BIRTH ORDER, ART AND SCIENCE: A STUDY OF WAYS OF THINKING

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To reach it, a ladder has to be set up. There is no stair.
What can we be looking for in the attic
but the accumulation of disorder?
Borges

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SUMMARY

Chapter 1 is a consideration of: (a) the neglect by researchers of the cognitive abilities of laterborn (b) complementarities of thought. The possibility that the thinking of firstborn and laterborn might reflect some such complementarity links these two lines of interest.

Chapter 2 is a consideration of the abilities of laterborn. The hypothesis that laterborn are more interested in perceptual and spatial phenomena is examined from two points of view. (a) By studying self-rated ability at video-games with the hypothesis that laterborn would rate themselves more highly than would firstborn. The hypothesis was supported. This study, though of interest in itself, did not lead on to the rest of the thesis. It is therefore included as Appendix I. (b) By studying the birth order of eminent architects. It was hypothesized that "great" architects would be more often laterborn than would be architects simply eminent enough to be listed in a biographical dictionary. This hypothesis was supported, lending credence to the idea that laterborn are more interested in spatial phenomena. But a similar effect is observed among literary figures. It is therefore suggested that "creativity" or an avoidance of the received wisdom of the field in question, leads to this effect. In Chapter 3, the idea that laterborn avoid received wisdom is developed further. It is hypothesized that laterborn are more represented in non-dominant cultural areas such as art, while firstborn are more represented in dominant cultural areas such as science. An analysis of the Dictionary of National Biography 1961-1970 supports this hypothesis.

This result is of limited interest if one cannot say how art is related to science, and hence what ways of thinking are being taken up by laterborn and firstborn. In Chapter 4 the need for a model of the relationships between art and science is discussed. In Chapter 5 such a model is constructed. This comprehensive model is a three dimensional surface (a cube or a sphere) which relates ways of thinking typified by social science, biology, physical science, mathematics, design, plastic arts, music, games, literature, history, myth and depiction. The surface is defined by three complementarities of thought: analysis/ambiguity, development/space, and form/resemblance.

In Chapter 6 the coherence of the model is demonstrated by further discussion and demonstrating the effects of distortion. In Chapter 7 the model is applied to the data from the Dictionary of National Biography used in Chapter 3, and a family size difference with respect to the development/space polarity is found. In Chapter 8 implications of this model for biographical, cultural and educational research are discussed.

Chapter 9 concludes the thesis with a brief recapitulation of the main points (a) empirical (b) theoretical (c) with reference to application. An epilogue, indicating some recent directions of thought, is included.

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Declaration

This thesis has been composed by myself and the work is my own.

Murdo J S Macdonald

CHAPTER 1

BIRTH ORDER AND COMPLEMENTARITES OF THOUGHT

1.1. INTRODUCTION

This work explores two approaches to the study of thinking. The first of these, reflected in the study of birth order and thinking, draws attention to differences in thinking. The second, exemplified by the development of a model of ways of thinking, draws attention to links between different ways of thinking.

The essential structure of the thesis is this: (1a) An initial question: do firstborn and laterborn have different preferred ways of thinking? (1b) Evidence for this with respect to eminence in art and science. (2a) The need for a comprehensive model of the relations between arts and sciences is discussed. (2b) Such a model is constructed. (3) The implications of this model are investigated.

1.2. STARTING POINT

My interest in cognitive differences associated with birth order was roused by two observations:

1.2.1. Laterborn as Ground not Figure

The first was that in many studies laterborn seem to be considered as a convenient comparison group for firstborn and little more. Thus laterborn only posses abilities by default, that is to say because firstborn don't have these abilities. For example firstborn are considered more dependent (Schachter 1959), rather than laterborn being considered more independent.

This seems a trivial point, but it is trivial in the same sense as is the default use of the male gender in writing or speech. The firstborn, like the male, is the point of reference. In the case of birth order this is understandable, both from a first things first point of view, from a historical point of view (e.g. rights of royal and aristocratic succession), and also because the firstborn is the most clear-cut birth order category. But it is a potential source of bias since it leads the investigator to frame questions in terms of the firstborn, i.e. "what might a firstborn do better or differently?" For this reason alone, he or she may emphasize firstborn characteristics at the expense of those of the laterborn.

This is a subtle bias: it doesn't mean that information is not forthcoming about laterborn, but investigators tend to revert to the firstborn as a reference point in each new study. The initial (implicit) question is "Does the firstborn do such and such better or differently?": this is then answered by the study; it is then concluded that firstborn do such and such laterborn do such and such. In the light of this a new study is carried out, but the initial question is still (in the light of this new evidence) "What does a firstborn do better or differently?"

We are thus faced with a list of findings most commonly expressed in terms of firstborn having more of quality "x". For example, firstborn are thought of as more: affiliative when anxious (Schachter 1959, Zucker et al 1968), fearful (Schachter 1959), intelligent (Terman 1925, Scottish Council for Research in Education 1949, Zajonc 1983), likely to attend college (Altus 1966, Schachter 1963), eminent (Galton 1874, etc: see chapter two), dependent (Rothbart 1971), responsible (Harris and Howerd 1968, Hansson et al 1978), and verbally able (Breland 1973).

In contrast laterborn are considered to have more of very little, and this only at the margins of the literature: perhaps ability in fighter combat, sub-aqua and dangerous sports (Schachter 1959, Nisbett 1968, Casher 1977) and some forms of creativity (Eisenman 1964). The former abilities, as would be expected in the light of the above discussion, are construed in terms of the firstborn being more socially evaluating or more fearful, the latter has little research on it.

Thus the general picture is that firstborn have more, laterborn have (by default, not consideration) less. The firstborn is thus considered the site of psychological happenings (good or bad). The laterborn is considered a kind of shadow or backdrop. The firstborn is the figure, the laterborn is the ground.

