 166 above.

114

Valley? A cut, a cleft in the earth, immediate sort of under crust, caused 1
by water erosion, river cut, can be modified by wind erosion or glacial

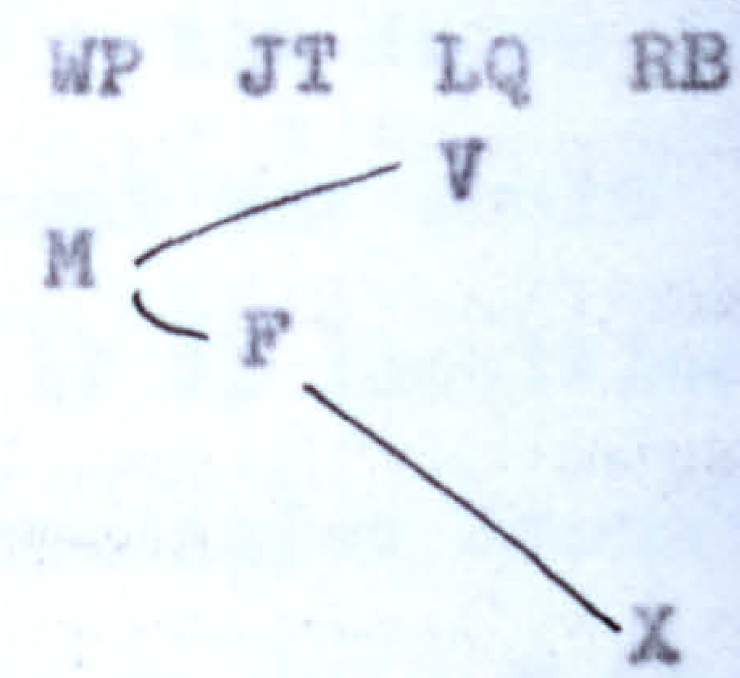
erosion. They slope from the top end 2
to the bottom end because of gravity.



114

Features? Cross profile, because of these various modifications, and
obviously long profile as well, - 3
features revealed in the long

profiles being nick points, showing
various stages in uplift which have 4
caused variations in gradient which can be seen on the valley bed.



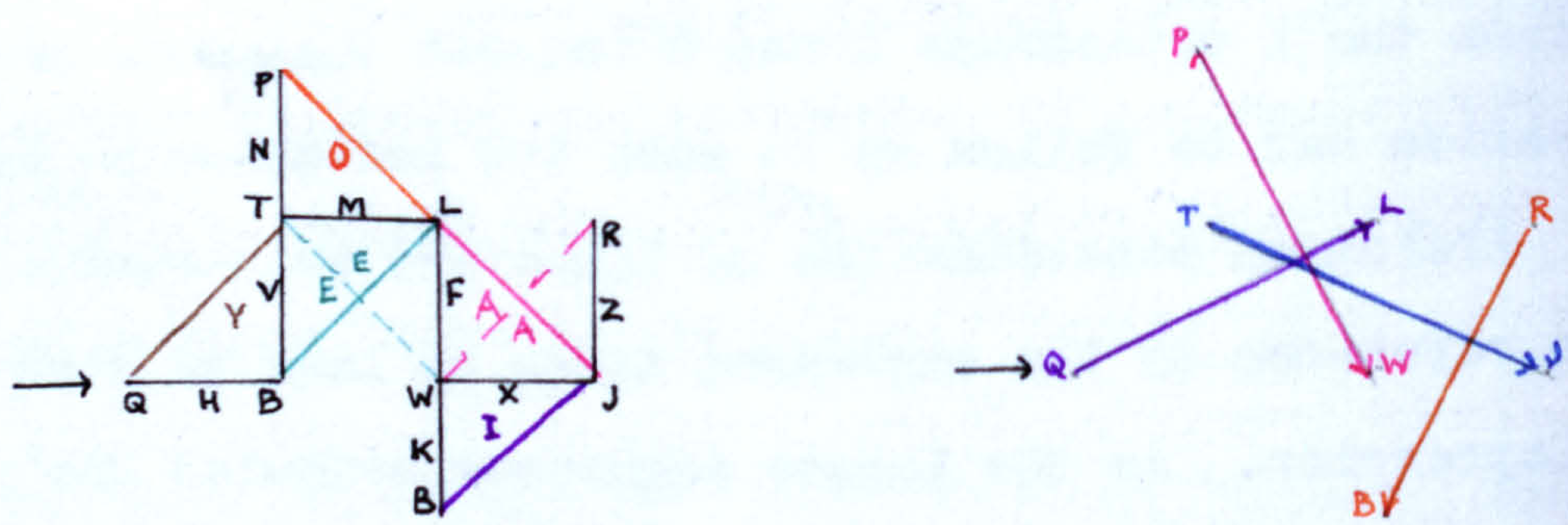


Fig. X.15. (i)

No. 50. Male Student, age 19 yrs. Home area: Saltash, Cornwall.

Landscape experience limited to S.W. England before coming to Yorkshire. G.C.E. A level in Geography, pass at E grade.

Sequences (red, classified, black, individual)

114 114 7887 1724/01547 27/01 27598/0030022

104/15/2735/809/2254/0013051 28 26 104 6 104/00157/243

108 6959/3023/550/0051

N.B. the first section of the individual sequences is in each case a classified type. The series of short classified sequences in the middle were replies to questions for clarification of points arising in the previous long sequence.

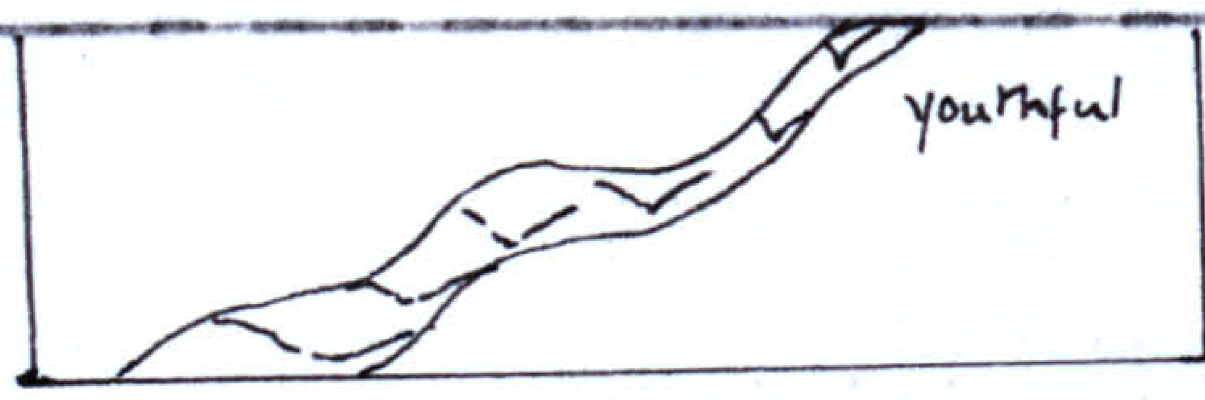
...114... All four aspect of thought appear in a brief sequence: QL - the symbolised question is mapped into thought: PW - the decision making operator retrieves knowledge from cultural storage: TJ - the Minded environment is expressed and with RB visual details recalled enrich the concept as it is expressed more meaningfully with this addition.

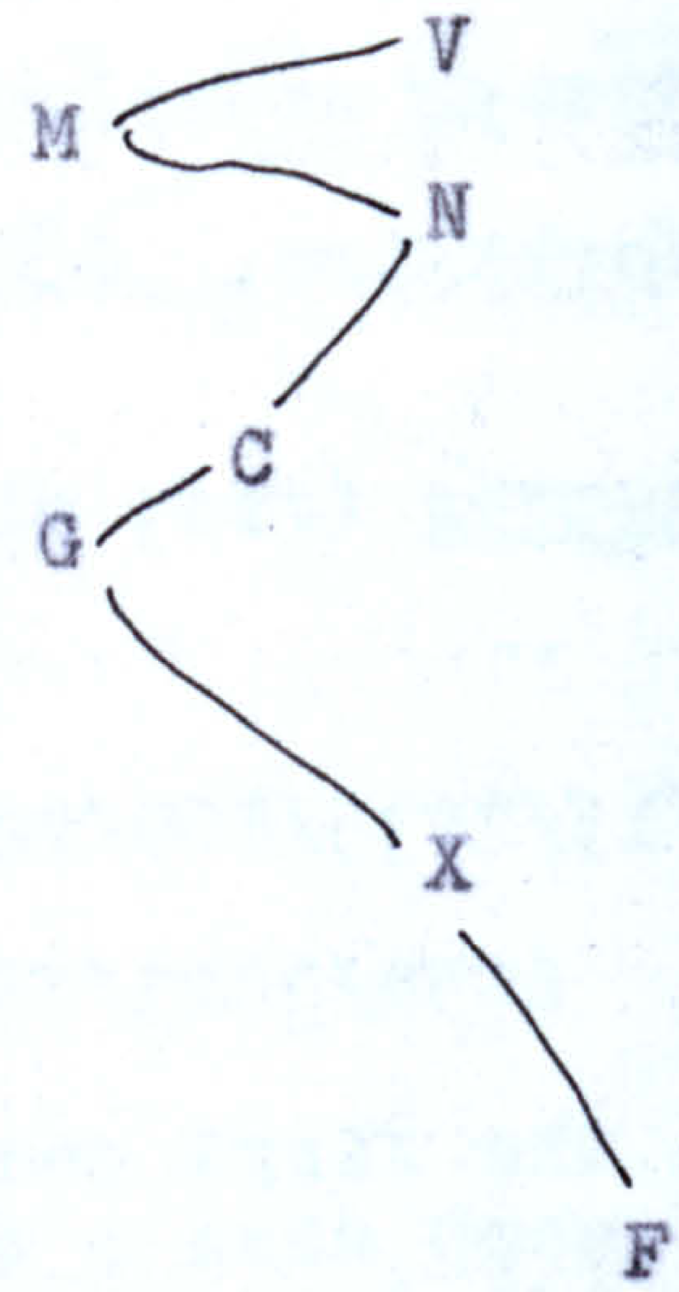
...114... A second sequence of the same character. Though the identification in orthotrons has necessarily organised the thought process sequentially, the Oppositional flow chart shows a focal point where the Oppositional axes of the three orthotrons are almost coincident.(x) Thus the simplified chart would seem to correct the artificiality of timing introduced by the analysis. The separate TJ/RB junction however is clearly sequential in both sequences as the "Meaning" switches on something capable of development.

7887

PW JT LQ RB

Sand



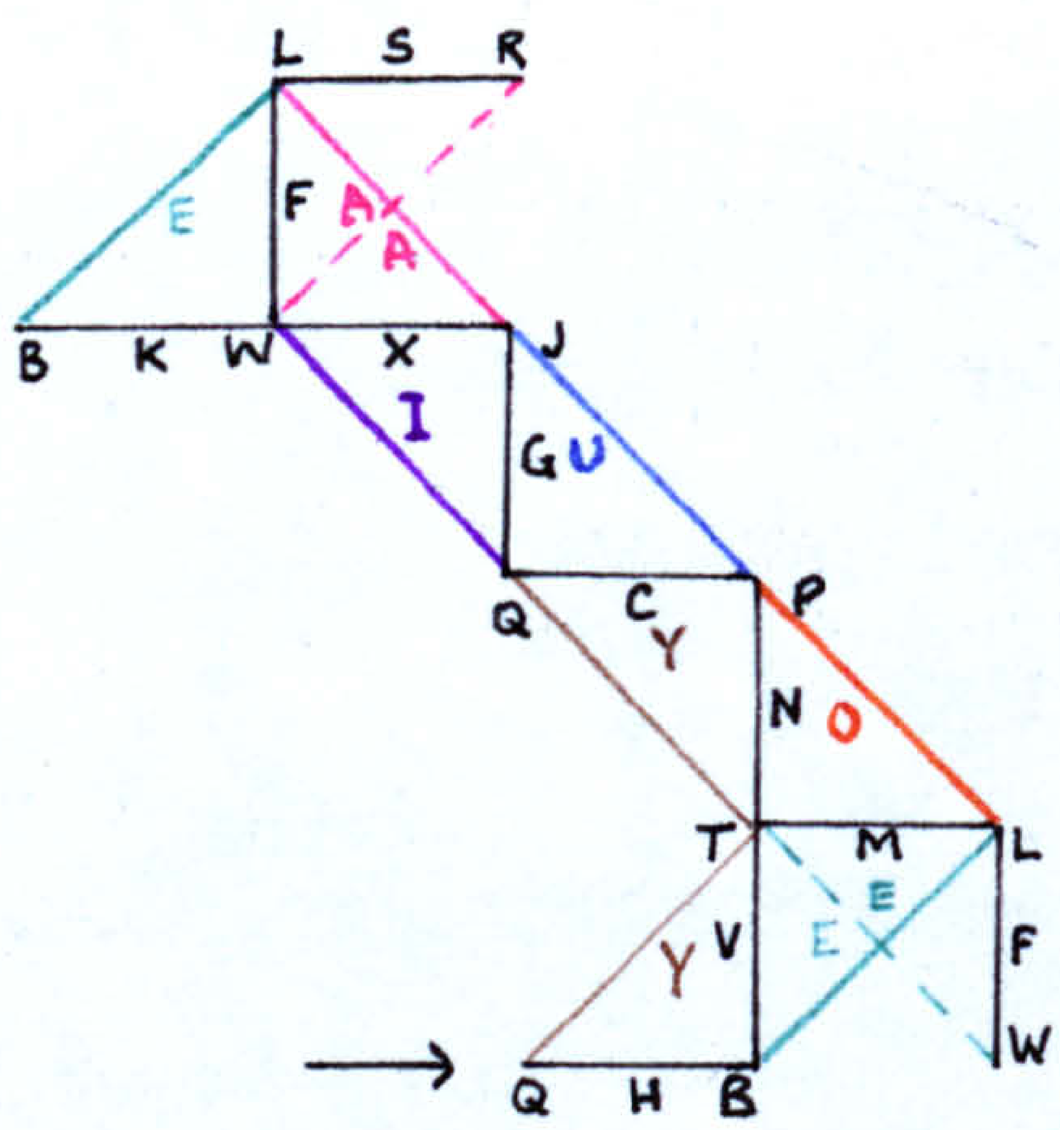


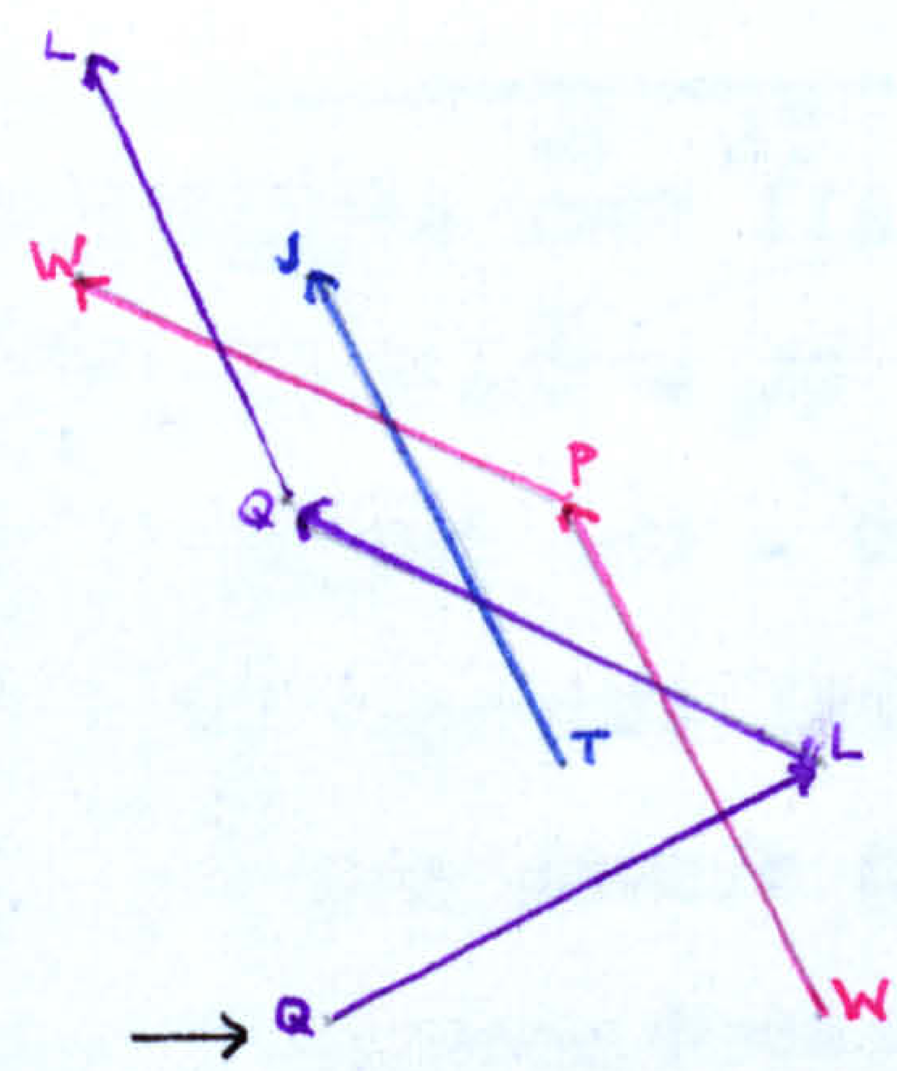
5

...Supposed to be a rather poor interpretation of interlocking spurs for a young river valley - the spurs would really be interlocking - the 6

bed itself comparatively narrow and small, there are many rocks and falls in the bed, can't show in sand - all these features are much more marked 7

in hard rock - a youthful valley in chalk, say, would have a much gentler cross profile. 8

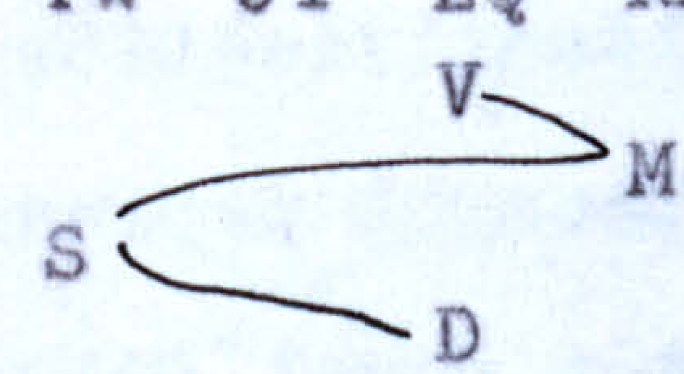


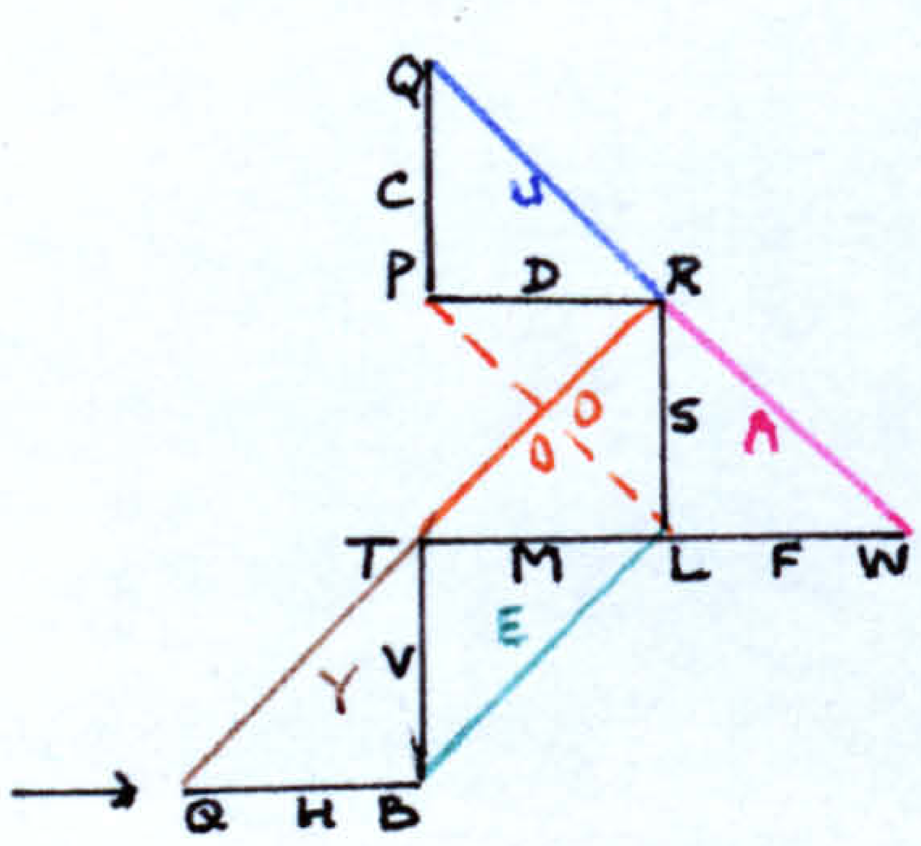


107

PW JT LQ RB

So this is the beginning of the valley? Yes, and the mature stage. (gestures downstream) 9