These assumptions imply a model in which first and laterborn are considered as qualitatively alike, differences between them being explicable in strictly quantitative terms. The idea that first and laterborn might approach their worlds in qualitatively different ways did not seem to be getting through; not because it had not been considered, (as it has been by for example Rosenberg and Sutton-Smith 1970) but simply because the firstborn was always the point of reference. A single point of reference does not enable one to make a qualitative distinction. This requires a minimum of two reference points. It was this latter sort of distinction in which I was interested. My belief that laterborn should be considered "actively different" rather than "passively less" than firstborn led me to consider the following point.

1.2.2. Firstborn and Laterborn Abilities Complementary?

This second point was that if laterborn are regarded as having positive abilities rather than simply the negative of firstborn abilities, these can be thought of as complementary activities to those of the firstborn. For example verbal and spatial ability. The greater ability of laterborn in fighter combat, deep-sea diving and dangerous sports, might suggest something like a spatial ability, complementary to the verbal ability of the firstborn, or an orientation to the physical rather than the social world. Similarly laterborn "creativity" might complement firstborn "responsibility". This interest in complementarities is central to my thinking, so its worth considering in more detail here.

1.3. COMPLEMENTARITIES OF THOUGHT

A dichotomizing approach is common in our thinking about thinking. A complementarity is a pair of ideas which go together, both of which are positive (ie one is not the negative of the other) e.g. verbal and spatial, art and science, linear processing and parallel processing. Thus a word and its negative, or an attribute and its lack (e.g. neuroticism/stability) do not constitute complementarities.

Since the 1960s attention has been focused on many of these in the context of research into differences in processing between the two hemispheres of the human brain. The overall dichotomy is between those methods of processing which take place in the so called "dominant", usually left, hemisphere, and those that take place in what Sperry (1983) has called "the neglected minor hemisphere", usually the right hemisphere. The neglect Sperry refers to is that of our educational system and modern society generally which, he claims, discriminates against this half of the brain.

Such research has been helpful in so far as it has provided a conceptual framework within which to try to relate complementarities of thought, however it has tended to reinforce the assumption that there is only one major dichotomy in human thought, and that this is reflected fairly simply in the physical division between the two hemispheres. This point of view, under the heading Bi-modality, has a seperate entry in the recently published Encylopaedic Dictionary of Psychology (1983), and this is some reflection of its current recognition as a way of approaching problems of differentiating cognition. This may be too narrow a perspective but is nevertheless a useful starting point.

To show how widely used these complementary ideas have been I reproduce a list adapted from Bogen (1969).

Each author's name is followed by a pair of concepts, the first regarded by that author as an attribute of the left hemisphere, the second as an attribute of the right hemisphere:

Jackson: expression/perception;

Jackson: audito-articular/retino-ocular;

Jackson: propositionizing/visual imagery;

Weisenberg&McBride: linguistic/kinesthetic;

Anderson: storage/executive;

Humphrey&Zangwill: symbolic-propostional/visual-imaginative;

McFie&Piercy: relations/correlates;

Milner: verbal/perceptual;

Semmes: discrete/diffuse;

Zangwill: symbolic/visuo-spatial;

Hecaen: linguistic/preverbal;

Bogen&Gazzaniga: verbal/visuospatial;

Levi-Agresti&Sperry: logical-analytic/synthetic;

Bogen: propositional/appositional

Bogen introduces a further list, which does not specifically refer to cerebral lateralization, under the appropriate heading of "A potpourri of dichotomies". It's contributors include Freud, James, Bruner, Hobbes, Spearman, Luria and Levi-Strauss. The dichotomies noted include: atomistic/holistic, abstract/concrete, numerical/geometrical, symbolic/perceptual, discursive/eidetic, digital/analogic, differential/existential, relations/correlates, directed/free, postive/mythic, and abstract/maplike.

To these one might add: self assertive/self transcendent (Koestler 1978), convergent/divergent (Guilford 1959), mechanistic/holistic (Smuts 1926), rational/empirical (many sources), metonomous/metaphorical (Jacobson and Halle 1956), agency/communion (Bakan 1966), action/appearence (Berger 1972) and romantic/classical (many sources).

These lists have a semblance of order, but are far from organized in any satisfactory theoretical way. However there does seem to be something like a common difference between the terms on the left hand side and the terms on the right hand side. But it is also clear that all the terms on the right are not synonymous, and that the same is true for the left.

We thus have: (1) two sets of terms which seem to differ in the same sort of way. (2) no clear idea of how synonymous or otherwise the terms within these sets are. One can add two speculations: (3) that any forced synonymity would simply lead to a conflation of ideas. (4) that there may be more than one dimension of difference between the two lists.

My thinking about birth order differences was strongly influenced by these ideas of complementarity. It seemed worth exploring the possibility that the sort of cognitive differences reflected in these lists might also be reflected in birth order differences. If so one would have the beginnings of an answer the question "do laterborn think in a qualitatively different way from firstborn?" and be able to suggest what sort of thinking this is.

At the beginning of my research point (1) was most salient in my thinking. In retrospect this seems much more a point of departure rather than a properly thought out position, but despite its one dimensionality it gave me access to the problem. As my research progressed (2), (3), and (4) became more obvious, culminating in the development of a model of ways of thinking. I don't mean to imply that this model was based on a consideration of this sort of list, however my approach to concepts was as complementary pairs, and thus has something in common with the approach of the authors of the above dichotomies.

The first section of this thesis (Chapters 2 and 3) contains studies of the relationship between birth order and ability in architecture and literature and eminence in art and science. These studies are investigations of positive laterborn abilities. The issue of complementarities of thought becomes progressively more prominent.

The second section (Chapters 4, 5 and 6), which has the most general

implications, contains a consideration of the relationships between complementary ways of thinking such as art and science. This leads on directly from the finding in chapter three that there is a birth order difference in eminence in art and science. While I was satisfied that the birth order difference existed, I was far from satified that I understood what this difference meant, because there was no adequately differentiated model of the relationships between art and science. I therefore developed a model of these relationships.

The third and final section looks again at family structure in the light of the model of the relationships between art and science (Chapter 7) and discusses the implications of the model for educational, cultural and biographical analysis (Chapter 8).

My starting principles were an interest (a) in bias (neglect of consideration of laterborn per se) and (b) in complementary ways of thinking (Bogen's dichotomies). The thesis as a whole can be regarded as a commentary on bias and complementarity.

CHAPTER 2

BIRTH ORDER AND EMINENCE IN ARCHITECTURE AND LITERATURE

2.1. INTRODUCTION

2.1.1. A Perspective on Birth Order as a Biographical Datum

Birth order means something to many people on an individual level. The description "youngest" or "only" child seems an important piece of biographical information. People often believe that psychologists are interested in them on this individual level. A common assumption on meeting a psychologist is "you know what sort of person I am", or more reasonably "you're interested in what what sort of person I am", with the emphasis on the "I" rather than the "sort". Psychologists dismiss such views easily, explaining to them that modern mainstream academic psychology is a discipline which attempts to elucidate general laws of human behaviour, and consequently has little interest in the individual.

Many psychologists swallow this nomothetic position, this search for general laws, whole. And yet, clearly, this is not what psychology means to the ordinary person. That person expects the psychologist to be interested in what goes on within his or her life. That person expects the psychologist to be interested in biographical issues, that is to say to be interested from an idiographic, or single case, standpoint. Psychologists do not talk the psychology of common sense.

In itself this is neither here nor there, but clearly, if we can talk the psychology of common sense without doing violence to our subject, we should. Such an approach benefits both psychologists and others alike.

Need we then be so divorced from this standpoint? Some psychologists, for example Howe (1982), recognize the importance of such biographical information, especially with respect to making psychological sense of the achievements of outstanding individuals. Detailed biographical study is not the intention of the present work, however the variable initially under consideration, birth order, is peculiarly suited to bridging the gap between idiographic and nomothetic points of view. This is because birth order information, which can be examined from a nomothetic point of view, is salient in idiographic studies.

Later in this chapter and Chapter 3 I make use of data derived from dictionaries of biography. The fact that these idiographic studies en masse yield enough of this data for a nomothetic treatment to be possible indicates the importance with which birth order data is regarded by the writers of these short biographies. However this importance is not explicitly recognized, because when biographical material becomes highly standardized (eg Who's Who), while marriage, children, etc are mentioned, birth order is completely neglected.

2.1.1.1. Galton

Interest in the influence of birth order on life history has been shown by Sulloway (1972,1979) who comments on its role in the cognitive flexibility of laterborn scientists such as Darwin, and on what he calls Freud's 'hybrid' birth order (he was his mother's firstborn, but his father's thirdborn). Hudson (1975), discussing Sulloway's 1972 paper, suggests that it establishes "a valuable bridge". The bridge he is refering to is that between the idiographic and the nomothetic. Interest in the influence of birth order on the course of life has also come from Fancher (1984) who suggests, from an Adlerian perspective, that Galton felt inferiority due to his position

in his family as a youngest born.

The theme of this last paper is the relationship between Galton's theoretical perspective and his life circumstances. Fancher points out that Galton regarded himself as an academic disaster, due to his failure to live up to family expectations and get a first at Cambridge. He suggests that this biographical fact led him to espouse eugenics as a way of explaining this, in terms of his own genetic endowment. He had no obvious environmental excuse, coming as he did from a well to do and highly gifted family.

Intriguingly, although Fancher mentions Galton's position in his family, he does not mention that in "English men of science" Galton espouses not only a eugenic position but also points out for the first time the greater tendency to eminence among firstborn. If we follow Fancher's argument that Galton espoused eugenics in order to make sense of his own academic failure, by the same line of reasoning, but this time applied to Galton's environmental explanation for firstborn eminence (greater inheritance, attention in infancy and parental emphasis on responsibility, see below), we see that Galton, as a youngest born is again able to explain his own academic failure. Whether this explanation is right or not, it is certainly interesting, since by pursuing Fancher's line of thought, that biographical fact leads to theoretical interest, another part of Galton's theoretical interests, birth order, falls into place in the structure of his life and thought.

2.1.2. The Individual and the Type

I have used Fancher's interest in Galton to illustrate concern with birth order among biographical researchers, but in the course of this I have

referred to Galton's own interest in birth order differences. This work is the first important contribution to the literature. Galton's approach was nomothetic but this is somewhat misleading, since the origin of his interest in these generalizations is in the biographies of individual people. He applies numbers to people but people are not for him mere numbers. In a radically nomothetic approach this is what people necessarily become. One is reminded of a quotation from Scott Fitzgerald's short story 'The rich boy':

> Begin with an individual, and before you know it you find that you have created a type; begin with a type, and you find that you have created nothing.

This would be a good motto for a psychology properly balanced between idiographic and nomothetic approaches, that is to say a psychlogy rooted in study of the individual, but concerned with generalizing from this. Perhaps this can give us some clue about re-integrating an idiographic approach into contemporary psychology. One way to try to generalize about groups and yet not lose sight of the fact that they are individuals is to deal with groups of highly eminent people. One need not name them or discuss them individually but simply because they are drawn from a dictionary of biography or whatever leaves one with the recognition that these are not nameless cyphers, but real people who have lived real lives.