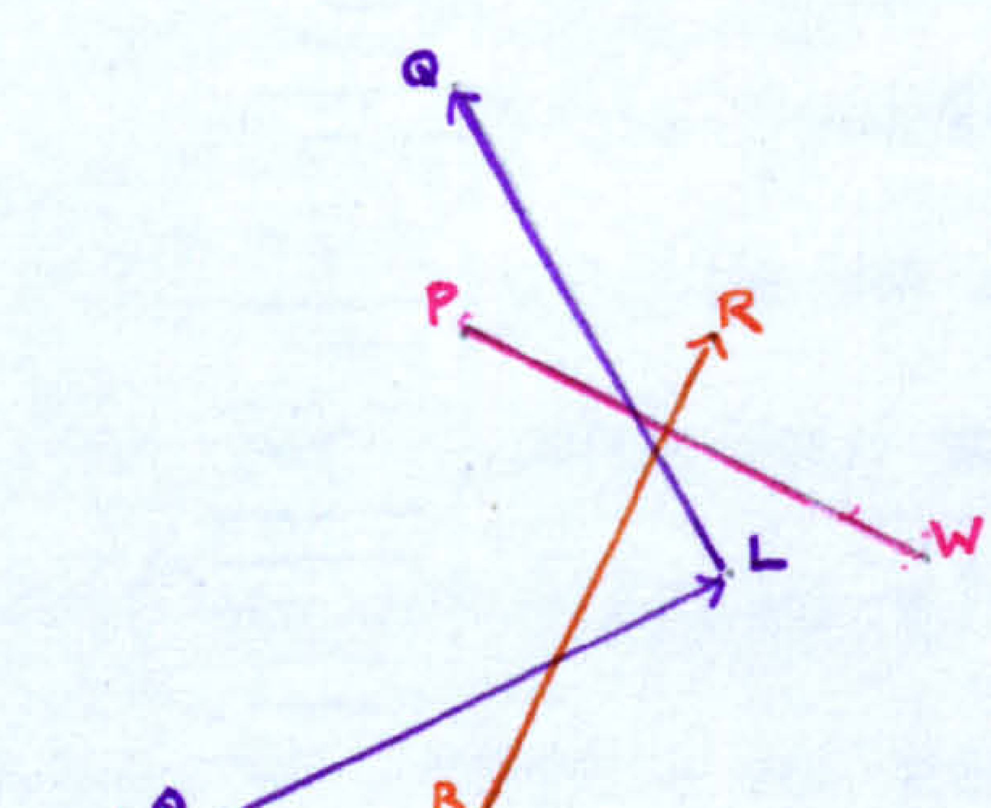
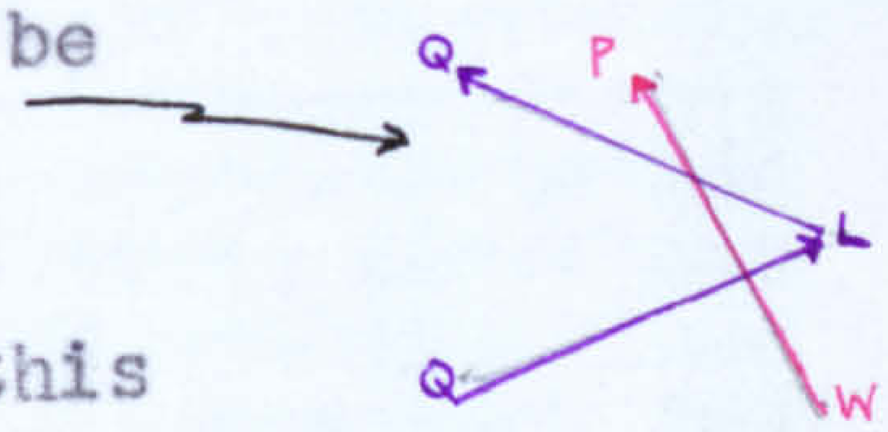
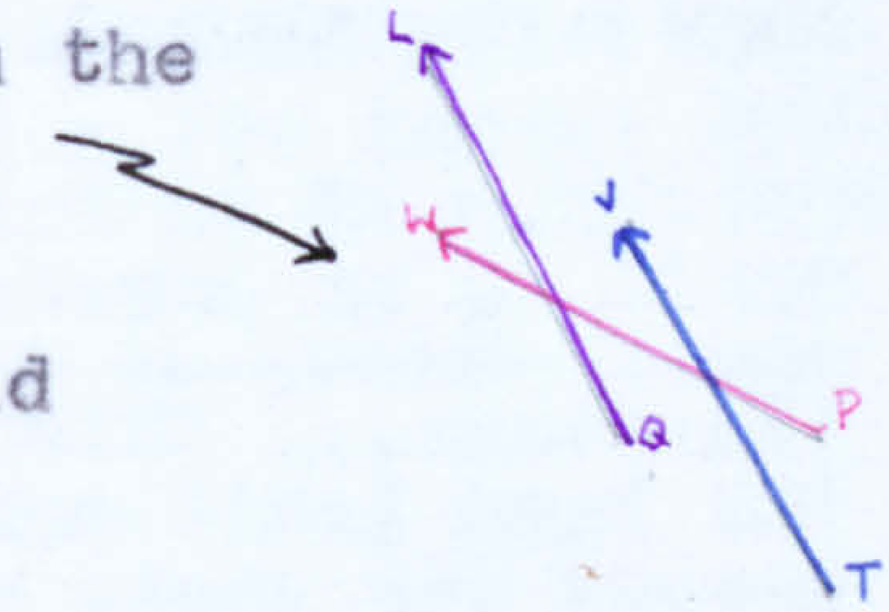


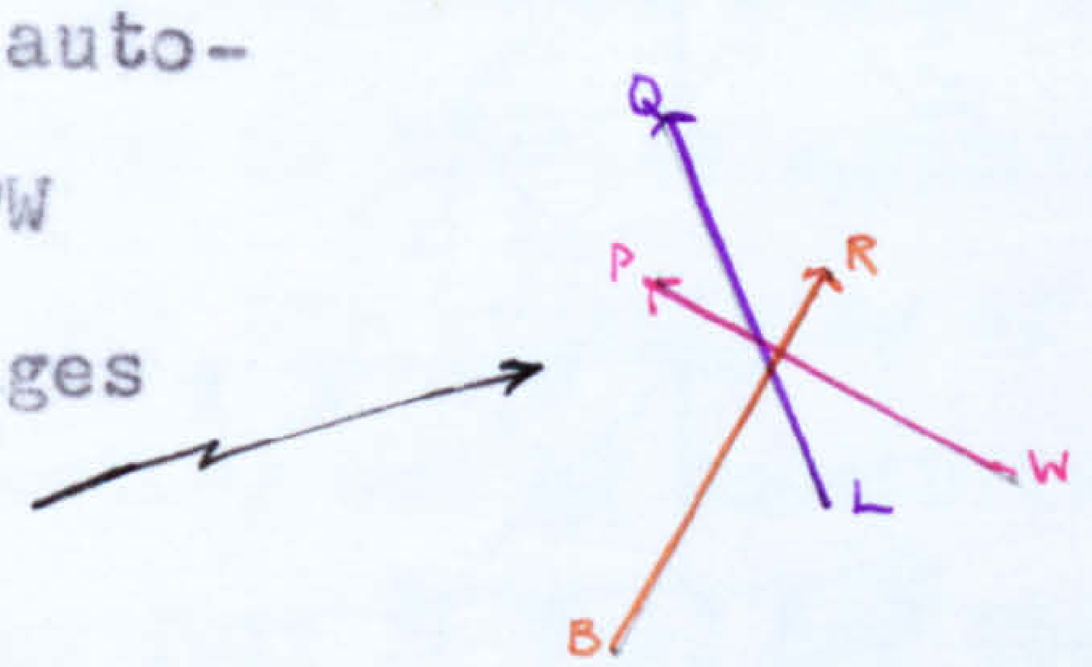
Fig. X.15 (ii)

...7887... The start is similar beinging in the vital communication link $\overset{+}{M}$/PW, but now, as required by the task the communicated concept leads to decisive action in mapping back into the model. This pattern could be picked out in a number of the sequences recorded. "Technical Reaction" follows this as the subject uses his own model and the information transmitted from it. The "operator" PW crosses the Minded concept (TJ), as it were carrying the J-information back towards the cultural concept within the individual schema L as the feedback is completed. This concluding pattern would seem to represent the correlating of theoretical concept and recalled landscape experience which is vital to valid geographical thinking.





...107... a short verbal sequence but analytical consideration suggests that the mapping of symbol-to-thought-to-model (Q-L-Q) must still be going on with the aid of the "operator". Another element comes in here, though, as the words "beginning of the valley" have switched on ($\overline{M}$/BR) a geographical concept, so that this time the operational automatically organised perception $\overline{S}$/PW places the conventional valley stages on the model. The simultaneous operation is reflected in the pattern again correcting the artificiality of sequence. JT is missing here; we do not know about the equilibrium state of this concept.



1724/01547

Valley pattern?

10

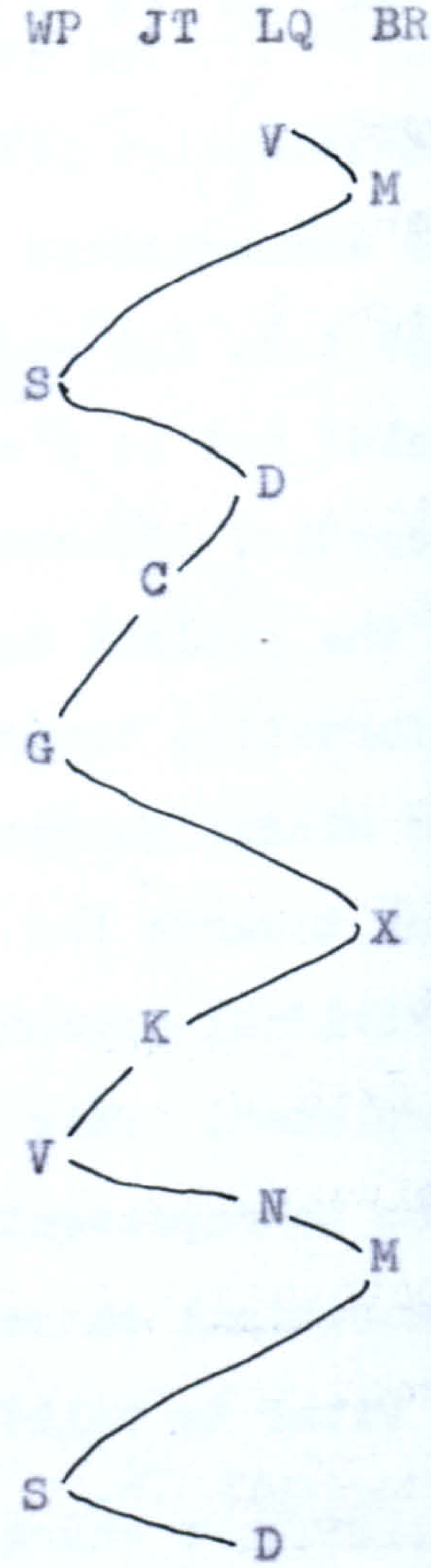
Radial drainage - the very steep gradients encountered at first would produce these youthful valleys but they would be going out generally in all directions, and spreading 11

out in the lowlands and beginning to meander, and this would be true... 12

something like drainage on a volcano - and spread out - they may well form deltas. If in fact the countryside is built up of porous rocks, like 13

limestone... this presupposes that the land isn't porous - if it was porous the whole of the rainfall would soak down through the top and you'd probably get resurgences appearing 14

right at the edges - or midway up, depending where the limestone beds finished and the other beds appeared. 15



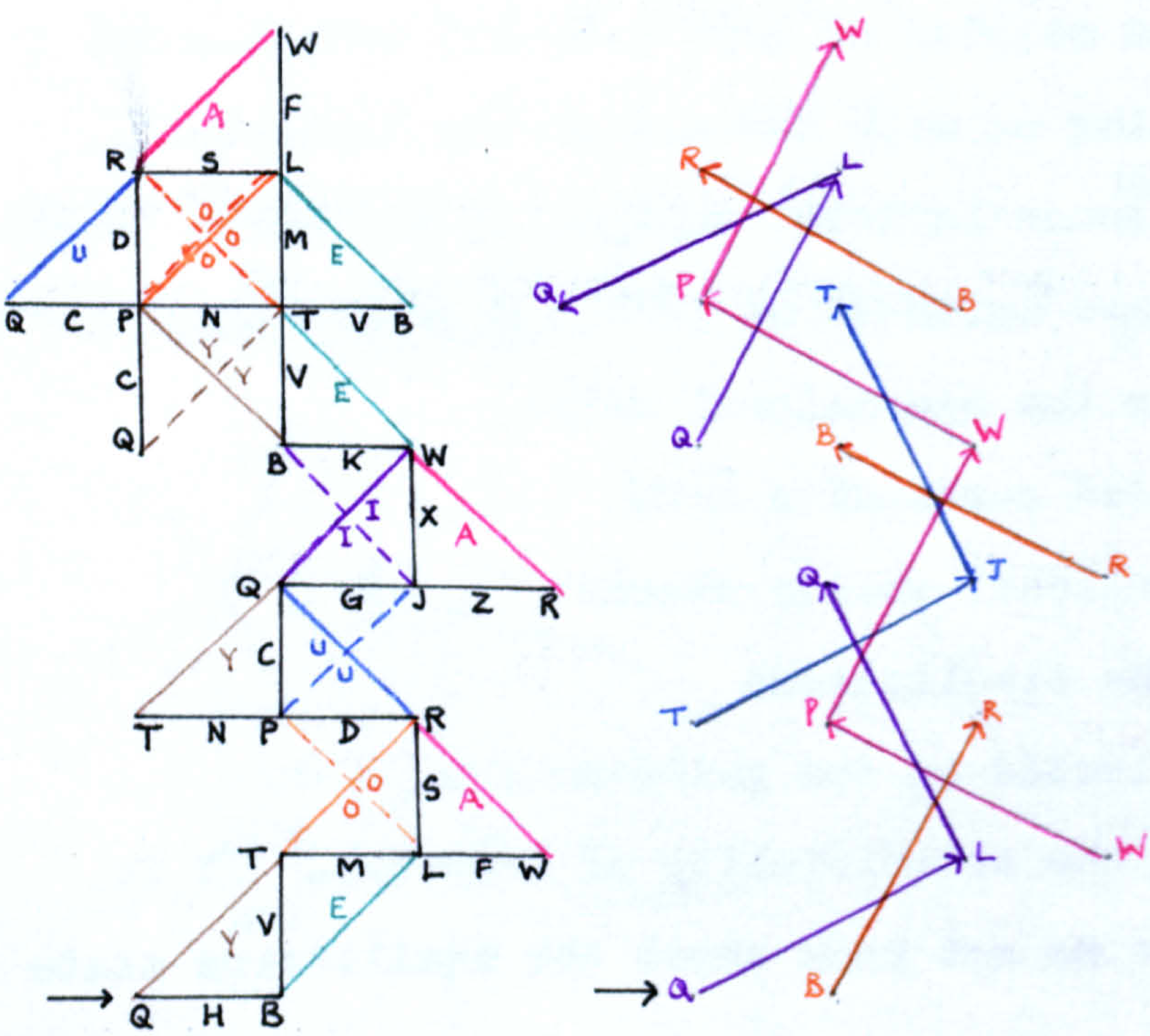


Fig. X.15 (iii)

...1724/01547... After a similar start this time JT does appear and the concept of radial drainage is obviously viable, as not only has it been mapped into the model but feedback of further ideas occurs. The pattern is dominated by the purposive PW strand. Reading through the sequence without analysis it is evident that the first use of the model has been a starter for recall of a number of concepts. In the middle phase T-J-T has replaced Q-L-Q: the model has sunk into the background as mediator as the catalytic X/RB comes in and he is relating directly to the phenomena of deltas and volcanoes. But Meaning again acts as a catalyst in $\bar{M}$/RB; from surface drainage he moves on to ground water drainage, and he works out the implications of a new hypothesis. Inspection of the orthotron flow chart will reveal the similarity to the initial part of the sequence. It has already been remarked (p.230) that Class (3) sequences are comparable in aspect of pattern with the Theoretical sequences, though not coincident since the tasks are not identical. In this individual sequence the comparability is marked. The dominance of PW is perhaps related to the fact that in this task there is no giving out of symbolic information by equipment so no meaning is carried automatically i this way and the subject has to do all the organising of the information. In considering the sorting out of possibilities and use of hypotheses here, it seems fair to ask, are these co-incident junctions already commented on an indicator or <u>formal operational thought</u>?

27598/003022

Comment on model. since the top is level - honestly this looks because it has been made of a polystyrene block - but it looks like the surface

of a plateau, which has had drainage incised into it, because if meanders I'm not quite sure of the scale - depending on the scale, they could be incised meanders or variations

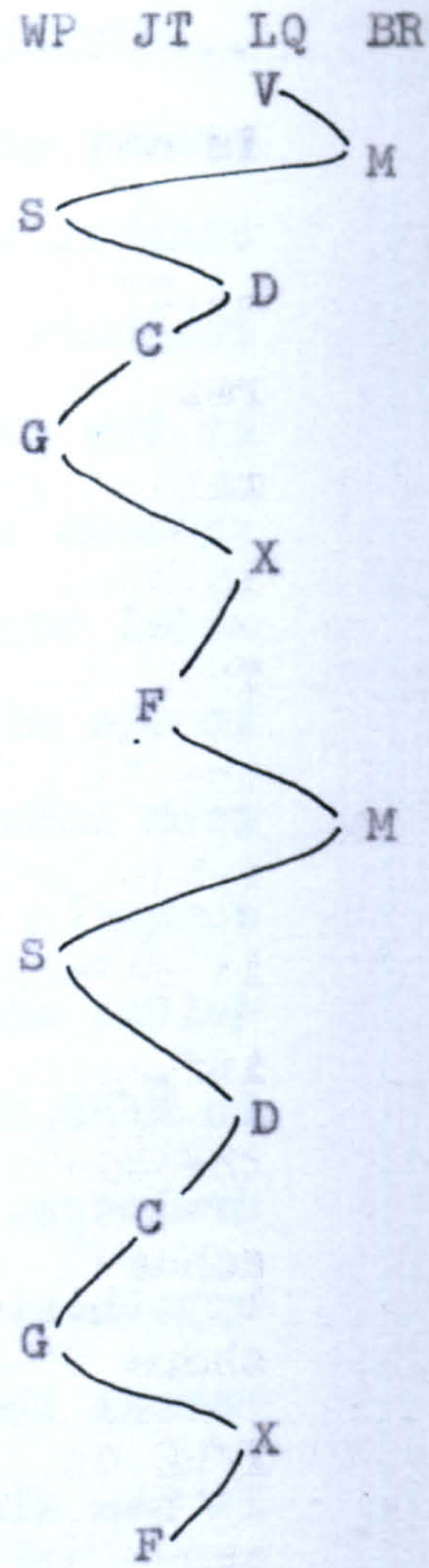
on the drainage pattern - it also looks remarkably like - it could be a glaciated valley - this being formed by a trough-end glacier -

you can almost imagine moraine along the sides there.
The valley is opening out here... the cross profile is becoming much

more gentle, so this could be... would be the mature stage, because in the old age it's much wider and more gentle. Yes, a very steep gradient at

the top here, obviously coming from a spring source here and no hanging valleys, in which case that discounts the theory ..yes.. both got steep gradients at

this point to the confluence.. and then begins to meander across the plain.