One can of course argue that such samples are by their very nature unrepresentative. This is true with reference to a national population, but in another sense they are highly representative, since at least they represent one group accurately, and at least they are more obviously identifiable as human beings. One can identify with someone in the Dictionary of National Biography (even if that person is not specified). One cannot identify with a number. An idiographic view enables such identification. A nomothetic view

does not. However this latter view allows one to group people in a coherent way. Ideally in psychology what one wants to be able to do is to class people together, while still recognising that they are people.

2.1.3. Idiographic implies Nomothetic

There are no real barriers between idiographic and nomothetic approaches however their relationship is directional. One can argue from idiographic to nomothetic, but not vice-versa. An idiographic description is implicitly nomothetic. It relies for its credibility on us accepting that the description fits with norms of human behaviour, known and unknown.

In contrast, a nomothetic approach need never refer back to individual experience. This is its prime methodological disadvantage. Once a regularity of behaviour has been discovered, the regularity is the thing: individuals are only of interest in so far as they exhibit the regularity. The individual is subordinate to the Gaussian distribution (note how the use of the word Gaussian, rather than 'normal', emphasises idiographic connotations, which would otherwise be missed. This helps to embed a study in social reality, rather than in the data base of a computer).

Thus in a psychology approached from a nomothetic point of view the individual is valued only in so far as he or she is an example of a regularity of behaviour. In contrast in a idiographicly based psychology the regularities of behaviour are implicit in the individual. Studies of eminence enable us to look for psychological regularities as parts of the lives of readily identifiable people, rather than process anonymous subjects in order to derive them. This latter approach has its value, however its present dominance, which necessarily distances psychology from people, should be called into question. The key point is that an idiographic starting point does not stop

you deriving laws. But it does stop you forgetting that people are individuals. In this sense Galton's "English men of science" is a successful piece of psychology, since one is always keenly aware of the people it refers to. It would be convenient to assume that it has this accessibility due to insight on Galton's part, but it is probably an accident. Galton strikes one as a Victorian interested in his eminent contemporaries (as many Victorians were, witness the birth of the Dictionary of National Biography, founded in 1882, only seven years after publication of 'English men of science') who also wanted to make psychological generalizations. Thus it was his position as a Victorian scientist which gave his works the form that they have, rather than any intuitive attempt to blend idiographic and nomothetic approaches. His studies, linked with his seminal work in statistics, can in fact be seen as steps on the road to the predominantly nomothetic psychology we have today. Indeed Kelves (1984) has commented with reference to this aspect of Galton:

> To enumerate human characteristics required no penetration beneath the phenomenological surface and established a wall of numerical objectivity between the observer and the forces of the heart.

thus indicating the anti-idiographic intentions in Galton's work. But for whatever reason, Galton's idiographic/nomothetic balance is a good one, and it was an interest in this balance that stimulated my own interest in biographical data. Thus, where appropriate, I have kept to a position on the borderland between individual human beings and numbers.

2.1.4. Galton and Birth Order

To turn to Galton's work on birth order: this has come in for both support and criticism. His study is in no way methodologically watertight:

he does not consider family size or social class as complicating variables, or consider that a baby boom might inflate the number of firstborn in his sample. But his study is at the very least highly suggestive. In a sample of ninety-nine well known nineteenth century scientists, he found that:

> .... (1) that eldest sons appear nearly twice as often as younger sons; (2) that, as regards intermediate children, the elder and younger halves of the family contribute equally; and (3) that only sons are as common as eldest sons...

The figures for this are as follows: only sons, 22 cases; eldest sons, 26 cases; youngest sons 15 cases. Intermediates: elder half of family, 13 cases; younger half of family, 12 cases. Galton explains these findings as follows:

> ... the elder sons have, on the whole, decided advantages of nurture over the younger sons. They are more likely to be possessed of independent means, and therefore to follow the pursuits that have most attraction for their tastes; they are treated more as companions by their parents, and have earlier responsibility, both of which would develop independence of character; probably, also, the firstborn child of families not well-to-do in the world would generally have more attention in his infancy, more breathing space, and better nourishment, than his younger brothers and sisters in their several turns.

In the wake of Galton's work came studies by Yoder (1894), Ellis (1904), Gini (1915), Clarke (1916), Cattell (1917) and Roe (1953). Like Galton, Cattell and Roe studied scientists, Ellis and Yoder studied the eminent in general, Clarke studied literary figures and Gini studied academics. These studies all support Galton's findings: firstborn are over-represented among the outstanding. In the light of this Hudson (1975) has commented:

> Subsequent research has supported (Galton) handsomely, and although efforts have been made to explain away the data in terms of social class, differential fertility and statistical mudddles of various sorts, the effect remains.

Further recent support comes from Albert (1980) and Falbo (1984). However doubts are cast by Ernst and Angst (1983) whose criticisms are in the tradition reflected in the quotation from Hudson above.

This dichotomy of views can be explained by the different perspectives of Hudson on the one hand and of Ernst and Angst on the other. The former is prepared to accept, and is interested in, data which refers to individuals from highly selected groups and may not necessarily generalize from those groups (There is, indeed, a suggestion from Altus (1966) that birth order effects are more prominent the more highly selected the group). That is to say Hudson is sympathetic to a relatively idiographic position. The latter authors are radically nomothetic in their approach. This is in fact the keynote of their book, and they seem primarily interested in variables which can be used as predictors in education. Birth order is not such a variable. **Note 1.**

This brings out the distinction between an approach which values the idiographic and one which does not. Hudson is explicitly interested in individual experience, for example he takes note of what Sulloway says about Darwin and Freud, and is fascinated by Rilke's extraordinary production of the "Sonnets to Orpheus".