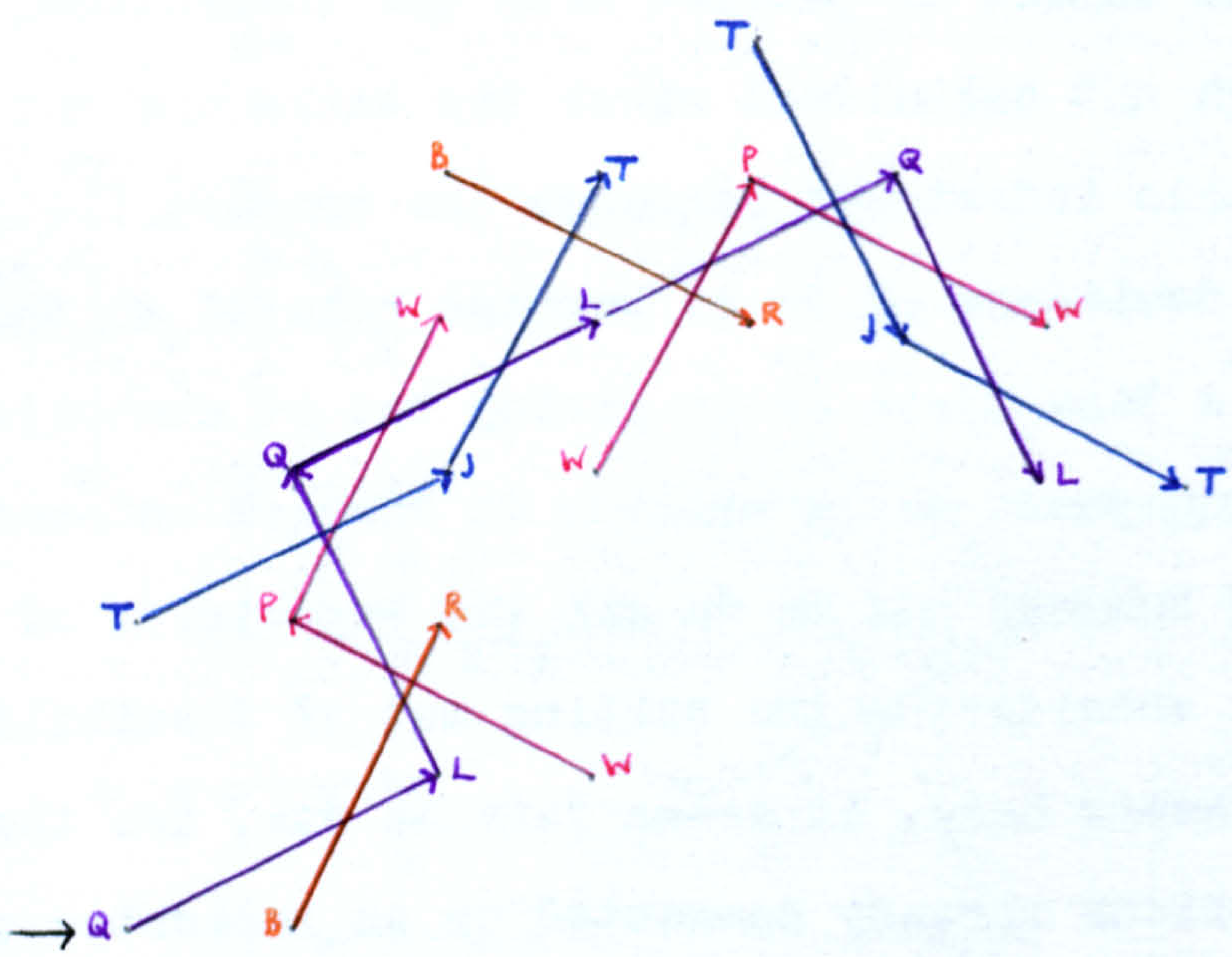


Fig. X.15. (iv)

A short response relating ideas to Dartmoor streams is not presented here. There follows comment on the model.

...27598/0003022... The second half of this sequence is a repetition of the first half, and the characteristics are not markedly different from the last sequence discussed, except in terms of the dominant Oppositional, which this time is QL. This can be accounted for by the nature of the task. For the valley pattern everything had to be produced by the subject on a neutral surface. Now he is using a given model; it does not give out symbolic information but it does provide information in terms of shape, and the Q-L links suggest the continual interchange of mapping model information into schemata and schematic ideas into the model. The difference shows up at X in midsequence, this time it is not the catalytic X/RB but X/LQ where the curves of the model valley and their cross profile are being <u>mapped</u> into the individual schema; there is some uncertainty here until M/RB snaps in with the mental image of glacial features. But the concept embodied in the subsequent S/WP is a retention of the valley-stage schema operating earlier in the sequence. The existence of two concepts here is significant and had repercussions later in the interview as it seemed to establish a disparate view of the upper and lower parts of the model which recurred in human geography and caused confusion.

104/15/2735/809/2254/0013052

Sites

WRJTLQBR.

V M S F X F S D Z G X F S Z G X K

Can I make a pre-supposition? that there has been uplift, & river terraces on this mature stage here

to build a settlement in the valley bottom would be silly - flood danger with

water draining off high land into narrow streams, with great velocity as the confluence,

settlement might spread up the valleyside, would be gentler, but would be

clear of river banks(V1,2) River at mature stage might be navigable, say

to confluence (V3) clear of v. floor, but unlikely

to spread up here, wilder. If like Switz. might be market - but produce wld be brought to confluence town & shipped out

WRJTLQRB.

V N C G X F F M S Z G X F S Z

Communications apart from river traffic- no, no point...

Meanders might have been short-circuited by canal up here -

though river may have been wide & deep -

but varying volume of water.. communic. wld like Aire V. follow

valley (A), joining town at head of settlement pattern so road & rail running there

& if agric. area, get alpine type roads - am not sure of scale.

(sequence précis-ed to leave room for flow diagram)

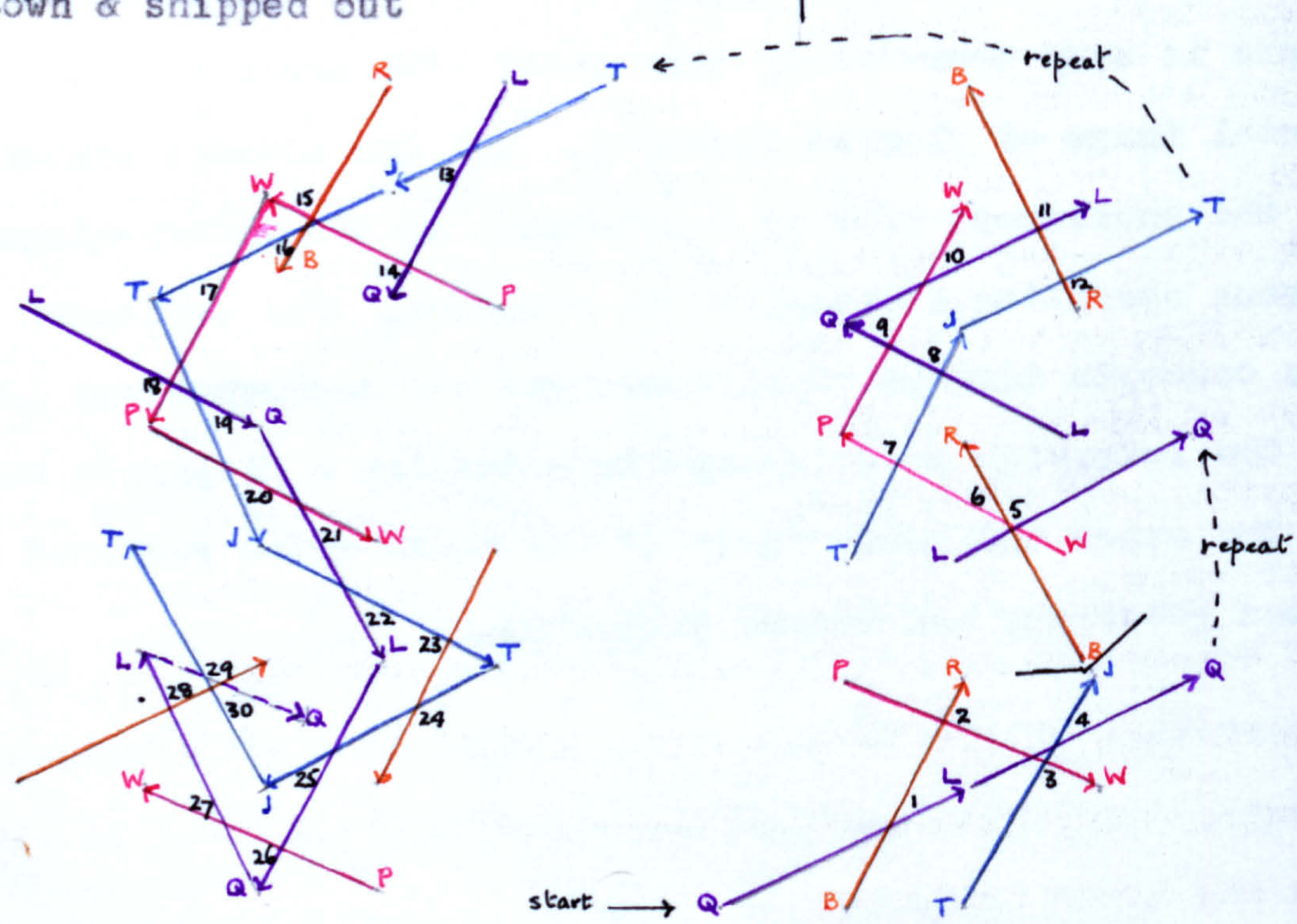


Fig. X.15. (v)

104/15/2735/809/2254/0013052... Continuous two-dimensional presentation of this sequence was not possible. At the second break the repeated orthotron is a JT type; thus from junction 7 there is a dominant JT strand. There are relatively fewer of the coincident junctions which have been suggested as concomitant with formal operational thought than occurred in the previous sequences. A third significant point is that the classified sequence with which it starts, ...104... has already been disucssed (p. 210 above) as presenting a halt on theory, undeveloped.

A review of the sequence shows that it is characterised by the appearance of a series of concepts, (i) uplift of land and river terraces, (ii) settlement sites avoiding flooding, (iii) the confluence site, (iv) Swiss environment, (v) water transport, (vi) an alpine type road net. This is a pretty mixed bag and reflects the disparate views of upper and lower parts of the valley which have already been mentioned. These are all recognisably geographical, i.e., cultural, concepts, and the F vector is prominent in this sequence, not only is the dominant vector of some orthotrons, but occurring as a minor vector in a number of others. $\overset{\pm}{F}$ has been identified (p. 248 above) as suggesting disequilibrium, especially when it is $\bar{F}$/JT, as it is in ...104... It seems that rather than searching for clearer integration of any one concept an alternative is taken up each time. As this alternation seemed to be getting out of hand eventually some questions were put on specific points; these short sequences are not shown here.

104/00157/243

Type of agriculture? was thinking of Swiss system, river meadows here with cattle moving to higher land in summer & warmer meadow in winter...

I keep saying things and thinking of objections - cold air runs downhill, ..not true there, but would be here

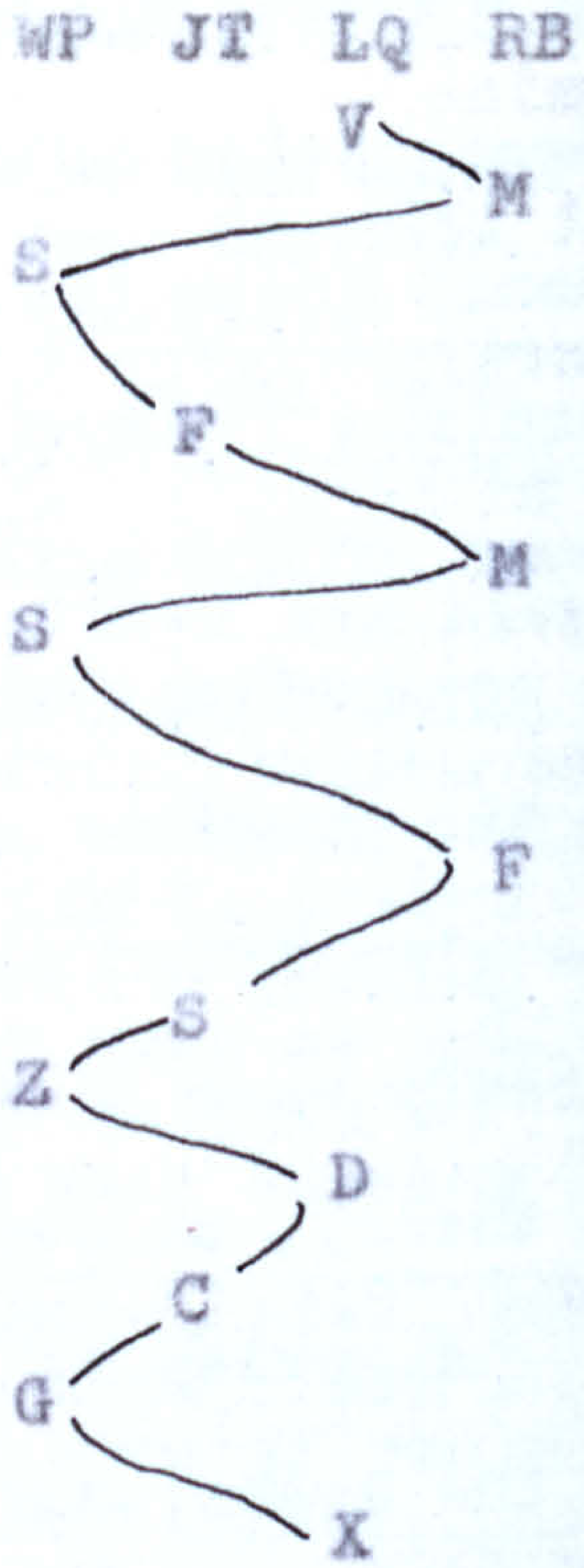
.. there'd be little agriculture here .. now which is North?

that's my North, so a westfacing slope clear of valley floor, so no mists, would have small amounts of agric..

on Swiss system, alpine meadows here, forestry perhaps right on the top slopes - but again conflicts with

what I have been saying about the lower- I've almost divided this block into two halves - very unlikely...

if this was a mountain region this would be the only type of agric. which could be practised - on western slopes.



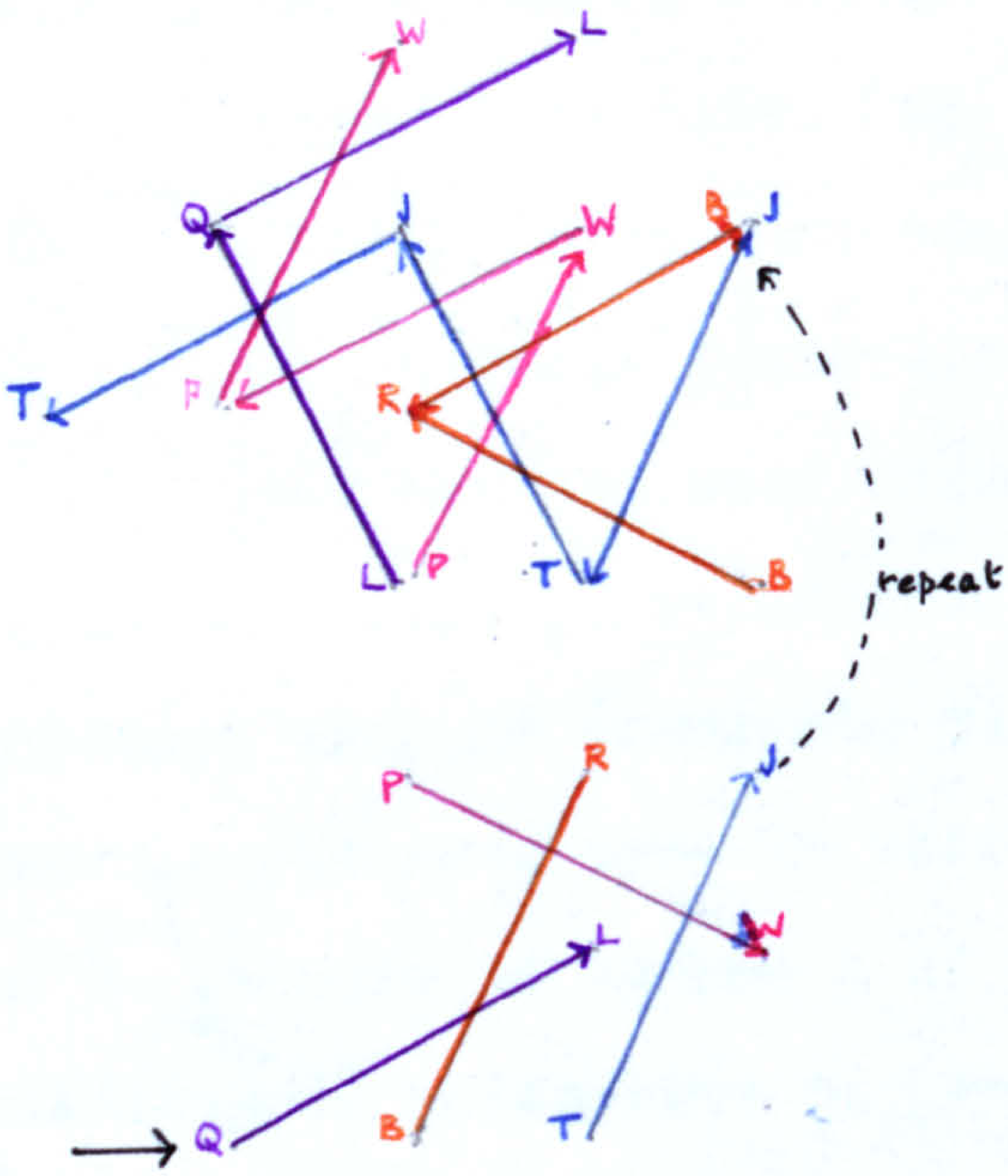


Fig. X.15. (vi)

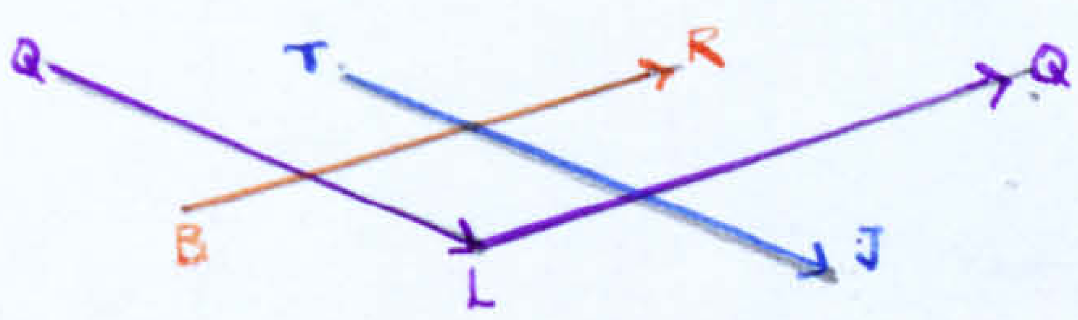
...104/00157/243... The following sequence also shows the dominant TJ strand; it also appears confusingly close-knit. But this time at F/JT the disequilibrium of his concepts is overtly admitted by the subject and he seeks clearer meaning in midsequence where JT and BR are interwoven. But no coincident junction appears until at D/LQ clearer Selection leads to his appreciation of his disparate concepts mapped into the model. His two levels of simultanious scanning in the background - perceptual and conceptual seemed to interrupt his conceptual thought too frequently, until he had to cut out from the task and deal with them consciously. This subject had carried out and written up some independent geomorphological study while still at school, and in the earlier sequences on the physical aspects of the valley he made more successful use of his better integrated concepts. On the human side on the other hand he had half-digested concepts, and necessarily regressed to less complex operations. Possibly the use of many concepts is, as Bruner suggests, not a way of coping with a problem, but a defence against the problem. Since this student could eventually diagnose his own trouble he might finally cope with the problem as in the earlier sequences; the re-appearance of a strong PW strand in the latter part of this sequence suggests more decisive thought taking over. A final long sequence, not displayed, of comment on the more elaborate model also shown to the students, is again dominated by the PW strand: again many concepts are used but are more effectively mapped into the model which itself offered more possibilities.

CHAPTER XI

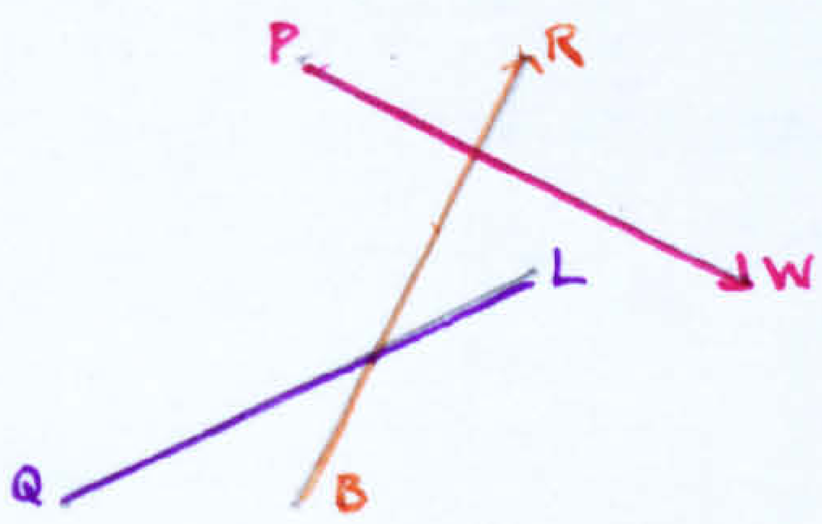
CONCEPTUAL THOUGHT AS REVEALED IN MATHETIC ANALYSIS COMPARED WITH CERTAIN IDEAS PUT FORWARD BY PIAGET AND BRUNER.

In view of the characteristics of the JT (Minding) Oppositional picked out on p. 246-248 above it seems appropriate to focus final discussion on this axis, coupled with consideration of the occurrences of the various types of junction patterns and their distribution over the age range. The types of junctions may be summarized thus:

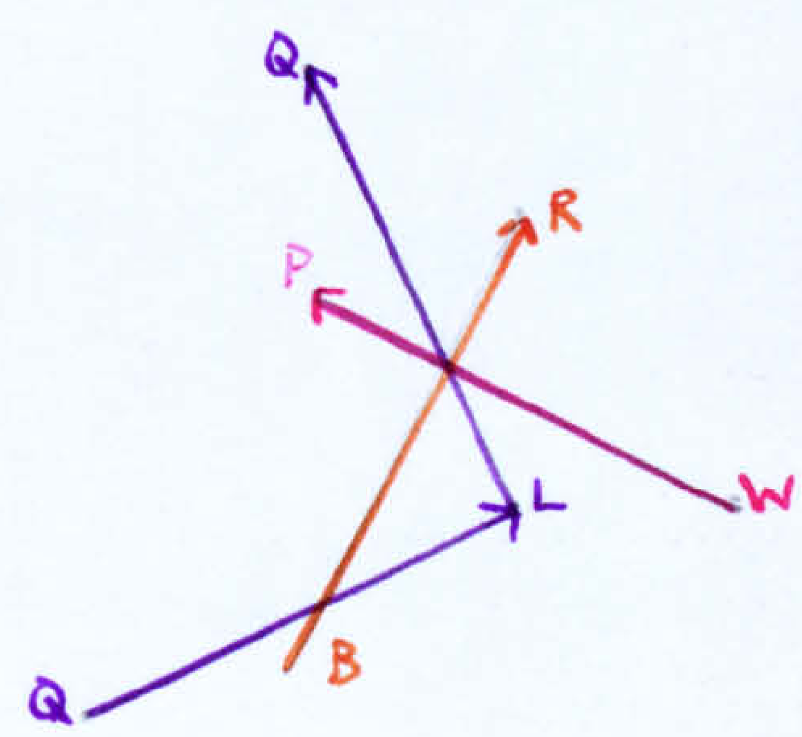
(a) purely oblique
e.g. ...108...



(b) oblique and orthogonal
e.g. ...26...

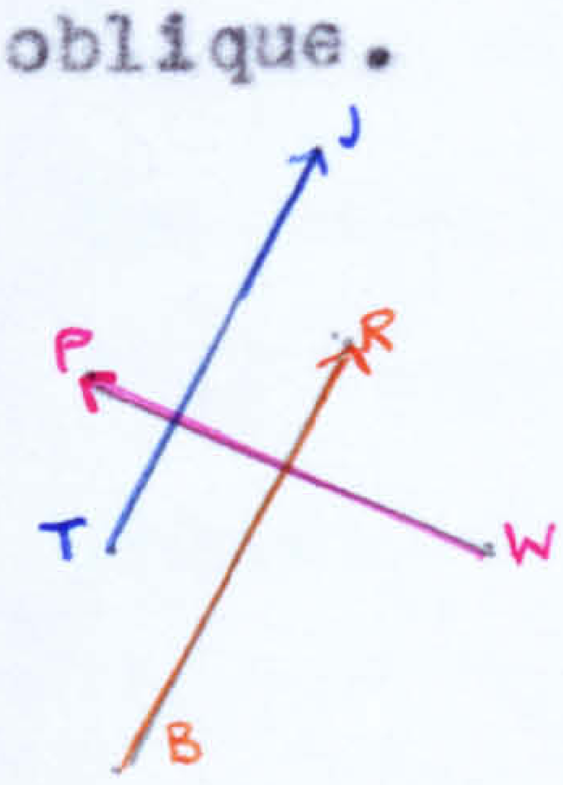


(c) the development of (b) to a "<u>triple</u>" junction, e.g. ...107...

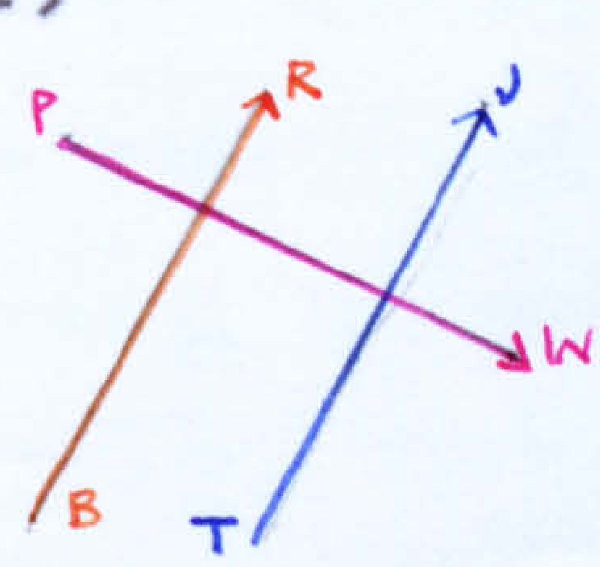


(d) there are three other alternative possible developments from ...26..., (i)...106... and (ii)...104..., both with a second orthogonal junction, and (iii)...105..., with an oblique.

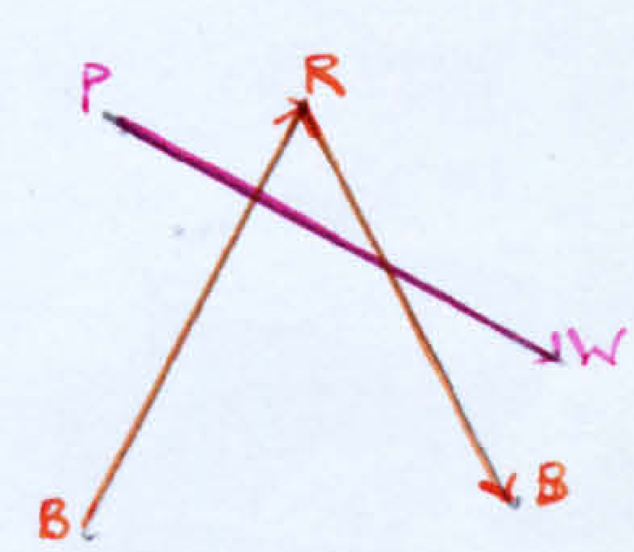
(i)



(ii)

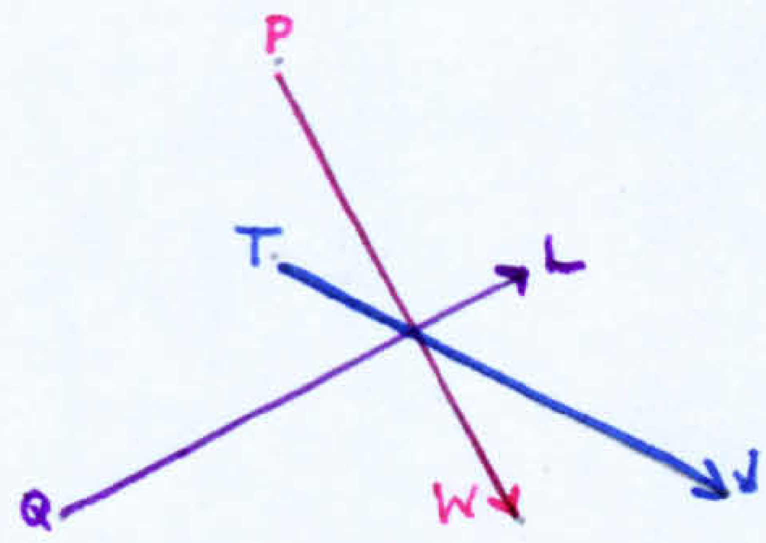


(iii)



The significance of the alternatives in (c) and (d) have already been discussed at length in Chapter IX, but we may remark on the more decisive D element leading towards P contrasted with the F element leading towards W, the latter representing a less economical sequence in terms of the successful application of the concept.

(e) in the present context the "triple" ...28... leading to JT is specially important, in the initial question, "What is a valley?"



In view of the questions arising in the discussion of the Oppositional analysis in Chapter X, it seems useful to put forward the following hypothesis,

that (1) oblique junctions represent a search for equilibrium, i.e. assimilation of new information and accommodation of existing schemata,

that (2) orthogonal junctions represent "potential equilibrium", and

that (3) "triple" junctions represent an achievement of equilibrium.

This may be a minor stage if the whole task is complex.
Piaget says,

"...thought processes seem to tend towards states of increasingly stable equilibrium throughout a variety of specific forms... There seems to be two main factors which can account for the difference between the stable and unstable forms; the first concerns the relative degree of extension of the cognitive field included in a given equilibrium, and the second, the instruments of co-ordination, i.e. the level of development of the cognitive structures which are available at any particular age".

(Piaget, 1958. XI.1.)

In writing this, he is about to embark on an analysis of the equilibrium characteristics of the stages of pre-operational thinking, concrete operational thinking, and formal thinking; in doing this he emphasises a progression from equilibrium in terms of an immediate empirical situation, through "outline plans for possible actions", to hypothetical possibilities in which "reality" is recognised as one of a number of alternative conditions. Considering this progression of the complexity of thought one might postulate that in Mathetic analysis of the type developed in this investigation the following progression might be relevant,

Concrete Operations - early stage (IIA) would be likely to be largely characterised by oblique junctions with occasional orthogonal junctions

Concrete Operations - late stage (IIB) and a following transitional stage (IIA-IIIA) would be characterised by increasing numbers of orthogonal junctions and some "triples"; the later increasing in the transitional stage,

Formal Operations - stage IIIA and stage IIIB would be characterised by having more triples, especially at IIIB (cf. the Theoretical patterns of Fig. X.4. (p. 232). In a complex task, however, these might be broken by oblique and orthogonal junctions in episodes where a longer search for equilibrium had to be made in an extensive cognitive field.

Bruner's distinction of types of strategies of thinking also appear relevant here; the "triple" might be regarded as economical, dealing with few instances, but involving high "cognitive strain", the oblique sequence, with more drawn-out steps in thought, but less cognitive strain, and the orthogonal junction as a compromise strategy characteristic. with middling cognitive strain (Bruner, 1956, XL2). His "ideal strategy" might be correlated with the Theoretical sequences postulated by Meredith which have been used for comparitive purposes and which are composed wholly of triples. Finally before reviewing the age range characteristics, we may remind ourselves of three aspects of each episode of thought on which judgment has been made. The first is the character and availability for recall of the subject's own mentally stored information. The second is the private organisation of this stored information in schemata. While, like Piaget and Bruner, we are concerned with thought operations, there does seem a need for some categorisation of the inferred state of the schema relative to some recognised "socialised" version of a concept, and neither Piaget nor Bruner seem to provide terms which give a useful verbal shorthand for these states. Perhaps we can find them from Vigotsky's writings (Vigotsky, 1962, XL3). He postulates as a first stage the formation of a "syncretic heap" of diverse unorganised elements which the contiguity in space or time may bring into relationship in perception. As the second stages the child forms a "complex" in which bonds exist between the elements, but the bonds may be diverse, in contrast to the identifying attributes of a concept. Vigotsky postulates four successive types of "complex", first "associative complex", then "functional grouping", then "chain complex" in which the decisive attribute keeps changing (as in Piaget's "concrete operations" one-to-one matching may shift on to a different element in the situation as a task progresses). Finally in a "diffuse complex", going beyond the concrete situation, limitless imaginary links may be made.

Vigotsky then introduces the notation of a "pseudo-concept" as the link between thinking in complexes and thinking in concepts.

> "The transition from thinking in complexes to thinking in concepts passes unnoticed by the child because his pseudo-concepts already co-incide in content with the adult's concepts. Thus the child begins to operate with concepts, to practice conceptual thinking, before he is clearly aware of the nature of these operations".
>
> (Vigotsky, 1962. XI.4)

One might doubt whether co-incidence of content is a valid assumption, perhaps one might put it that both child and adult assume this and communicate on this basis. This brings us to the third aspect of each analysed episode of thought, i.e. dependence on the communicablity of the operation either in verbal or in decisive behavioural terms. Vigotsky is dealing with verbal conceptual thinking, but there seems no reason why his terms should not serve in association with the non-verbal evidence also, including his remaining term, "potential concept",

> "Potential concepts may be formed either in the sphere of perceptual or in that of practical, action-bound thinking - on the basis of similar impressions in the first case and of similar functional meaning in the second".
> (Vigotsky, 1962. XI.5)

Perhaps we can distinguish the child who responds to the question, "what is a valley" by saying, "Is it a wood"? as operating with a "pseudo-concept", and the child who can model two separate hills and a space between, as having a "potential concept". Perhaps the second is what has been regarded as a viable schema, but not showing evidence of how it can be used in further conceptual thought in that episode, and the first as something which could not be made explicit but required the tester's intuition to pick up a clue to meaning which could be related to the socialised concept.

In reviewing the performance of the various age groups in the light of the significance attributed to the Mathetic patterns, the classified sequences were examined to check their worth in terms of potential equilibrium (orthogonal junctions) and equilibrium (triple junctions); these are given in Fig. XI.1. Individuals were then scored on equilibrium.

Class 1.	Orthog.		& Triple	
28	0	+	1	... 3
114	1	+	1	... 4
29	2	+	0	... 2

Class 2				
30	1	+	0	... 1
123	1	+	0	... 1
492	1	+	0	...1
1971	1	+	0	... 1
7887	2	+	0	... 1

Class 4				
27	0	+	0	... 0
108	0	+	0	... 0
434	1	+	0	... 1
437	2	+	0	... 2
1739	0	+	0	... 0
1737	0	+	1	... 3
6958	1	+	0	... 1
6953	1	+	1	... 4
6959	2	+	0	... 2

Class 3.	Orthog.		& Triple	
26	1	+	0	... 1
107	0	+	1	... 3
104	2	+	0	... 2
105	1	+	0	... 1
106	2	+	0	... 2
431	1	+	1	... 4
426	3	+	0	... 3
419	1	+	1	... 4
1705	3	+	0	... 3
1724	0	+	2	... 6
1709	3	+	0	... 3
6889	0	+	2	... 6
27598	0	+	2	... 6
27599	1	+	2	... 7

The "triple" has been scored with a weighting of 3 compared with 1 for the orthogonal junction.

Figure XI. 1. Equilibrium rating of Sequences

The Junior School Group

Age Range 7.4 to 10.9 years. Equilibrium Range: 0-9

Quality of Concepts: 5 - 15 (Valley 0 - 3: Settlement 2 - 6: Location 2 - 7)

The majority of sequences were in Class (4), mostly ...27... and ...108..., which, as Figure XI.1. will show, carry no Equilibrium score, being all oblique in their junction character. The chief mental activity was concerned with matching reality in terms of their recalled experience with their own map or model, or with the given model. The Class (2)...30... sometimes appeared at the beginning as the communication of a simple concept, occasionally 'valley', but more usually 'hill'; this did have an orthogonal junction with potential development implied.

The most advanced subject was No. 10 (9.9), who could give a verbal definition of a valley:...28... has a triple culminating in JT. This was followed up by the triple leading to LQ of Class (3) ...107..., matching the idea to the model and elaborating a road net. He was quoted on p. 137 for Level 1 of the Location concept in "socialised reasons", at the level of personal activities associations. No. 5 (8.3) is also interesting. This West Indian boy was scored at ...1724... for one episode; this carries two triples, leading to LQ and PW, this because of his decisive mapping of his own movements in his neighbourhood. Both these examples illustrate where the strength of this group lay, that is to say, in personal activity. "Spatial concepts operate as internalised activities, not merely as images of external things". (Piaget, 1956. XI.6) It is important to draw a distinction though, between these two subjects with their comparitively high Equilibrium scores. No. 5 (who could model a hill, but not a valley) was dependent on vivid recall of personal experience. No. 10 (who could model two separate hills and a valley) was able to make simple hypotheses, still based on personal experience, but not dependent on recall of specific experienced episodes, and was able to discriminate relative distances and make a choice of two possible routes.

The strong element of reference to personal experience, though in one sense a limitation, has been spoken of as a strength, because of the strong personal involvement in these rudimentary "potential (or sometimes pseudo-) concepts", an involvement that may be lost as more "socialised" expressions of the concepts are acquired. Though it would be hard to prove, it would seem worth suggesting that a residual element of pseudo-concepts formed at an early age is likely to be present in an older individual's schemata especially where ikonic recall is concerned. In the case of No. 5 the pseudo-concept of "hill" emerged in such a phrase as, "we don't live on the hill, we live right up at the top...". The problem of valley slope hill is surely one which needs positive attention, to help along a flexible verbal/ikonic schema development. It is evident from the quality-of-concept score that the landform concept was the weakest with these younger children, despite the fact that they were living in a situation where landforms were positive in character to the geographical eye (compare Long's report on picture study quoted above, p. 20). On the other hand, a sense of pattern and location, though limited and more ikonic and kinaesthetic than verbal in expression, raised the score on the other two concepts analysed. The adult geographer, for whom pattern and location have been socially linked with measurement and Cartesian co-ordinates, may be tempted to assume lack of the concepts and unreadiness for them, or to assume that these mathematical concepts must have precedence, rather than that the ikonic and kinaesthetic, Mapped into Meaning verbally, may be Mapped into qualitative sets. Note the Oppositional tracks of ...108... on p. 270, with the elements of LQ, RB, and TJ, but lacking PW whose decisive character and implications of socialised learning might stabilise the concept at least as "potential" (as in the case of ...28..., occurring with No. 10).