Ernst and Angst have no such interests. What concerns them are the method and the mean, not the person. Their book is an example of what Hudson (1972) has called "the cult of the fact", and as such risks throwing the baby out with the bath water. Their work is nevertheless useful because of its comprehensive nature, but with reference to this it should be noted that they mention neither Hudson nor Sulloway. Whether one finds birth order an interesting variable or not thus seems depend largely on

subjective criteria, that is to say, what one thinks psychology is about.

2.1.5. Early Parental Attention and the Firstborn

It seems that when we actually look at what happens in society, firstborn are particularly adept at filling positions of eminence: why should this be the case? It is easy to reject Galton's suggestion that the firstborn is more likely to be in a position of eminence in science because of independent means consequent on inheritance. This is simply because the effect shows up again in Roe (1953). Thus it is constant across Galton's independently financed British amateurs, and Roe's institutionally financed American professionals. However the possibility remains that the firstborn is economically favoured within a family whilst still a child. Galton's other line of consideration, that firstborn children receive more parental attention, has received considerable support in the literature, although, oddly, Galton himself has not been recognized as the originator of the suggestion.

2.1.5.1. Attention, intervention, intrusiveness and interaction

Results supporting such a view come from a variety of studies. Lasko(1954) studied sibling pairs of first and secondborn at the same ages (ranging from two to ten):

> .... the first child, in the preschool years, is subjected to a great deal of verbal stimulation and acceleration. Special accelerative attempts seem to occur before the first child is two and again when he is five; these ... possibly represent parental emphasis on skill acquisition (language, toilet training, etc) for the very young child, and school readiness for the five year old. The second child is also subjected to acceleratory pressures by the time he is school age but escapes the earlier efforts to speed up development.

Similarly Sears et al (1957) found that parents were more interventionist and also less consistent with firstborn and Rothbart (1971) found that

mothers exhibit a greater anxious intrusiveness into the performance of firstborn. More recently, Lewis and Kreitzberg (1979) have reported that parents have more interaction with firstborn. Maccoby (1980) has suggested that many of these effects result from firstborns having inexperienced parents, but she also makes the point that this very inexperience may be instrumental in the subsequent higher achievement of firstborn. They get used to paying attention to the demands of authority. One could say that authority makes sense to them. It is their reality.

2.1.5.2. Firstborn are "onlies" early on

In addition to any active intervention by parents, a firstborn as the only child present in the family for, normally, well over a year is likely to get considerably more and indeed a different type of, parental attention than a laterborn during the equivalent period of life, simply because no other child is present to be attended to. This is a key time in the life of any person. Lipsitt (1969) has argued that the newborn can learn better than he or she will be able to at any later age. This emphasises the importance of this early period of life. At this time the firstborn is thus likely to find parents a more important source of information than will the laterborn. One can extend this idea by suggesting that firstborn will in later life consider parents a more important source of information.

The picture which emerges is this: the firstborn is used to his or her life being mediated by people in a parent-like role, that is to say by people in whom (at least from the point of view of the firstborn) the norms of a wider society are vested.

2.1.6. Differing Behaviour of Firstborn and Laterborn Adults

Turning now to the behaviour of adults: there is evidence that firstborn adults actively seek social norms, rather than simply responding to them when necessary. This need for social comparison on the part of firstborn was demonstrated by Schachter (1959). He found that firstborn were more dependent on others as sources of "approval, support, help and reference" (1959, p82). He related this to the Sears et al study referred to above. In several experiments concerned with the relationship between anxiety and affiliation, firstborn were more anxious when faced with a stressful situation than were laterborn. When both were equally anxious, firstborn chose to be with other subjects more than did laterborn. He goes on to say:

> An attempt is made to formulate these findings in terms of a relationship between ordinal position and dependence. It is assumed that dependent behaviour will be most strongly manifested in conditions of disturbance and anxiety but that there should be other non-anxiety related indicators of such a relationship. Independent measures of dependence prove to be systematically related to ordinal position, with first-born individuals consistently more dependent than later-born individuals. Influencibility, which is assumed to be in part a function of dependence, is demonstrated to be related to ordinal position.

Support for the relationship between affiliation, anxiety and birth order comes from Zucker et al, who in a natural experiment carried out during the New York blackout of 1968, a distinctly anxiety provoking situation, found that in those waiting in situations congruent with Schachter's theory, that is to say firstborn waiting with others, laterborn waiting alone, anxiety was significantly lower than in those waiting in situations not congruent with the theory. Schachter's correlative theory, that under stress, in isolation, laterborn will perform better than firstborn, is supported by his own reanalysis of data from Torrance (1954), in which he showed that laterborn fighter pilots perform better than do firstborn. Following up this work,

Helmreich (1968) found that among U.S. Navy divers, another set of people who must perform under stress in isolation, laterborn performed better.

The finding that, regardless of stress, firstborn are more affiliative than laterborn has been supported by Dember (1964), Koenig (1969) and Nowicki (1971). Pulling these strands of social evaluation related behaviour together, Adams (1972) concluded, in a review of the literature, that:

> ... affiliation, dependence, conformity, and responsibility all appear to be greater among firstborns than laterborns...

These attributes reflect an awareness of what society expects of the individual. Such an awareness is functional in the gaining of a position of eminence.

2.1.6.1. Studies of social behaviour in children of differing birth order

Snow, Maccoby and Jacklin (1981) report a behavioural difference in children of 33 months which may be an early indication of this awareness. They found that firstborn showed more social behaviour of several types than did laterborn. The types of social behaviour they observed included both "social assertiveness - aggression" eg attempting to take a toy from another child, and "positive social behaviour", eg offering a toy, or moving close to another child. This firstborn behaviour seems to be concerned with the initiation of social activity, which fits in with the idea of seeking social comparison, rather than interaction with peers per se, because in the home environment Davie et al (1984) found that firstborn actually spent less time interacting with peers than did youngestborn. In contrast firstborn spent much more time interacting with parents than did youngestborn. One might suggest that for a firstborn parents are the prime comparators, but peers will do if no parent is available.