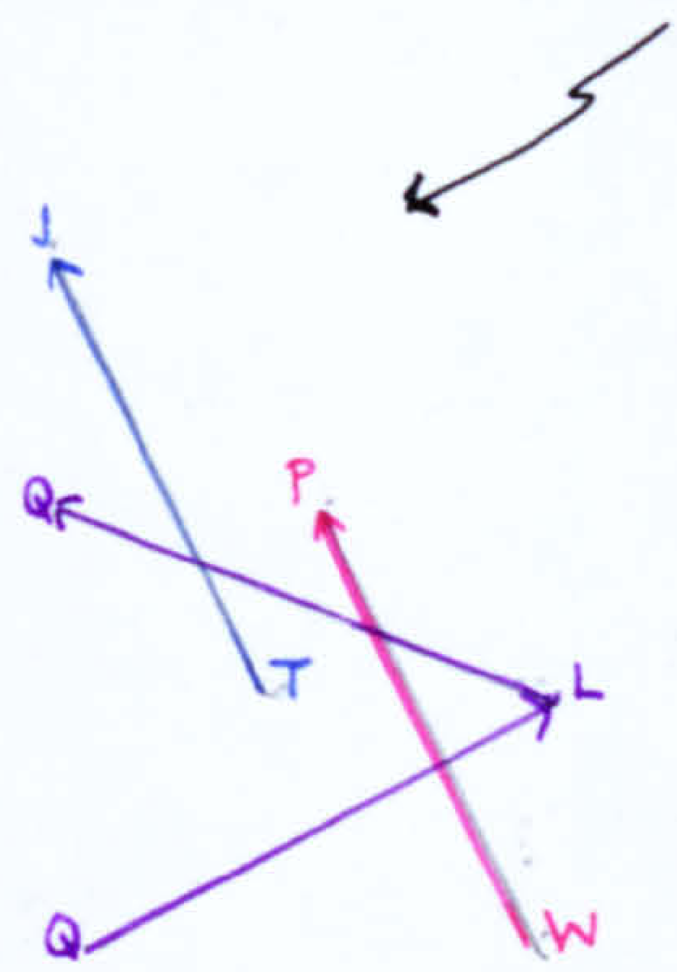
The Junior High School Group

Age Range: 11.5 to 13.0 years. Equilibrium Range: 2-28

Quality of Concepts: 2-25 (Valley 0-6: Settlement 1-9: Location 1-10)

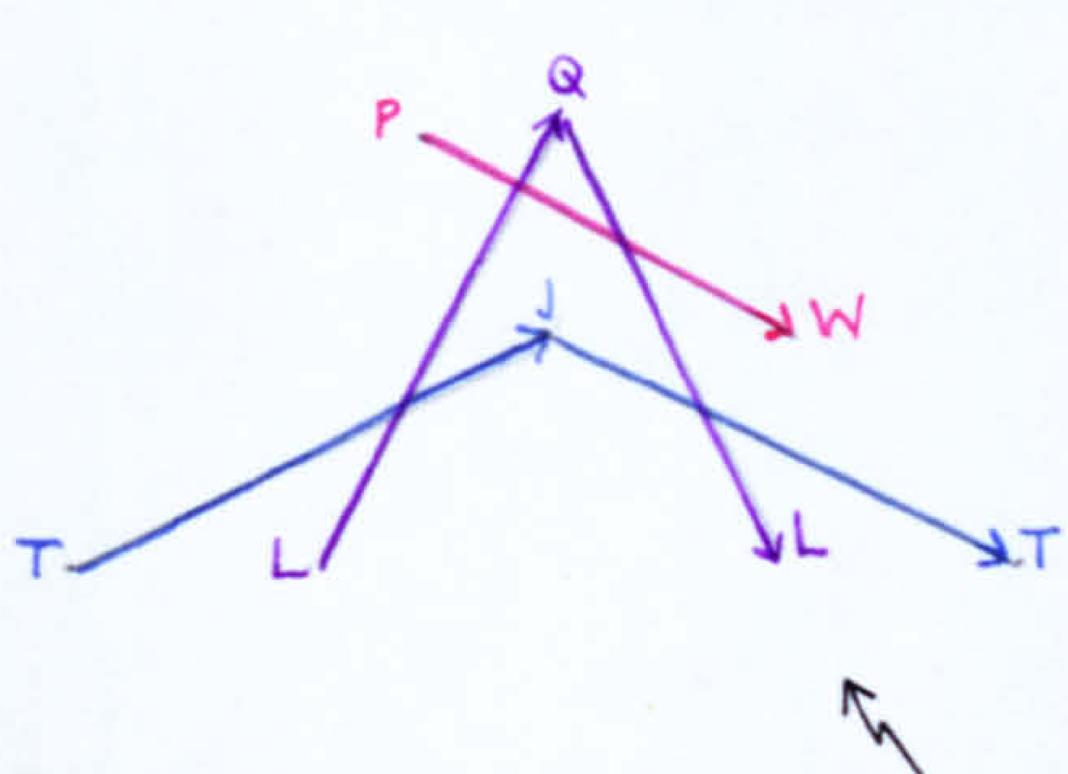
Again the Class (4) sequences ...27... and ...108... are characteristic, concerned with matching reality in terms of their recalled personal experience with their own model or given model, but they are joined by the Class (2) ...28... with its triple leading into JT Minding, since the cultural concept of a "valley" is atleast adequate for communication and activation of operative thought. Also about a quarter of the episodes have been judged to fall into Class (3). These are mainly concerned with a socialised concept, to do with people living together (village, town, city), working (farming, growing crops, keeping cattle, fishing, coalmining), travelling somewhere, building bridges. Sometimes the potential equilibrium is attained in Mapping the concept into the model, for instance, land use possibilities on the valley slopes. In occasional occurrences of ...106... and ...104... the Minding JT element appears with a second orthogonal junction (see p. 270), and dealing with a slightly more complex version of the concept being handled.

In Class (2), which arises with the modelling of their own ideas of a valley, the feedback from their modelling activity may take them on from ...30... to ...123..., which introduces JT obliquely. A look at the longer sequences of this type ...7887... shown in Figure X.5. (p. 233) shows that this "concrete operation" with the aid of the model continues obliquely, matching other elements of the concept, but refer also to the development of this type of sequence in the case of No. 50 (p. 261) with his much more advanced concepts, where it was commented on as a vital element in geographical thinking.



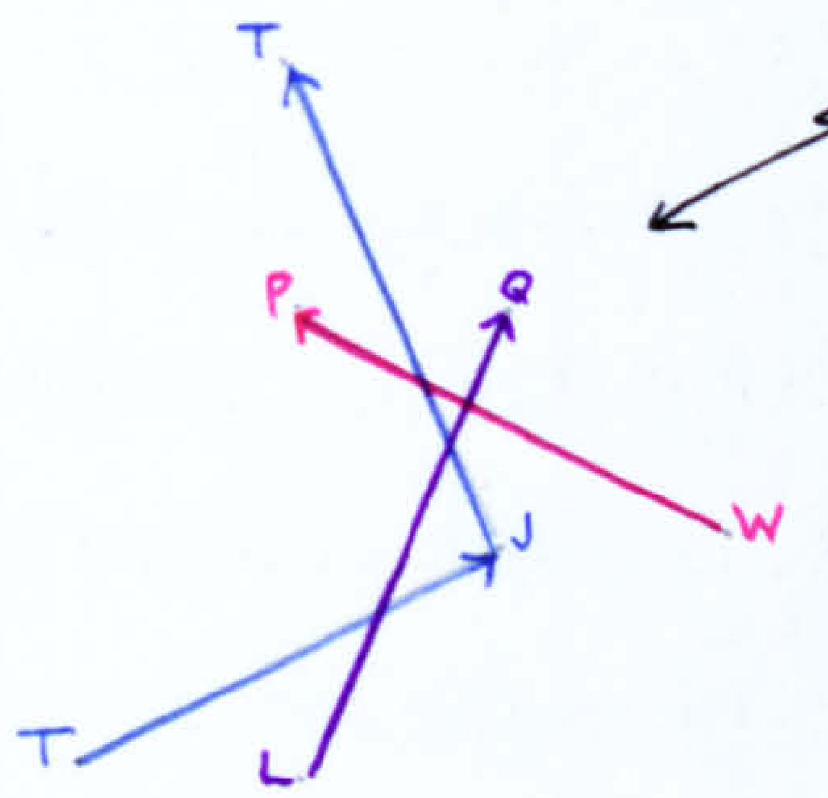
...123...

Although ...123... or its successor ...1971... do not contribute more than ...30... to the equilibrium score, they occur in the records of subjects whose score was within the upper half of this group's range. Other longer sequences belonged to Class (4), again with dependence on the feedback from the given model. The longest (...6958...) shows a final pattern akin to that



...6958...

shown above. i.e. The concept handled (the shape of a valley head) was not in equilibrium and was not adequately demonstrated.



...1737...

On the other hand, ...1737... shown below with its triple represents equilibrium in relating settlement site to slope at the concrete operational level with the help of the model. But the subject No. 25 for whom the ...6958... was recorded, had a higher Equilibrium score (19) than No. 20 (who had the ...1737...) with a score of 13 only. No. 25 was reaching for an equilibrium at a level above the Concrete Operational with a concept in which ikonic recall was not matched by available vocabulary or modelling ability (he had the highest Quality of Concept score of the group).

On the basis of such a small number of randomly chosen subjects from a particular school it would be rash to make prescriptive suggestions. However on the evidence for these particular concepts and these particular children, the tendency towards achievement of equilibrium at the level of Concrete Operations would perhaps tend to suggest that continuity of teaching in the Middle School, whether 8 to 12 years, or 9 to 13 years could be advantageous. The 12-plus group tended to have Equilibrium scores lower than their Quality-of-Concept score, while the reverse occurred in some cases in the 11-plus group, but in both groups the range of both scores was wide.

The Grammar School Group (Forms 3 and 4)

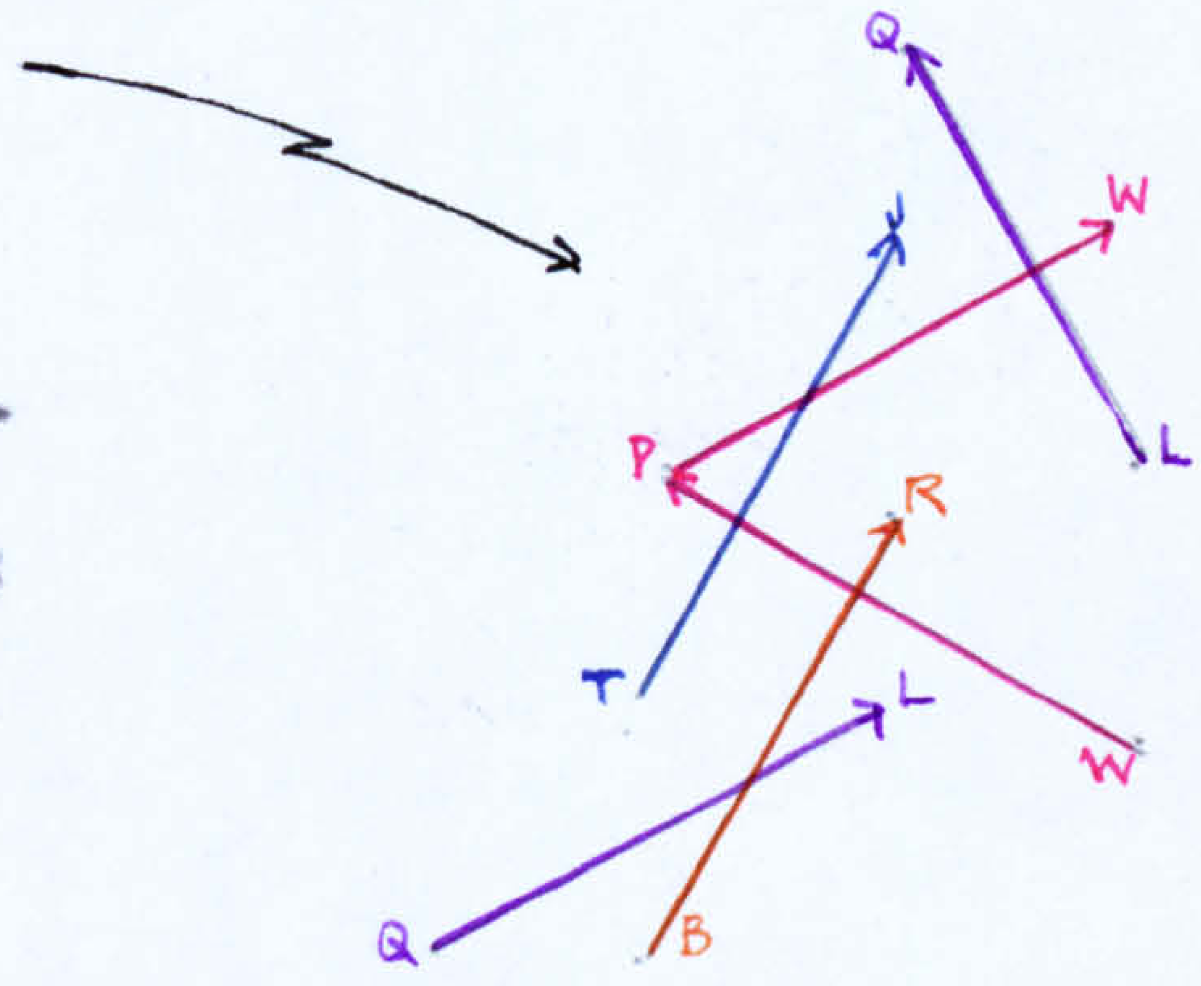
Age Range: 13.9 to 15.1 years. Equilibrium Range: 14-27

Quality of Concepts: 18-29 (Valley 3-9: Settlement: 7-11: Location 5-11)

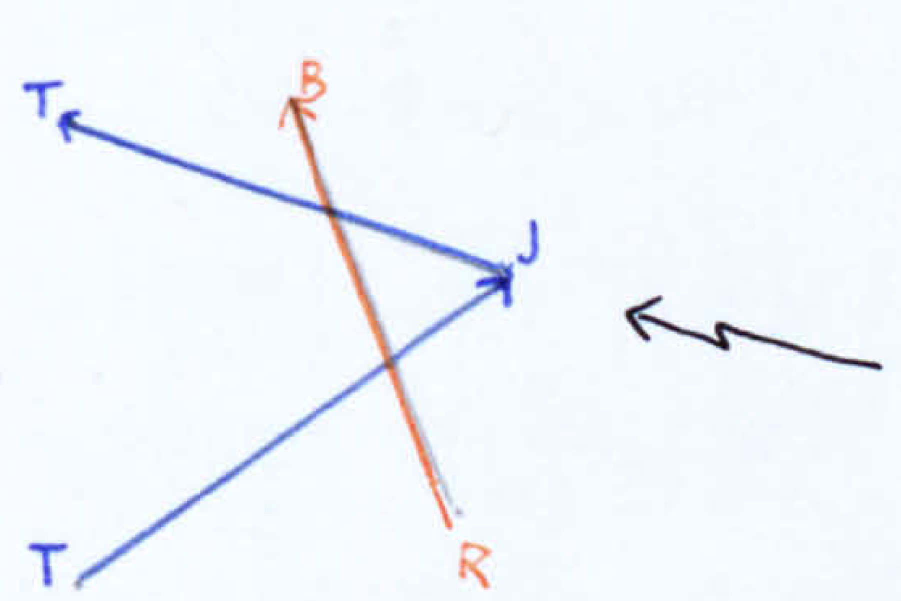
This group was chosen from a smaller population, a form of middling ability, so the smaller range of scores may reflect this. Advances beyond the younger group's performance were not startling, but were positive in certain respects. In Class (1) the ...28... triple representing equilibrium for the Valley concept in simple verbal terms is present in every case, and the occasional development to more meaning at ...114... introduces more potential in another orthogonal junction (it leads to interesting individual Minding (JT) developments further up the age range). Class (2) development through feedback from modelling activity has already been discussed above, but in this group the modelling is much improved. However the quality of the landform concept is still lagging behind that of the settlement pattern and location concepts. Class (4) sequences again reflect the improvement in modelling, but do not advance significantly beyond what has already been discussed.

In Class (3), to which one-third of the sequences belong, there is an increase in length of sequence, and an increase in equilibrium in some cases. The most frequent sequence is ...107... where "Reflex Perception" by a stable implicit concept leads to selective Mapping into the model; feedback from the model in some cases alerted another concept (from the "Bridges" class topic of Form 3) with potential equilibrium at ...431... or even attaining equilibrium with the triple in ...1724... But verbalisation is still weak and the concept is expressed concretely in the model. No. 34, whose record was taken for the full illustration of the method of analysis (Chapter IX above, pp. 178-195), though communicating concretely through good modelling and having a Quality score of 29, has an Equilibrium score of only 16. His relative forwardness of quality of ideas is being achieved by more separate steps than by the older subjects. Where he seems to use the model as a symbol rather than be dominated by its precise character, as in discriminating possible land uses, or placing roads, the classified sequence is ...1709..., which carries an unusually low Equilibrium score for a Class (3) sequence of that length, but which contains three potential equilibrium junctions.

PW is operating on JT, but the JT and LQ are separated, not simultaneously operating as in ...1724...'s triple junctions.



The highest Equilibrium score was attained by the youngest subject in the group, No. 29. He had two individual variations on the classified sequences. One resulted from his reference to the local area as shown on a map, resulting in the association of BR and JT as the symbolic representation of the Minded environmental phenomenon is dealt with. The other arose from careful working out of the cost of alternative toll-bridge



or circuitous road building. There are more orthogonal than triple junctions in his sequences, but there is much more variation in the type of sequences in which equilibrium is approached as compared with younger subjects with relatively high Equilibrium scores. He is clearly on his way towards Formal Operations.

<u>The Grammar School Group (Forms 5 and 6)</u>

<u>Age Range</u>: 15.2 to 17.9 years. <u>Equilibrium Range</u>: 25-50

<u>Quality of Concepts</u>: 24-42 (Valley 6-15: Settlement 8-15: Location: 8-15)

Clearly there is a big jump upwards in both scores, but it must be borne in mind that now the population consists of those who have opted to take geography as an examination subject. Class (3) type sequences are now dominant, carrying high equilibrium scores.

In Class (1) sequences the use of more technical vocabulary, more reference to the formation processes and their correlation with valley form raise the quality of the concept. The most interesting development was the long sequence of No. 45 (17.9) ...114/099/0063..., which was illustrated in Figures X.2 and X.4 (p. 228-233). After emerging from the first triple, the JT Minding strand is continuous. The β axis is dominant. The second triple marks a stage at which the subject having re-cued himself verbally started actively to model, so there are two cycles of thought within the sequence, the second more drawn out with LQ operating while modelling and feedback of information takes place. The JT orthotrons are F,K, in the first cycle in which the socialised conceptual elements are being organised, and C,S, in the second cycle where active modelling and landscape recall are operative. This sixth-former (classed as <u>not</u> highly motivated) seemed rather self-conscious about admitting to knowing anything (as if 'knowing things' academically was not his accepted life style), but his "extension of the cognitive field" and "instruments of co-ordination" (see Piaget, quoted on pp. 271-272) were such that he could co-ordinate his knowledge in this β axis (individual time) sequence, carrying a high Equilibrium score (9), and carrylon at a generally high level to reach a total score of 42.

The second half of this sequence had really switched to Class (2) characteristics, but with a higher equilibrium level. In general the equilibrium level crept up rather slowly in connection with the modelling of the valley features, perhaps because there was much more technical verbal expression of the concept which was not yet well assimilated. Bruner distinguishes between "verbal attainment" and "behavioural attainment" of a concept; the sequence analysed above seems to illustrate these in turn in the two cycles, but this group as a whole was stronger in verbal attainment than behavioural. No. 39 (15.9) was an exception who seemed able to risk more cognitive strain, in Bruner's terms; he suddenly became aware that the concept he was dealing with was that of a glaciated valley, and switched to comparison with a young river valley. This kind of switch seems an important development characteristic of the Formal Operations stage, for it seems to imply more complex thought of more abstract character, carried verbally and available for pick-up in a conceptual scanning process. In this particular case, however the preceding train of oblique junctions suggests a relatively early stage of Formal Thought relative to the task in hand.

In Class (3) sequences there is a great leap forward, the vectors X and F dominating as more highly developed associations of more sophisticated awareness of wider landscapes play their part in schemata. Also as Class (3) types replace Class (4), "Selection" (D) on the γ axis of socialised operative thought replaces the emphasis on "Recognition" (Z) on the β axis. The ...6889...27598...27599... sequences with their high Equilibrium rating and their greater comparability with the theoretical scientific sequences (Figs. X.4,5) occur in eight out of the nine interviews. The JT (Minding) element is not high; these sequences mark the <u>employment</u> (LQ) of already attained concepts, until the final stages when a fresh concept is "switched on" at F/JT in ...27598... and at S/JT in the extended ...27599... (a potential orthogonal junction). The long individual sequence of No. 44 (17.9) which apparently starts as Class (4) is deceptive; this subject had a strong ikonic recall of landscape, and the "Recognition" emphasis was only a prelude to a second cycle of thought of Class (3) type dominanted by a selective decision about the aspect of the valley slopes on the model.

<u>The Student Group</u>

<u>Age Range (1)</u> 18 to 20 years <u>Equilibrium Range</u> 13-44: exception: 80

<u>Quality of Concepts</u>: 21-44 (Valley 8-15: Settlement 7-14: Location 8-15)

<u>Age Range (2)</u> 30-39 years. <u>Equilibrium Range</u>: 20-47

<u>Quality of Concepts</u>: 29-43 (Valley 8-14: Settlement 10-14: Location 11-15)

The Equilibrium range of the normal student group is startling and points to an obvious problem in the teaching of such a group, although the majority of scores are within the same range as the upper Grammar school group. The high qualitative scores of the mature students for the Settlement Pattern and Location concepts is also interesting, emphasizing the value of the greater experience of phenomena and the relationships involved in human activity. It should be noted, perhaps, that in grading the quality of concepts, only one-fifth of the score was used to grade the style of verbal expression and only one point out of fifteen possible points was specifically gained by properly employed technical terms, good clear expression in common language terms being regarded as sufficient.

Considerable comment has already been made on the student population in other contexts particularly on the greater variety of sequences recorded as compared with the school groups. No. 50, with his exceptional Equilibrium score of 80, analysed in detail in Chapter X, has revealed sufficiently varied examples of Oppositional patterns. The long sequence shown in Fig. X.15 (v) (p. 266) gives the most remarkable example of JT dominance, and of the alternation of high equilibrium phases with oblique phases. The succeeding Fig. X.15 (vi) shows the complex pattern of Minding, Meaning and Making where he was explicitly sorting out his conflicting schemata, having numerous orthogonal junctions, ending in a decisive triple as a firm decision is made in the application of the selected schema.