Thus the context within which a firstborn acts seems to be substantially composed of the opinions, actual or potential, of other people. The context within which the laterborn acts seems to be much less composed of other peoples's opinions. What then might this context be?

2.1.7. Social versus Physical?

Initially I was interested in the possibility that while firstborn cope well with the conventions of society, laterborn cope better with physical phenomena. My interest in this possibility originated in Schachter's (1959) reanalysis of data relating to Korean War fighter pilots, which indicated that laterborn were more capable in fighter combat than were firstborn.

It seemed to me that Schachter's explanation might deal with only one side of the phenomenon since it might also be the case that laterborn had a positive ability that helped them in these situations, such as a greater awareness of physical phenomena such as space, gravity and movement, in addition to needing to socially evaluate less than firstborn.

Results which support this position come from Eisenman (1964), who found that laterborn had better design ability than firstborn, Wiedl (1977) who found that lastborns had a greater interest in visually complex stimuli than did firstborns, and also that lastborns were superior in perceptual speed to firstborn, a finding also reported by Koch (1954). A further result of interest here comes from Bassett et al (1978) who found that laterborn perform better on tasks of visual co-ordination and figure ground discrimination.

I thus accepted Schachter's idea that firstborn need to socially evaluate more, but suggested that in addition laterborn, rather than simply needing

to socially evaluate less, were also positively more able to deal with certain situations, namely perceptual and spatial. This exemplifies the approach I advocated in in Chapter one, that is to say to consider laterborn of interest in their own right rather than simply as backdrops to firstborn.

One can make sense of such abilities on the part of laterborn by considering that infants are active beings and in the absence of parental attention laterborn won't just lie there doing nothing, but will investigate alternative sources of information, kicking their cots or whatever, to enable them to analyse the physical contingencies of the environment. Piaget (1953) describes precisely such creation of information from inanimate objects, and Watson (1972) has described the satisfaction infants derive from gaining control over physical systems.

2.1.8. A Dual Approach to the Problem

I approached the problem in two ways. Both yielded results, but they led in different directions, and attempts to synthesize them, though interesting, in fact only led to a conflation between, on the one hand, creative, and on the other, perceptual, thought. In one part of this dual approach I looked at a situation analogous to Schachter's fighter pilot study, but without the enforced isolation, namely interest in video-games. The other part of the approach was to study a group which can reasonably be considered to be highly aware of their spatial environments, namely eminent architects. I was additionally interested in this latter study because it was based on the relationship between idiographic and nomothetic principles which I discussed above with reference to Galton. The video-games study yielded results consonant with Schachter's work, that is to say laterborn rated themselves more highly than did firstborn, however these are not followed

up in the present work. For details of this study see Appendix I. The other study forms the basis for the rest of the thesis and is discussed below.

2.2. BIRTH ORDER AND GREAT ARCHITECTS

One profession that is particularly suited to individuals who have an orientation to spatial phenomena is architecture. I therefore searched for a suitable way of obtaining data about both birth order and competence in this profession.

2.2.1. Method

The source of data I decided to use was Colvin's "Biographical Dictionary of British Architects up to 1840". A substantial number of these entries give information about birth order. The comprehensiveness of the book is such that the majority of the architects entered are relatively unknown.

This comprehensiveness gave me the opportunity to compare the birth order of great architects with those who were merely eminent enough to appear in the book. This comparison had the advantage that it allowed the capabilities of the laterborn to be considered, even if, as seemed likely in the light of the birth order and eminence literature considered above, firstborn were over-represented among eminent architects as a whole, as they are in other professions.

Thus the question was not "are firstborn over-represented among eminent architects?" but "given a specified sample of eminent architects, are laterborn more represented among those considered great when compared with those considered merely eminent?"

This avoids the difficulty faced by most birth order/eminence studies, namely the possiblity that an over-representation of any birth order category is an artifact of demographic change. For example: if in any sample there are more firstborn than one would expect by chance, this could be the result of an unusually high rate of marriages immediately prior to the period during which the sample members were born. This would clearly lead to more firstborn births than in a normal period.

2.2.1.1. A Criterion for deciding "Greatness"

The criterion for greatness was taken as three columns devoted to either life or works in the dictionary. This criterion drew the line appropriately between the great and the eminent. To give some indication of who is included in the greatness category: it stretches from major figures such as Robert Adam to lesser but still important figures such as William Henry Playfair, who is best known for his public buildings in Edinburgh, which include the National Gallery, the Royal Scottish Academy, and New College. The architects in the merely eminent category are comparatively unknown. There is a notable exception to this, namely Thomas Archer builder of St John's, Smith Square, London. However he is a genuine exception, and as such lends support to, rather than challenges, the chosen criterion.

In making my analysis I used only information available in the dictionary. Thus although I knew that Sir Christopher Wren was a laterborn, since this information was not present in the dictionary it was not used. This avoided problems of differential selection of information on my part.

2.2.1.2. The Approximate nature of the Data

A problem with the data was that architects were frequently described as "the eldest son of" or "first of two sons of" or something similar. From this sort of description it is of course impossible to know whether or not the architect is firstborn. In contrast there is no such problem deciding whether an architect described as "second son of" or "fifth son of" is laterborn. Full family structure details were rarely given. For this reason my comparisons are made between a possibly firstborn group (n = 90), consisting of those described as first, only or elder son; elder brother, son and heir, and son and succesor, and a definitely laterborn group (n = 98). Total N = 188. For data see Appendix II.