Concentration on the conceptual "Minding" achievement has meant that the close correlation with the assimilation/ accommodation of new information to existing schèma of Piaget's equilibrium concept has, we hope been maintained, but it will also have appeared that the triple junction of three out of four axes, from which one of the four will lead on to what follows in the thought sequence, distinguishes a number of types of "equilibrium". It may, in JT, result in a clarified concept, or in PW, result in decision-making procedure, in LQ, in using equipment, in employment of the concept as an "instrument", or, finally in BR, result in the use of or clearer understanding of, symbols. This latter type of equilibrium has appeared very rarely in this investigation because of the design of the project and the deliberate avoidance of Categorizing symbolism in the apparatus employed. In this context "Meaning" has been identified as a "catalyst" because it has appeared operative in the "switching on" of a new idea. But in Meredith's theoretical sequences of scientific thought, it shares the honours with the decision-making of PW.

Bruner makes some points that seem appropriate to pick up here (Bruner, 1960. XI.7). He has described the act of learning as a series of episodes and is discussing the shaping of these episodes. He says,

> "If one respects the ways of thought of the growing child, if one is courteous enough to translate material into his logical forms and challenging enougn to tempt him to advance, then it is possible to introduce him at an early stage to the ideas and styles that in later life make an educated man".
>
> (Bruner, op.cit. XI.8)

The analysis of the same concepts over such a wide age range as has been attempted in this investigation has in a sense an assumption of this possibility behind it; that the Valley concept was often lacking in the younger children only implies that some of the elements of that concept such as the stream, how a child meets with these phenomena in his normal play and neighbourhood explorations, are more meaningful and can be handled more easily enactively (to use Bruner's term) and ikonically than verbally.

The other important point concerns the relationship between intuitive and analytical thinking. Bruner says,

> "Usually intuitive thinking rests upon familiarity with the domain of knowledge involved and with its structure, which makes it possible for the thinker to leap about, skipping steps and employing short cuts in a manner that requires a later rechecking of conclusions by more analytic means, whether deductive or inductive."
> (Bruner, op.cit. XI.9)

He goes on to say that "to identify a particular problem-solving episode as intuitive" is difficult, "or, indeed to identify intuitive behaviour as such". This makes one ask whether it is possible that the sudden switch-on of a new concept which has been remarked on in some of the longer sequences could be regarded as being examples of intuitive thought (BR acting as a catalyst, not as a major component as in the theoretical sequences used for comparison). To suggest this may itself be an "intuition" which might not stand up to re-checking and analysis. Whatever might be the answer to that, one might say that, at the least, the Epistemic pattern recording might have been shown to provide a tool which might help with further research into the evaluation of thought episodes.

CHAPTER XII

CONCLUDING CONSIDERATIONS

After the static display of disciplinary concepts in Orthochoric diagrams, and the dynamic Mathetic analysis of the evidence obtained of individual versions of those concepts, the further interpretation of that analysis in Chapters X and XI has looked forward towards the use of Mathetics as a "planning tool for teaching situations (p. 8) or a "test for teaching plans". The implications of the bundle of information about a thought sequence episode held together in an Orthotron have been explored with that end in view.

Gregory's comment on the variations of opinion amongst Geography teachers with regard to the use of quantitative methods and abstract models has already been quoted (I.3. p.4). The issue of "Geography" in which this article appeared was devoted to the discussion of new approaches. Fitzgerald (1969. XII,1), commenting on the American High School Geography Project which has a specifically conceptual approach, adapts Helburns' 'activity analysis' (1968. XII.2) diagrams to represent application of the ideas with the added incorporation of fieldwork.

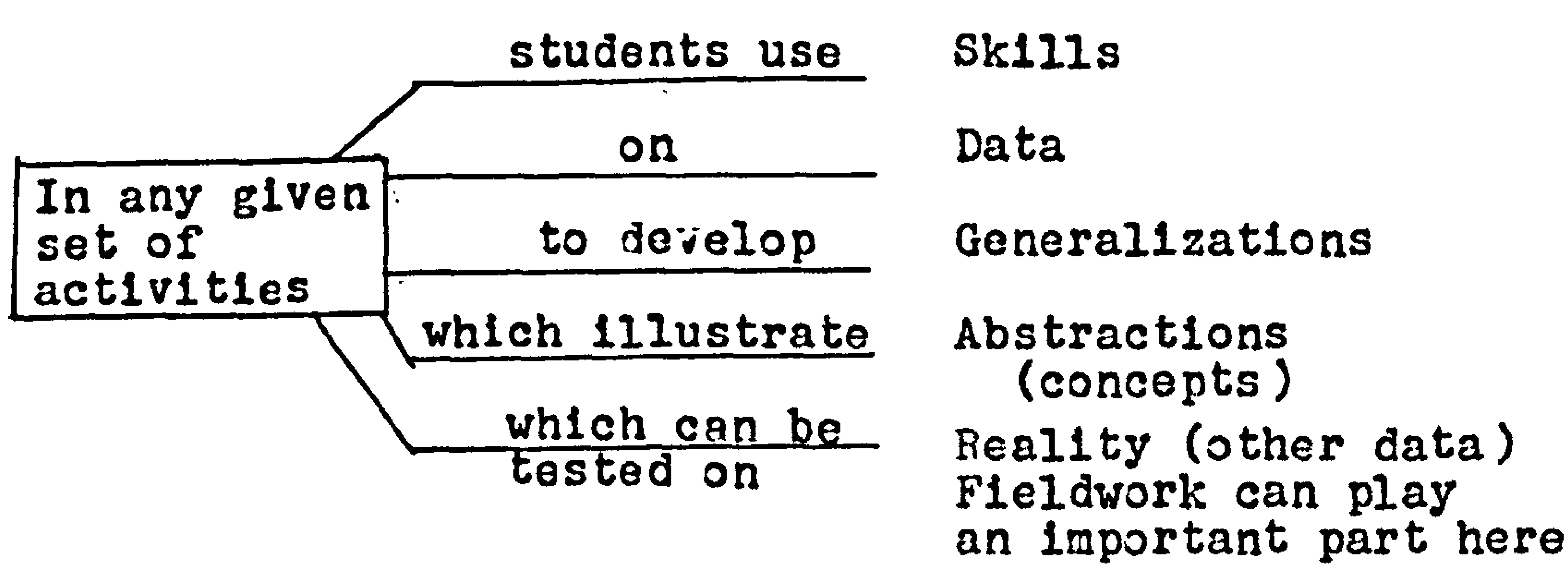


Figure. XIII.1.

He says,

> "In this case, if a concept-orientated geography is accepted, and teaching makes extensive use of generalised conceptual 'models', the final intellectual step should be the testing of models created. In many instances the best method for doing this is by testing in the field the concepts learned in the class".[x]

Thus the real example and the concept would be linked. It is clear that he is speaking of "principles" or "transformational concepts" (p. 80 above) but there seems no reason why this should not be read as applying to phenomenal concepts as well.

The article which follows (Everson, 1969. XII.3) deals specifically with the approach to fieldwork; after critizing the lack of structure in many types of fieldwork exercises which are commonly used, he elaborates on a structured approach adapted from J.P. Cole and set out diagrammatically (Fig. XII.2). The example which he gives deals with the accessibility of the Central Business District of St. Albans, but here we will relate it to our selected Valley concept, and take as our problem the character of a particular mountain valley, and as our hypothesis the existence of the features of the classic "young valley" of the Davisian cycle-of-erosion model. Taking for granted that the general programme to be followed is as on Figure XII.2, let us use Mathetics to explore possible variations of behaviour in the early stages of the task. Landform sketching and morphological mapping of slopes

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x A much more dynamic concept of fieldwork that the "mainly illustrative" - see p. 5.(I,5)

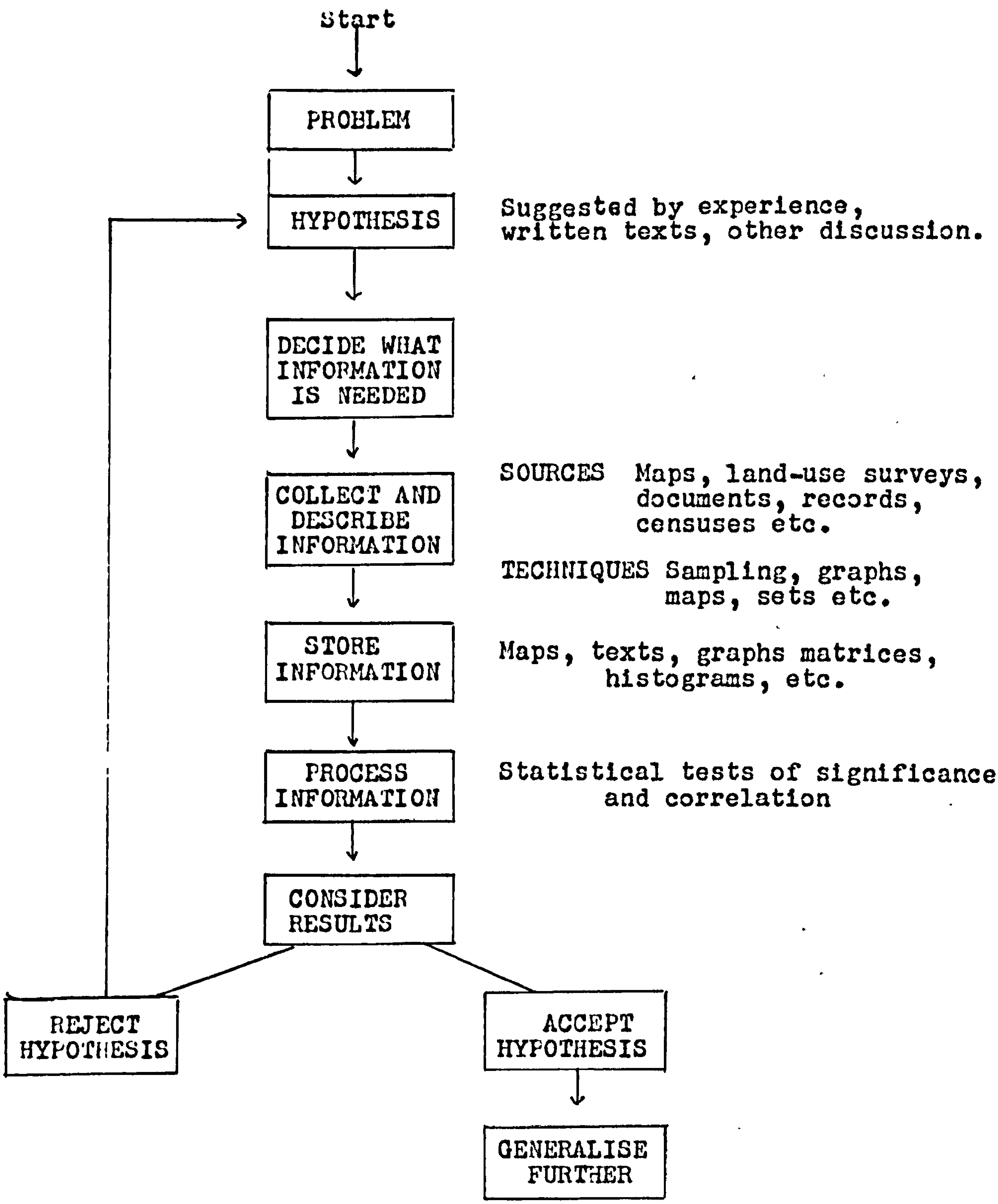
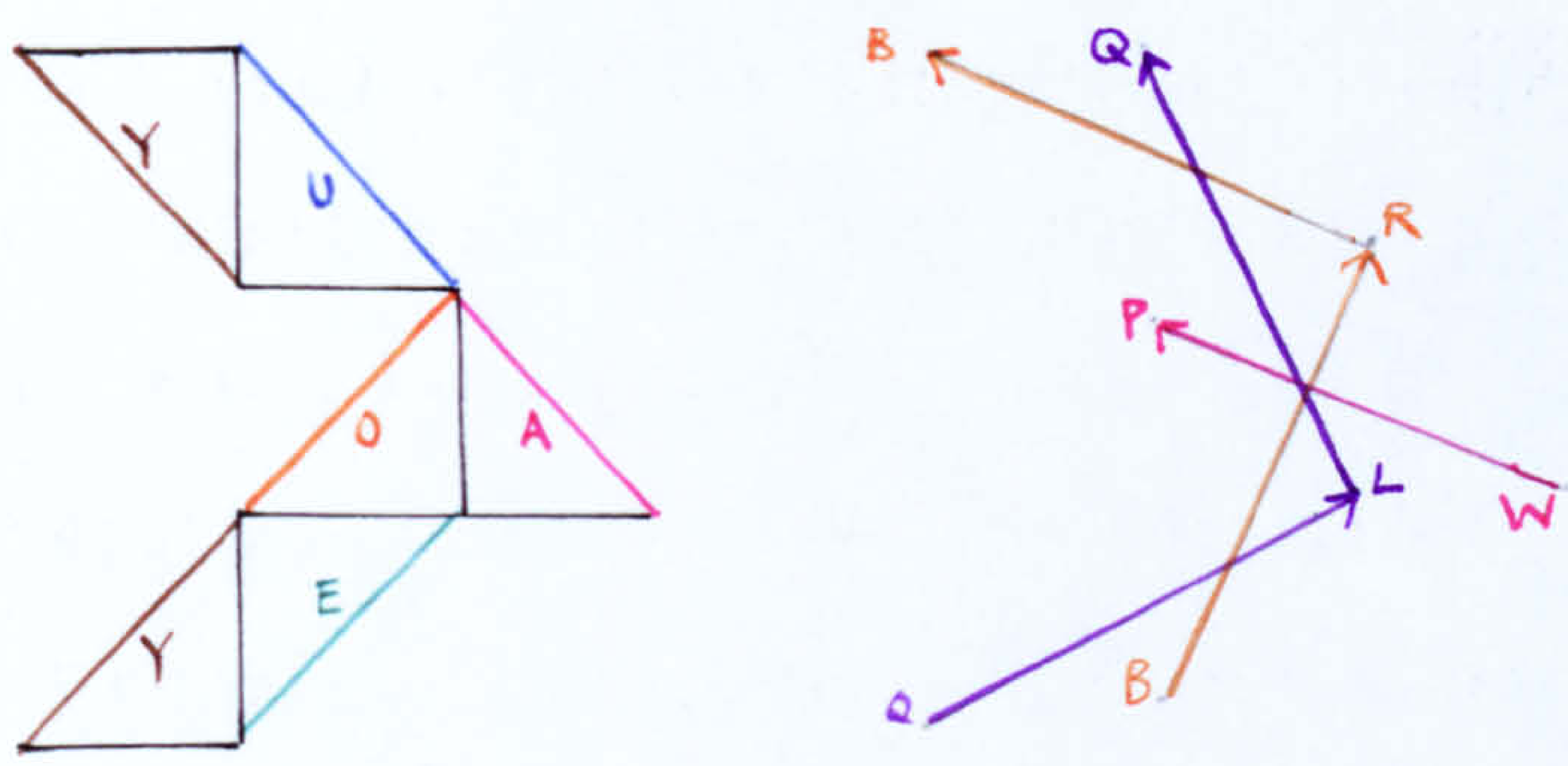


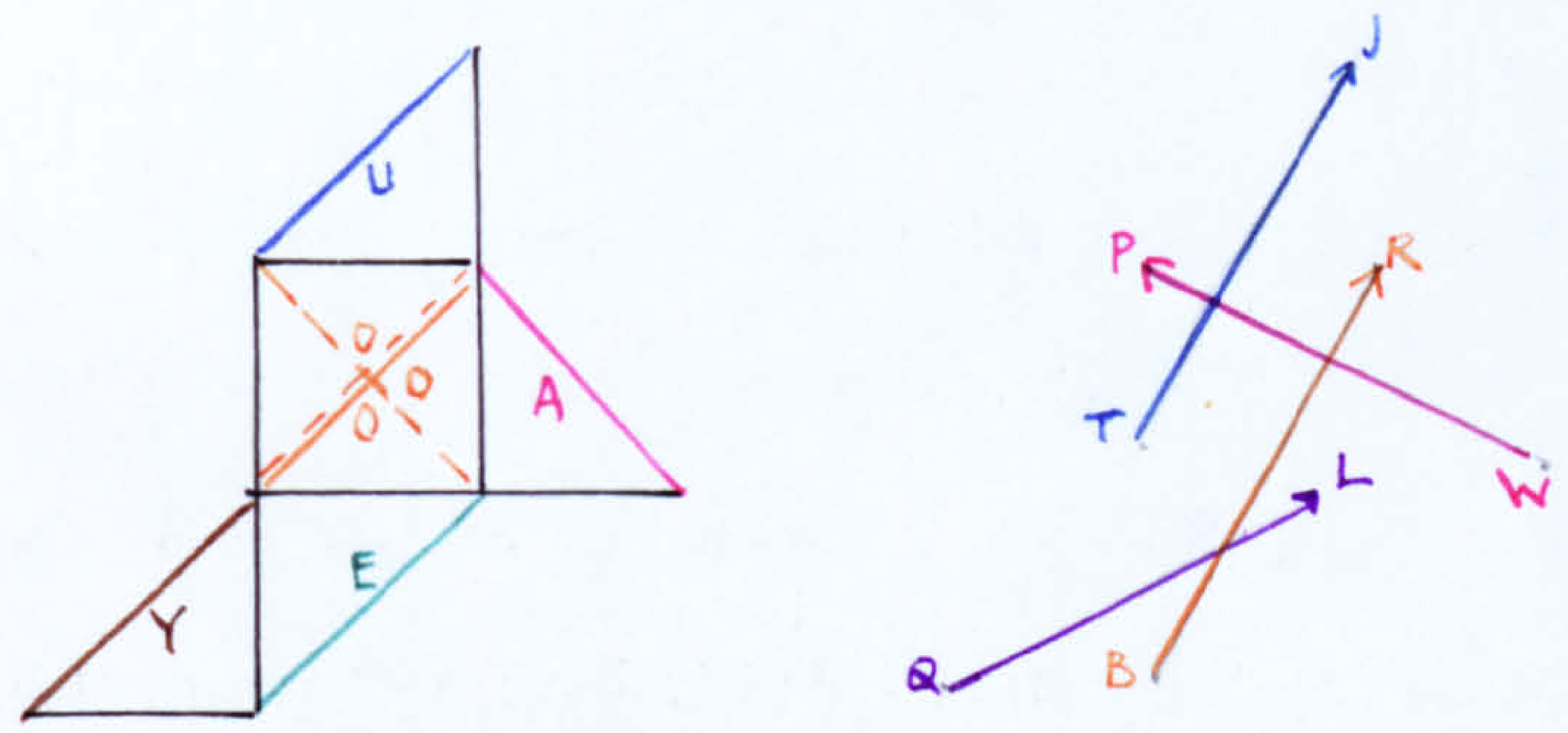
Figure. XII.2. Suggested organization of fieldwork (after an idea of J.P. Cole) (Fitzgerald, 1969. XII.3) may be used to describe and store information and processing need not be statistical but these are minor details not upsetting the general pattern of procedure envisaged.

(a) Implicit Concept Activated



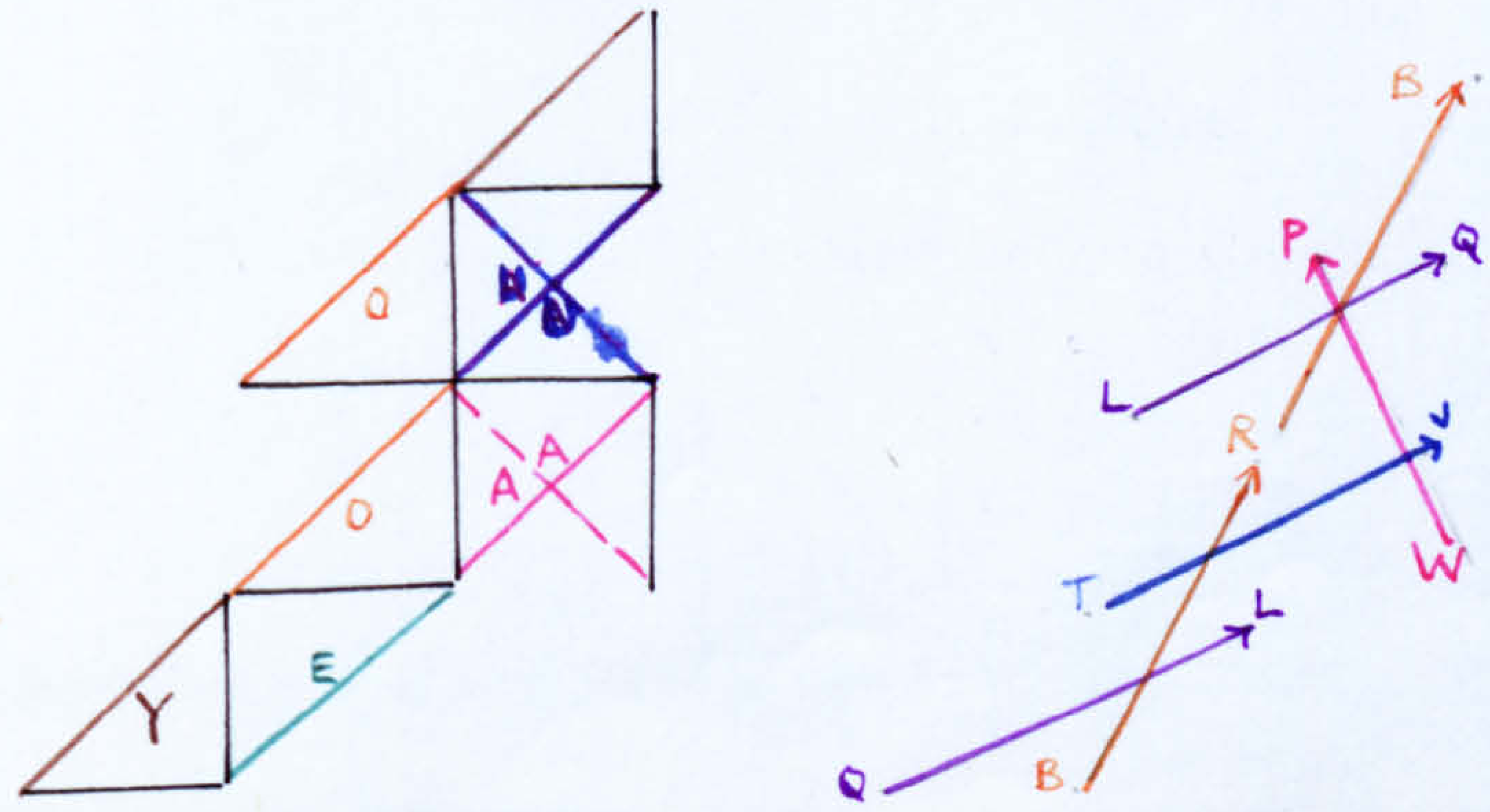
The implicit valley form concept is accepted, schema matching socialised concept, and mapping in embarked upon, using specific symbols. There is a quick launching into action, which is desirable, if the implicit concept is adequate in content quality.

(b) Concept is referred back to landscape



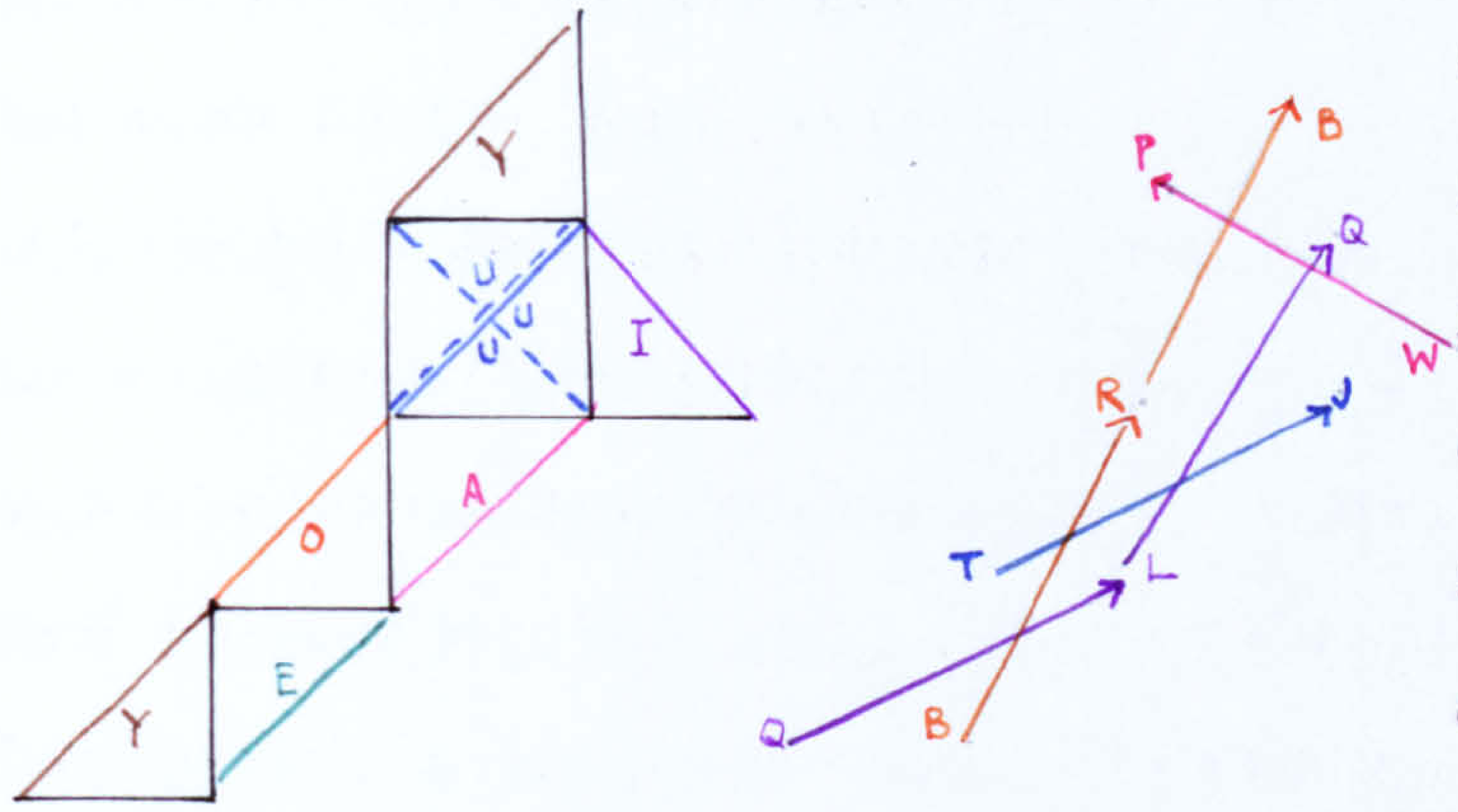
The implicit valley form is accepted; but the concept is considered in relation to the landscape, before action is embarked upon, so it may become more explicit. Possible development to Z will appear in other variations.

(c) Decision on procedure to map selected features to clarify concept



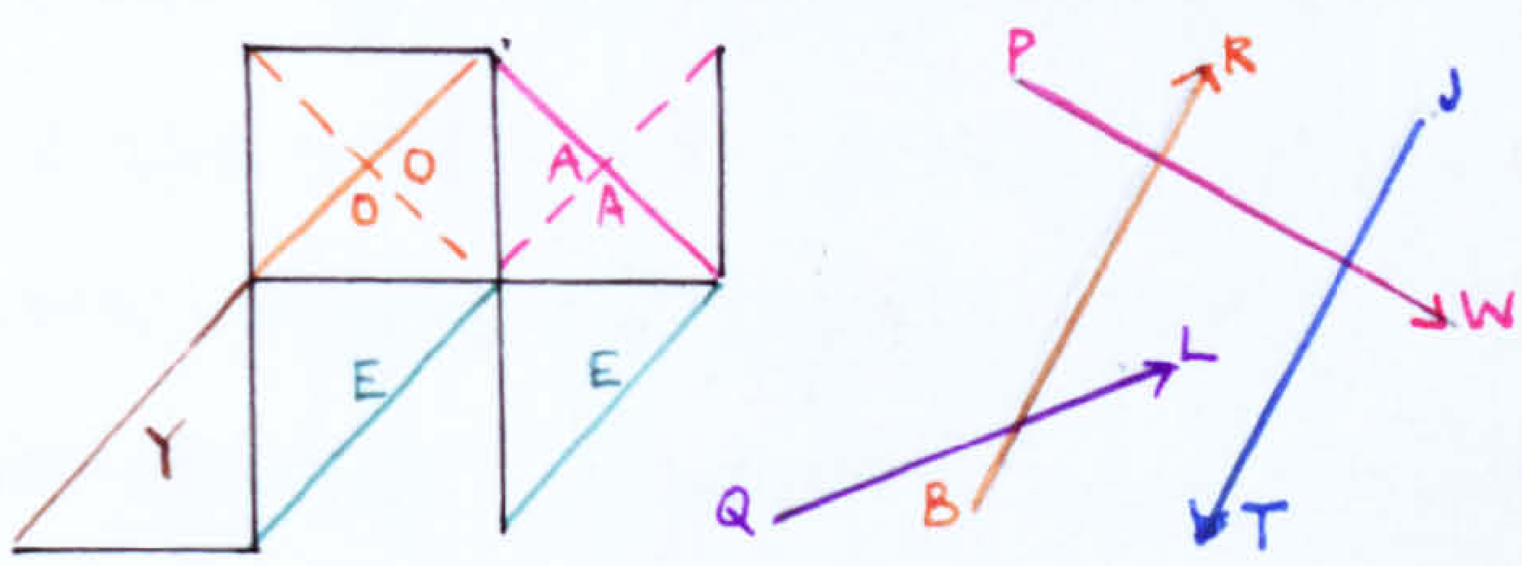
The area is identified as the one for study, accepted as a valley; the decision is taken to map it in symbols. Further judgment is reserved until meaning is clearer, emerging from the mapping procedure.

(d) Concentration on selection of mapping procedure



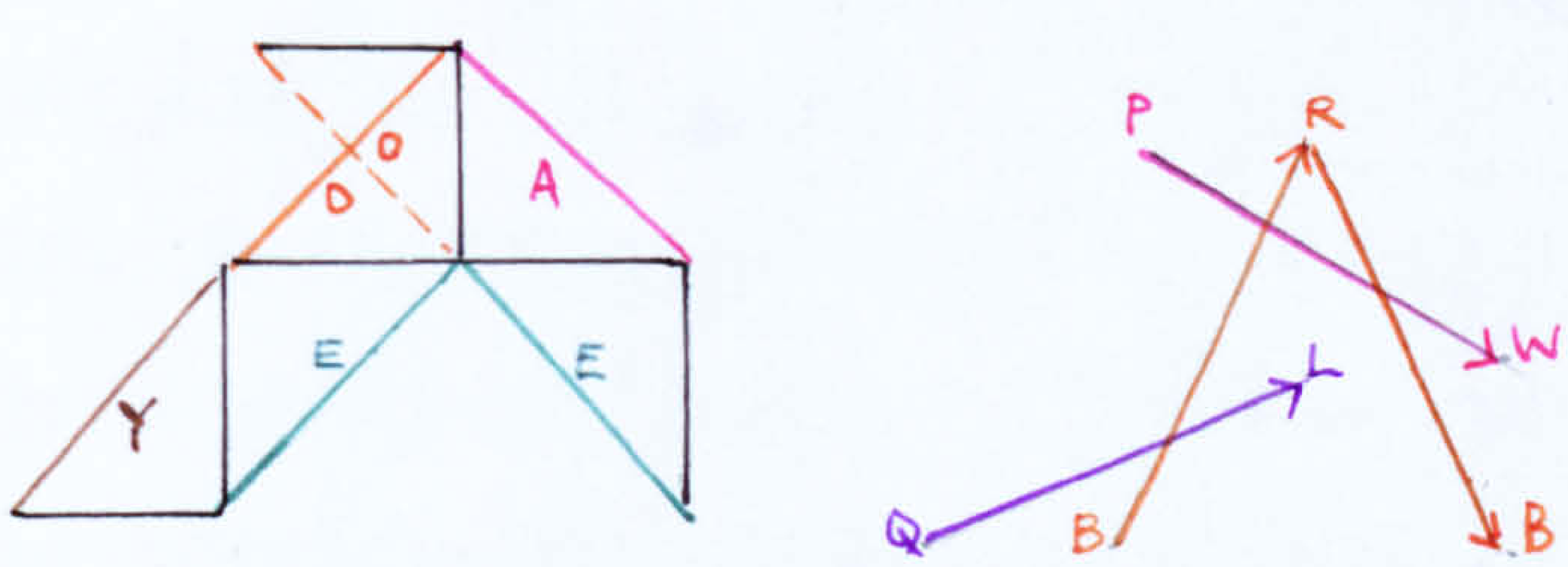
The area is identified as the one for study; it is recognised as requiring a 'tool' to carry information about it. Decision is made on a means of mapping it. Compared with (c) there is emphasis on the selection of the method of recording as against emphasis on what has to be selected from the landscape.

(e) Socialised Concept explicit



There is immediate recognition of valley form with the socialised concept explicitly in mind and ready for application (i.e. potential equilibrium, but action is still in doubt).

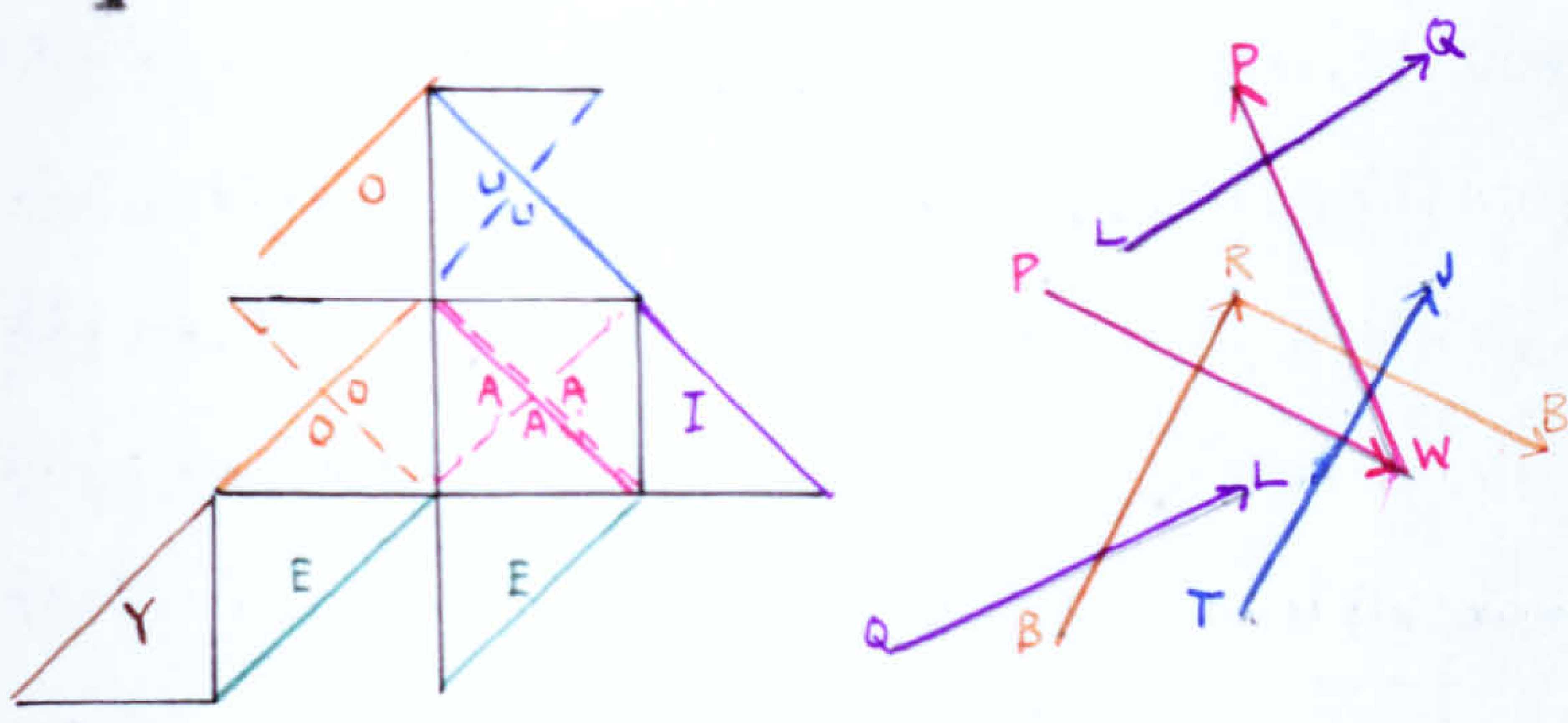
(f) Meditation on meaning of concept



There is immediate recognition of valley form with the switching on of specific verbal learning, labelling what is seen meaningfully. We are moving away from the decisive P towards W, so there is meditation rather than decisive action.

This may be correlated with the start of the "Collect and describe information" stage of Figure XII.2. but the sub-programmes may operate variously in this way, although by different Epistemic tracks they may reach the same destination. The most risky, i.e. with the greatest cognitive strain, is (a), because of the lack of self-analysis on the quality of the concept. We have here all the $\overset{\pm}{D}$ and $\overset{\pm}{F}$ alternatives explored in earlier chapters. It should be made clear perhaps, that in working out these theoretical sequences the Orthotron Thesaurus was used and only afterwards was comparison made with empirical sequences.

(d) and (e) offer particular contrasts in strategy. The careful teacher, wishing to make sure that a task was carried out step by step, would be likely to programme for (d), proceeding obliquely with the minimum essential basic concept to initiate the operation assumed implicitly, and proceeding with minimum cognitive strain initially, but with a build-up of potential equilibrium as the task proceeds. The same teacher, setting about fieldwork at his own level of sophistication, training, tempo and temperament, might adopt any of these strategies. A further illustration of (e) as a contrast to (d) because it can be extended from recent personal experience in particular circumstances. The task in this case was to identify and describe characteristic landforms of the "New Moraine Landscape" of Central Denmark in a particular district. The socialised concept had been studied in advance, and there was "immediate recognition", but doubt about action. To continue the sequence, one must take into account the causes of the doubt. These were (1) the very short time available and (2) difficulties of carrying out practical techniques of geomorphological study in a landscape mainly covered by barley fields ready for harvesting. This resulted in a turn (e_1) to an emphasis on Cultural Reality - $\bar{X}$/RB(W) in interpretation of the landscape, e.g. using the symbolised (K) form "dead ice topography" to carry the socialised concept.



Then there was Recognition - Z/WP(J) - in decisive terms and a Yield (to P) of preparing to map this as a specific form (e_1). The limits of two-dimensional representation are being reached at the end of the flow-chart.

Comparative sequences with PW emerging from a "triple" can be seen in No. 50's sequences (p. 259-270). There is a high degree of risk in terms of the quality of the individual schema, but it is considered with conscious matching between socialised concept and landscape (the landscape was not one which was already familiar). It is important to note that the taking of the risk in interpretation was related to the short time available for the task in hand. Time is something which teachers are frequently short of, and the taking of risks in conceptual strategy in teaching procedure is therefore common. Even in "concept orientated " teaching, while risks may not be taken with specific concepts at the core of the programme, there is going to be a fringe of concepts operating peripherally in the situation which are implicit. For any particular student there is the risk that at some point in a thought sequence it may be side-tracked into a sub-programme to grapple with some inadequate peripheral concept.

It may be, then, that in any teaching/learning situation we need to have in mind a double structure in which two dynamic Mathetic sequences might be operating, those of the teacher and the student. The situation in a specific episode might be represented by the "Hypercube"* (Figure XII.3. p. 299). This might be drawn in two different ways. In (a) the Opposition Axes of the inner and outer cubes corresponds. We can consider P_o the student and P_1 the teacher, and so on. But it may be more appropriate to <u>reverse</u> the directions of the axes for the outer cube as in (b). P_1 then corresponds with W_o (the teacher's decision is conveyed to the student as socialised information). Q_1 corresponds to L_o - the teacher's methods of conveying information connect with the student's schemata. B_1 corresponds to R_o - verbal teacher-directives are matched to the student's reception of them. T_1 corresponds to J_o - the purpose of the teacher presents a particular referent to the student. If we want to emphasize the interchange of information (b) will serve us best. If we want to compare the Epistemic Constants on which each is operating within their own system, then (a) will be more useful.

Behind the teacher lies the textbook and behind the textbook the compiler, the statistician, the research worker. We might extend our nesting Cubes outwards in space/time, if we wish to speculate, but for more practical purposes if we take any two persons communicating in a geographical context

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* The Hypercube is borrowed from Meredith, 1969. VIII.7 , but simply for display of relations without the logical implications applied in that context.