2.2.1.3. Hypothesis

It was hypothesised that laterborn are significantly more represented among great architects than among architects who are merely eminent.

2.2.2. Results

11 great architects were possibly firstborn; 23 great architects were definitely laterborn; 79 of the remaining eminent architects were possibly firstborn; 75 of the remaining eminent architects were definitely laterborn.

	possibly firstborn	definitely laterborn
great	11	23
other	79	75

Chi squared = 3.2828, 1df, p<.05, 1 tailed. **Note 2.**

The hypothesis was thus supported.

2.2.2.1. Family size

This result could be due to family size rather than to birth order, since there are proportionally more laterborn to firstborn in large families than there are in small families. Thus it may be that great architects tend to come from larger families. There was insufficient data to test this alternative hypothesis, however I will comment on this again when discussing literary figures, below.

2.2.2.2. Social grouping

Cox (1966) has commented with respect to the definition of social classes:

> Probably the social classification hitherto adopted is too simple to be of any great value, for the Registrar General has recently shown a tendency to break down the five groups into their component parts.

This caveat is particularly appropriate here because it is difficult to tell from the data on what socio-economic level a father was, for example, an "architect" or a "mason". In addition, in line with Cox's comment about the growing tendency to group by similarity of activity, one may doubt the relevance of grouping them separately. In some cases families described as masons, such as the Mylnes of Edinburgh, whose surviving productions include buildings such as St Cecilia's Hall, the Tron church and Milne's Court, would certainly today be considered families of architects. Similarly, Yarwood (1970,p37) points out that William Adam was "Master Mason of Scotland". Yet this title signified his position as Scotland's premier architect of the day, pupil and successor to Sir William Bruce. In the event I decided to ignore accepted demographic frameworks (social class and socio-economic group) and use three groups which seemed to be relevant to the data. These groups were (1) Father occupation stated as architect; (2)

Father occupation related to architecture: i.e. mason, stuccoist, painter, drawing theorist, sculptor, bricklayer, joiner, carpenter, builder, artist; (3) Father occupation something other than architecture or related.

This classification leads to the interesting finding that the major part of the effect observed above is accounted for by those whose fathers were engaged in architecture or related occupations.

father occupation: architect or related

	poss firstborn	laterborn
great	4	14
eminent	43	38

Chi squared = 4.4564, 1 df, 2 tailed, p<.05

father occupation: other than above

	poss firstborn	laterborn
great	7	9
eminent	36	37

Chi squared = 0.0162, 1 df, 2 tailed, p<.45, not significant

Laterborn seem to respond better if brought up in an environment in which the sort of thought which characterizes architects is present.

2.2.2.3. Firstborn over-represented as a whole?

It should also be noted that the proportion of possibly firstborn to definitely laterborn is 90:98, approximately 1:1. Bearing in mind that the number of 'firstborn' is raised by the necessity of including the possibles, this ratio nevertheless strongly suggests that firstborn are over-represented in the sample as a whole, as one would expect from the eminence literature.

Such a suggestion is in line with a finding by Craik (1961). This is unpublished but it is reported by Datta (1968). Craik is said to have found: "that highly creative architects tend to be firstborn rather than only children or laterborns". This is consistent with my data in that (a) all the architects in my sample could be rated highly creative, since what I have been looking at is relative creativity within what is undeniably a group of highly creative individuals, (b) even among great architects firstborn may be over-represented, the proportion of possibly firstborn to definitely laterborn is 11:33. Due to the approximate nature of the data I cannot comment on this further.

2.2.2.4. An uncritical assumption

At the beginning of this study I somewhat uncritically assumed that I knew what sort of thought characterized architects, and that was: thinking orientated to spatial phenomena and that "greatness" would be evidence of a greater capability in this type of thinking. This is not an unreasonable assumption and indeed such a type of thinking is obviously of importance to architects. It does not however follow that the difference between first and laterborn picked up in this study reflects this variable. Rather than concluding at this point that something like a greater interest in spatial phenomena on the part of laterborn leads to their relative over-representation among great architects, I considered another possibility.

2.2.3. Convention versus Creativity?

Some authors, for example Eisenman (1964), have suggested that laterborn are more creative than firstborn. "Creativity" is not an easy concept to define, but may usefully be thought of as a process working independently of the received wisdom of any field, and more, a process

which works best if for some reason the creating individual is isolated from that received wisdom. Mcluhan(1967) has called such creativity 'amateur':

> Faraday's ignorance of mathematics contributed to his inspiration ... it compelled him to develop a simple, non mathematical concept when he looked for an explanation of electrical and magnetic phenomena ...
>
> Professionalism is environmental, amateurism is anti-environmental. Professionalism merges the individual into the patterns of total environment. Amateurism seeks the development of ... the critical awareness of the ground rules of society. The amateur can afford to lose. The professional tends to classify and to specialize, to accept uncritically the ground rules of the environment. The ground rules provided by the mass response of his colleagues serve as a pervasive environment of which he is contentedly ... unaware. The "expert" is the man who stays put.

One has only to think of Newton's isolation from Cambridge during the plague of 1665, Einstein's lowly position in a Patents Office in the early years of this century, Kohler's internment on Tenerife during World War I, or Kekule dozing in front of the fire, events which correspond closely to the development of important new theories and insights, specifically Newton's theory of Universal Gravitation, Einstein's special relativity, Kohler's insight into insight, one of the foundation stones of Gestalt Psychology, and Kekule's recognition of the structure of the benzene ring, to realize the creative usefulness of being isolated one way or another from the received wisdom of the field, or "environment", in question, or as Kuhn (1963) would call it "the normal paradigm".