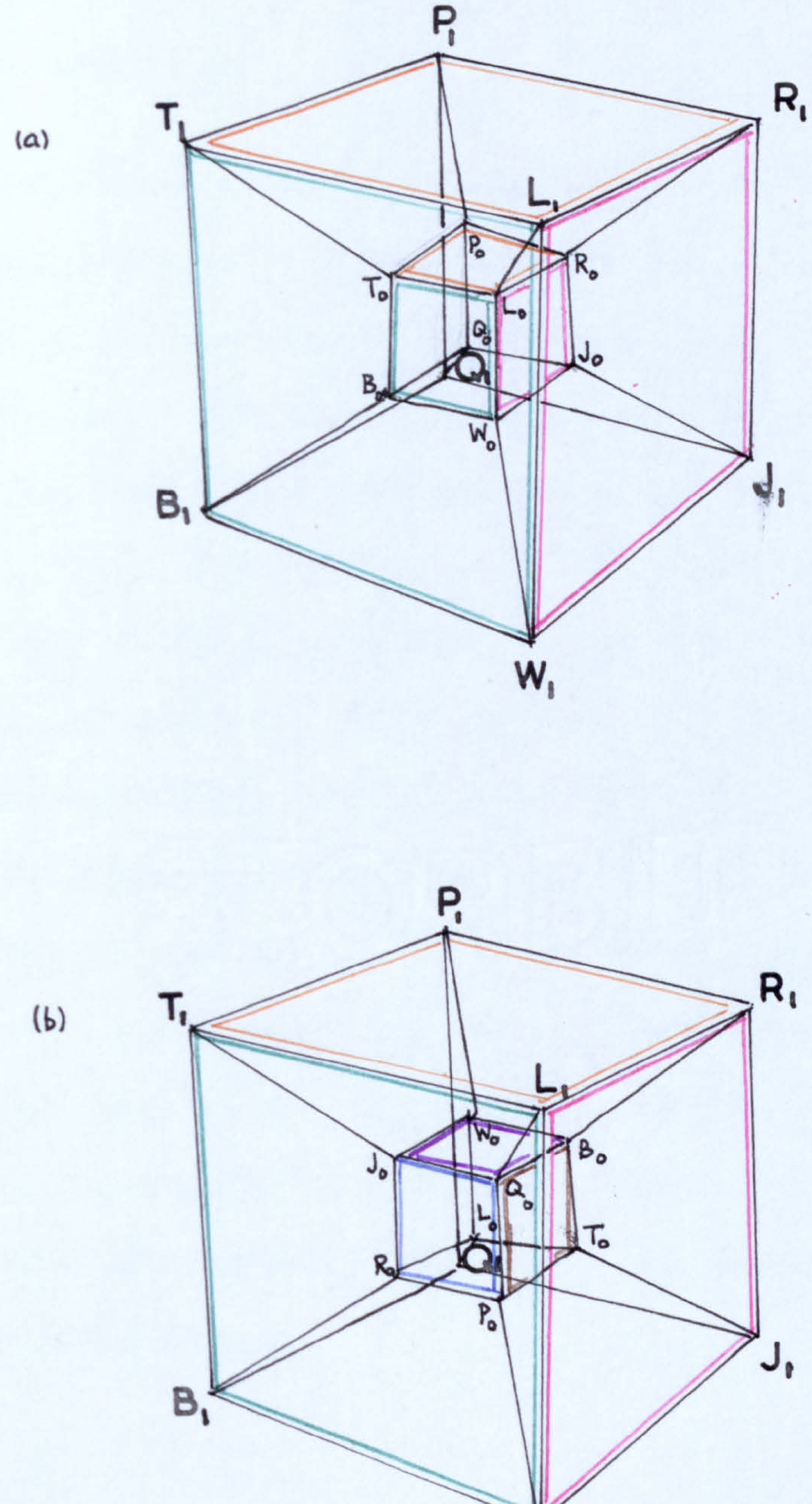

Figure XII.3. The Hypercube.

we have two systems each with their own "relative degree of extension of the cognitive field included in a given equilibrium and level of development of the cognitive structures which are available"
(Piaget, XI.1).

The Orthochoric display may help with comparison through maintaining syntactic relations between the Epistemic elements of "knowing", associating "knowledge" and the "knower" systematically. Mathetic analysis maintains these relations imposing an order on decisions upon episodes of thought; the mode of decision itself could be checked by the same system. The multi-dimensional concept allows for the extraction of sets of evidences of particular kinds which can be fed back into the general framework. Some of these sets of evidence particularly concern the matching of ideas with landscape and the forms in which evidence about the landscape is being received and communicated. It is hoped that always having had to return to the medium of word-by-word prose to interpret and communicate the information held in the multi-dimensional analysis, the results of the analysis have been made clear.

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Geog. Geography. (Geographical Association)

G.J. Geographical Journal. (Royal Geographical Society)

J. of G. Journal of Geography.

Tr. I.B.G. Transactions of the Institute of British Geographers.

Int.J. Ed. Sci. Educational Sciences: An International Journal.

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APPENDIX A

Glossary of Epistemic and Orthochoric terms used

EPISTEMICS	The empirical study of knowledge structures and processes.
MATHETICS	The empirical study of learning operations.
ORTHOCHORICS	"Behavioural Geometry": a method for the precise recording of the structure of learning behaviour.
SEMALOGISTICS	The brain using signs and symbols to relate to objects.
SYNTACTIC CONSTANTS	The eight corners of the Epistemic or Cultural Cube representing modes of attention in cognitive behaviour.
ORTHOTRON	A tetrahedron whose faces are all right-angled triangles. In this study it is used to relate together three of the eight Syntactic Constants.
DOCUMENTARY SPACE	The reporting on the two dimensions of paper of events which take place in physical space and time. The reduction of the number of dimensions involved is a constraint on the communication of information.
OPPOSITIONAL AXES	Lines connecting opposite corners of the Cube. representing relations which provide four categories of cognitive behaviour.
ORTHOGONAL AXES	Lines connecting opposite faces of the Cube and representing three different types of timing in learning behaviour, relating six cognitive functions in pairs.

TETRALECTIC A fourfold square presenting the complexity of relations in cognitive behaviour, e.g. the four Syntactic Constants which appear at the corners of a single surface of the Cube.

SEMANTIC MATRIX An ordered structure of meaningful signs in a spatial framework, e.g. the Epistemic Cube.

PROCESS VECTORS The twelve edges of the Cube, representing, with two-way movement, twentyfour possible categories for judging part of a cognitive behavioural sequence. Their significances form a "Thesaurus".

VERBAL INDICATORS Expressions used to convey the significance of the categories expressed in the various components of the Cube.

NEIGHBOURHOOD The surfaces adjoining and the three Process Vectors meeting at a corner of the Cube and defining the semantic relations of the Syntactic Constant.

ORTHOTRON JUNCTION The manner in which two successive Orthotron are linked in representation of episodes in a thought sequence. In two-dimensional display they may appear Oblique, Orthogonal or Triple (in which an Oblique and an Orthogonal Junction combine and three Oppositional Axes co-incide).

HYPERCUBE Two Cubes, one nesting inside the other, represent the interaction involved in the communication of information (in this context between teacher and student).

APPENDIX B

Individual Scores for Concept Quality

For details of the five aspects scored at three levels see Fig. VII. 5.

Note (-) signifies no evidence from response
(0) signifies poor response below Level 1.

Mature Students	Valley	Settlement Pattern	Location
61	2 2 2 3 2...11	3 3 2 3 3...15	3 3 3 3 3 ...14....39
60	3 2 2 3 2...12	1 3 1 3 2...10	3 3 3 3 2 ...14....36
59	2 1 1 2 1... 8	1 1 2 3 3...10	1 2 2 3 3 ...11....29
58	3 3 3 2 2...13	3 3 3 3 2...14	3 3 3 3 3 ...15....42
57	2 2 1 2 2... 9	3 2 2 3 3...13	2 2 2 3 2 ...11....33
56	2 1 1 3 2... 9	3 3 2 3 2...13	3 3 3 3 3....15....37
55	3 3 3 2 3...14	3 2 3 3 3...14	3 3 3 3 3 ...15....43
Normal Students			
54	1 2 2 1 2... 8	2 2 2 3 2...11	2 2 2 3 2 ...11....30
53	3 2 2 3 2...12	2 3 2 3 3...13	3 3 3 3 3 ...15....40
52	1 2 1 1 1... 6	1 2 1 2 1... 7	2 1 2 2 1 ... 8....21
51	2 2 2 2 2...10	1 3 1 2 2... 9	1 2 2 1 2 ... 8....27
50	3 3 3 3 3...15	3 2 3 3 3...14	3 3 3 3 3 ...15....44
49	2 2 2 2 2...10	1 1 2 2 2... 8	1 2 2 2 2.... 9....27
48	2 2 2 2 2...10	2 2 1 2 2... 9	3 2 2 2 2 ...11....30
47	2 2 2 3 2...11	2 3 2 3 2...12	1 2 3 3 2 ...11....34
46	2 2 2 2 2...10	1 1 1 2 1... 6	2 2 2 2 2 ...10....26
VIth Form			
45	3 2 2 3 2...12	3 3 3 3 3...15	3 2 2 2 2 ...11....38
44	3 3 3 3 3...15	3 3 2 3 2...13	3 3 3 3 2 ...14....42

VIth Form Cont.	Valley	Settlement Pattern	Location
43	3 3 2 2 2...12	2 3 2 2 2...11	3 3 3 3 3...15....38
42	2 3 3 1 2...11	1 1 2 2 2... 8	1 1 2 2 2... 8....27
41	1 2 1 2 2... 8	1 2 2 2 2... 9	2 1 2 1 1... 7....24
15 +			
40	1 2 1 2 2... 8	3 2 2 3 2...12	3 2 2 2 2...11....31
39	1 3 3 1 2...10	3 2 2 3 2...12	3 2 2 2 2...11....33
38	1 2 1 2 1... 7	1 2 2 2 2...9	2 2 2 2 2...10....26
37	1 2 - 2 1... 6	1 3 2 2 2...10	3 2 2 2 2...11....27
14 +			
36	- 1 - 1 1...3	1 2 1 2 1...7	3 1 2 0 1... 7....17
35	- 1 - 111... 3	2 3 1 2 2...10	1 2 2 2 2... 9....22
34	2 2 1 3 1... 9	1 3 1 2 2... 9	3 2 2 2 2...11....29
33	1 1 1 1 1... 5	1 2 1 2 2... 8	1 1 1 1 1... 5....18
13+			
32	1 1 1 2 1... 6	1 3 1 2 2... 9	1 1 2 2 2... 8....23
31	1 1 1 2 1... 6	1 3 0 2 1... 7	1 1 2 1 1... 6....19
30	1 - - 1 1... 3	3 2 2 2 2...11	1 1 1 1 2... 6....20
29	1 1 1 3 1... 6	2 2 1 2 2... 9	1 2 2 2 2... 9....24
12 +			
28+	1 1 - 1 1... 4	1 3 1 3 1... 9	2 1 2 2 2... 9....22
27	1 1 - 1 1... 4	1 3 1 2 1... 8	1 2 2 1 1... 7....19
26	- - - - -... 0	1 2 1 2 1... 7	1 0 0 1 0... 2.... 9
25	1 1 - 2 2... 6	1 3 1 3 1... 9	2 2 2 2 2...10....25
24	1 1 - 2 1... 5	2 2 0 2 2... 8	2 2 2 2 1... 9....22
23	1 1 - 2 1... 5	2 2 1 2 1... 8	1 2 2 2 1... 8....21

	Valley	Settlement Pattern	Location
11 +			
22	- 1 1 1 1... 4	2 2 2 1 1... 8	0 1 1 1 1... 4....16
21	- 1 1 1 1... 4	0 2 1 2 1... 6	1 1 1 2 1... 6....16
20	- 1 - 1 1... 3	0 3 1 1 1... 6	1 1 1 1 1... 5....14
19	- 1 - - 1... 2	0 2 0 1 0... 3	0 1 1 1 0... 3.... 8
18	1 1 - 1 1... 4	0 2 1 1 1... 5	1 2 1 1 1... 6....15
17	- - - - -... 0	0 1 0 0 0... 1	0 0 0 1 0... 1.... 2
10 +			
16	- - - - -... 0	0 1 1 1 0... 3	- 1 1 1 1... 4.... 7
15	- - - - -... 0	0 2 1 1 0... 4	0 2 1 1 1... 5.... 9
14	- 1 - - -... 1	0 2 1 2 1... 6	1 2 1 2 1... 7....14
13	- - - - -... 0	0 2 0 2 0... 4	1 2 1 1 0... 5.... 9
9 +			
12	- - - - -... 0	0 1 1 1 0... 3	0 1 1 1 0... 3.... 6
11	- 1 - 1 1... 3	1 2 1 2 0... 6	0 1 0 1 0... 2....11
10	- 1 - 1 1... 3	0 2 1 1 1... 5	1 2 1 2 1... 7....15
9	- - - - -... 0	0 2 0 1 0... 3	1 1 1 0 0... 3.... 6
8 +			
8	- - - - -... 0	0 2 1 1 0... 4	1 1 1 1 0... 4.... 8
7	- - - - -... 0	0 2 0 1 0... 3	1 1 1 1 0... 4.... 7
6	- - - - -... 0	0 2 0 1 0... 3	1 0 1 0 0... 2.... 5
5	- - - - 1... 1	0 2 1 1 1... 5	1 2 1 2 1... 7....13
7 +			
4	- - - - -... 0	0 1 1 1 1... 4	1 2 1 1 1... 6....10
3	- - - - -... 0	0 1 0 1 1... 3	1 2 1 2 1... 7....10
2	- - - - -... 0	0 2 1 1 0... 4	1 0 1 0 0... 2.... 6
1	- - - - -... 0	0 1 0 1 0... 2	1 1 1 1 0... 4.... 6

APPENDIX C

Examples of Coded Sequences

One example is given from each age group, chosen as the median Equilibrium score from that group (see Appendix D).

Black: recurrent classified sequences

Red: individual sequences not recurring.

COLLEGE OF EDUCATION

Mature Students

No. 56. 31 years. male

28 123 28 1705 106/0051 419 419/00252 1739 437 108 29/862 1739 6958.

Normal Students

No. 54. 19 years 6 months. Male

114 1971 1739 1739 108 419/00922 27599/11 27598/003 419 108 108 6958

GRAMMAR SCHOOL

VIth Form

No. 42. 17 years 5 months. Male

28 114 492 28 108 28 27599/3 431 107 107 6899 27599 108 434/10 26 26.

15 +

No. 38. 15 years 6 months. Male

28 28 123 104 27 434 108 107 27599/3 1739 108 106 7 104 108 28 26 26.

14 +

No. 35. 14 years 11 months. Female

28 7 492 26 28 27 108 108 108 108 434 108 108 27/07 107 108 107 1.

13 +

No. 32. 14 years. Male

114 123 26 26 1724 26 1737 1739 107 26 419

JUNIOR HIGH SCHOOL

12 +

No. 28. 13 years. Female

28 6 123 26 26 108 27 108 108 27 108 1739 108 1 107 108 106
28 106 108.

11 +

No. 20. 11 years. 7 months. Female

28 1 30 6 27 108 108 108 1 108 1737 108 1 27 108 6 108 28 7
28 1 1 1 1 27

JUNIOR SCHOOL

10 +

No. 14. 10 years 5 months. Male

108 108 1 108 1 27 27 27 108 108 26 108 108 434 108 434 6 108
108 434

9 +

No. 11. 9 years 11 months. Male

28 1 30 28 1 7 108 27 6 108 108 108 108 6 108 108 27 108 27
108 27 27

8 +

No. 8. 8 years 4 months. Male

27 108 30 27 108 108 1 108 108 108 108 6 27 108 6 6 1 108 27 26

7 +

No. 2. 7 years 5 months. Male.

7 7 30 7 1 27 108 108 108 6 7 1 1 108 107 108 27

APPENDIX D

Quality of Concept and Equilibrium scores and ranking

Score (Rank)

	Quality	Equil'm		Quality	Equil'm		Quality	Equil'm
Mature Students								
61	39 (6)	22 (28)	15+			11+		
60	36 (10)	20 (29)	40	31 (14)	38 (8)	22	16 (39)	27 (19)
59	29 (17)	30 (16)	39	33 (12)	31 (13)	21	16 (39)	28 (18)
58	42 (3)	47 (4)	38	26 (23)	31 (13)	20	14 (43)	13 (40)
57	33 (12)	35 (9)	37	27 (19)	30 (16)	19	8 (52)	7 (44)
56	37 (9)	35 (9)	14+			18	15 (41)	24 (37)
55	43 (2)	45 (5)	36	17 (38)	18 (33)	17	2 (61)	2 (55)
Normal Students			35	22 (29)	17 (34)	10+		
54	30 (15)	26 (21)	34	29 (17)	16 (35)	16	7 (54)	4 (49)
53	40 (5)	44 (6)	33	18 (37)	14 (39)	15	9 (49)	0 (58)
52	21 (32)	20 (29)	13+			14	14 (43)	4 (49)
51	27 (19)	25 (22)	32	23 (27)	25 (23)	13	9 (49)	3 (53)
50	44 (1)	80 (1)	31	19 (35)	25 (23)	9+		
49	27 (19)	35 (9)	30	20 (34)	16 (35)	12	6 (56)	0 (58)
48	30 (17)	31 (13)	29	24 (26)	27 (19)	11	11 (46)	7 (44)
47	34 (11)	26 (21)	12+			10	15 (41)	9 (42)
46	26 (23)	13 (40)	28	22 (29)	16 (35)	9	6 (56)	0 (58)
VIth Form			27	19 (35)	20 (29)	8+ 8	8 (51)	4 (49)
45	38 (7)	42 (7)	26	9 (49)	3 (53)	7	7 (54)	1 (57)
44	42 (3)	49 (3)	25	25 (25)	19 (32)	6	5 (60)	0 (58)
43	38 (7)	32 (12)	24	22 (29)	7 (44)	5	13 (45)	8 (43)
42	27 (19)	50 (2)	23	21 (32)	16 (35)	7+		
41	24 (26)	25 (23)				4	10 (47)	7 (44)
						3	10 (47)	2 (55)
						2	6 (56)	4 (49)
						1	6 (56)	6 (48)

THESIS ABSTRACT

RUTH HANNAM (DEPARTMENT OF EDUCATION)

THE ANALYSIS OF SOME GEOGRAPHICAL CONCEPTS AND THEIR DEVELOPMENT IN THE LEARNING PROCESSES OF THE INDIVIDUAL MIND

This study sets out to make use of the Epistemic theory of Professor P. Meredith to clarify and analyse geographical concepts as they appear in the common body of knowledge in the subject discipline and as they appear in various forms in the thinking of individuals. In reviewing previous research into geographical learning it becomes evident that until very recently concepts have been treated implicitly rather than explicitly, but a great deal that is relevant to conceptual learning is to be found in studies relating to the communication of geographical information and in those concerned with some special interest or ability, or based on the developmental theory of Piaget.

"Epistemics" is identified as combining epistemology ahd psychology in its concern with the activity of "knowing". Definitions of concept are discussed, and the term Schema defined as here distinguishing an individual's working version of the "socialised" concept. The Epistemic Cube forms a semantic matrix linking aspects of episodes of thought, i.e., Object,Thought, Symbol, Response, Knowledge, Purpose, Learning and Equipment. Lines and surfaces in and on the Cube can be used to explore significant relations within this Orthochoric framework. The Cube is used to analyse the major geographical concept of areal extent and the building up of the subject discipline by geographical thinkers of the past and present.

Three linked concepts are selected for investigation: Valley, Pattern of Settlement and Location. Individuals' ideas were explored by a standard interview: subjects ranged from the age of seven to seventeen years in school and included normal aged students and a group of mature students in their thirties.

Two analyses were carried out, one based on internal geographical criteria, the other on external Epistemic criteria. The latter was "dynamic", preserving the progress of the train of thought, twentyfour Orthochoric categories being used in making a series of controlled judgments on a recorded thought sequence, each episode being systematically linked to the next. Orthotrons (tetrahedra representing parts of the Cube) when presented two-dimensionally show patterns of overlapping triangles forming flow-charts which could be classified. These were converted to simple line-type diagrams. These distinguish within the flow-charts four sets of aspects of conceptual thought which are interwoven.

It seemed reasonable to hypothesize that the characteristic patterns might have significance in terms of Piaget's concept of equilibrium and of Bruner's concept of differing strategies of thinking relative to cognitive strain. The evidence of conceptual development throughout the age range is reviewed in the light of these hypotheses. Finally the possibility of using the method of analysis to evaluate proposed plans for teaching/learning situations is examined, illustrating some variations of individual attacks on a particular problem in a planned framework.