It will be noted that the discussion of eminence in general, earlier in this paper, suggests that it is precisely such normal paradigms, intricate structures of convention, that firstborn are particularly adept at grasping and using. If this is the case then laterborn are less likely to become involved with received wisdom and thus though they may for this reason be

less likely to become eminent, for the same reason, if they do become eminent they are likely to be creative in that position of eminence, and thus they may eventually be considered exceptional. Being laterborn could thus be seen as another way of being isolated from the dominant paradigm. More profound, but nevertheless similar in effect to being interned on an island, dozing off, or thinking about fundamental problems in a patents office or an orchard.

Certainly this interpretation could be applied to my findings with regard to architects. It would also be in accord with the clinical insights of Adler (1939):

> I have always found that the first-born possesses a sort of conservative tendency. He takes the element of power always into consideration ...

and with respect to some last-born:

> Restlessly pushing forward, they surpass everyone by their initiative (Kunstadt) frequently transcending the normal and becoming pathfinders.

2.3. BIRTH ORDER AND CLARKE'S "AMERICAN MEN OF LETTERS"

In order to investigate this "creativity" hypothesis further, I carried out a reanalysis of Clarke's 1916 data on American men of letters. This covers a group of similar social standing to the architects, engaged in an activity with a similar requirement for creativity, but demanding this in a verbal rather than a spatial medium. I should point out that this sample, contrary to the impression one gets from title, includes many women.

2.3.1. Method

2.3.1.1. Data Selection

Clarke divided men and women of letters into 13 categories: patron, librarian, actor, orator, publicist, narrator, erudite, popularizer, speculative, prose writer, poet, and dramatist.

I made three comparisons defining "creative writer" in three progressively more selective ways. First of all, I compared writers in four of Clarke's categories: prose writers (by which Clarke means novelists), poets, dramatists and actors (included here because even though they are not writers they seem more appropriately placed in the so called "creative" group) with all men and women of letters in the remaining categories (ie patron, librarian, publicist, orator, narrator, erudite, popularizer and speculative). It could be argued that "actor" should not be classed with "creative writer" however in my judgement this classification was more appropriate than the alternative, to class "actor" with "patron, librarian, etc". This decision was easier to take because there were so few actors in the sample that an inappropriate classification was unlikely to unduly influence the results. Thus in practical terms at least the classification is satisfactory. N = 251. For data see Appendix III.

2.3.1.2. Hypothesis

It was hypothesized that creative writers would be more often laterborn than other eminent men and women of letters.

2.3.2. Results

2.3.2.1. First analysis

33 "creative" men and women of letters are firstborn; 54 "creative" men and women of letters are laterborn; 58 remaining men and women of letters are firstborn; 116 remaining men and women of letters are laterborn.

	firstborn	laterborn
"creative"	33	54
other	58	116

Chi squared = 0.1558, 1df, 1 tailed, p<.9, not significant.

No pattern is discernible in this data.

2.3.2.2. Second analysis

In the second comparison my definition of "creative writer" was more demanding. The selection criteria were (a) that the individual in question was a poet, novelist, dramatist or actor, as classified by Clarke, and (b) that he or she had an entry in Chambers Biographical Dictionary (1975). I used this second criterion since an entry in this dictionary of persons of international historical importance indicates a greater eminence than does a listing in Clarke's book. These "creative" writers (plus actors) can all be thought of as historically important figures. This produced the following list, which I insert in full because of it's relevence to the third comparison:

Freneau P, Barlow J, Paulding J K, Key F S, Irving W, Cooper J F, Payne J H, Goodrich S G, Bryant W C, Percival J G, Halliburton T C, Child L M, Abbott J, Emerson R W, Hawthorne N, Forrest E, Simms W G, Willis N P, Longfellow H W, Whittier J G, Holmes O W, Poe E A, Ossoli M S F, Stowe H B, Very J, Cushman C S, Thoreau H D, Lowell J R, Whitman W, Cary A, Curtis G W, Taylor B, Foster S C, Jefferson J, Alcott L M, Booth E, Clemens S L, Daly A, Roe E P, Allen J L, Field E.

Note that this list only includes those in Chambers Biographical Dictionary for whom Clarke had birth order data. For this reason several figures, eg Herman Melville and Henry James, do not appear. This procedure was adopted in line with that of the architects study (see comment above concerning Christopher Wren), in order avoid bias on my part resulting from differential remembering of biographical detail in line with my hypothesis. Such a problem may seem unlikely, but when one has an interest in such details it is very easy to, for example, skim through a biography in a shop, remember the detail one agrees with, and forget, simply because one is less primed for it, detail which does not support the hypothesis. Precisely delimiting the source of information (eg to a Biographical Dictionary, or to data already collected by Clarke) enabled such bias to be ruled out.

8 historically important "creative" writers were firstborn; 33 historically important "creative" writers were laterborn; 73 of the remainder were firstborn ; 137 of the remainder were laterborn.

	firstborn	laterborn
"creative"	8	33
other	73	137

Chi squared = 2.9854, 1 df, 1 tailed, $p<.05$

It can be seen that the pattern is similar to the pattern for architects.

2.3.2.3. Third analysis

My third comparison was most comparable to that carried out in the case of architects, since I compared "great" creative writers with all the remaining men and women of letters. The criterion I used for greatness was simply that the writer in question should have survived to the present day as a source of continuing literary interest rather than just as a historically interesting figure. The writers to whom this description seemed to apply,

refering to the above list were: Samuel.L.Clemens (Mark Twain), Walt Whitman, Henry David Thoreau, Henry Wadsworth Longfellow, John Greenleaf Whittier, Oliver Wendell Holmes, Edgar Allan Poe, Nathaniel Hawthorne, Ralph Waldo Emerson, Harriette Beecher Stowe, Louisa M Alcott, Washington Irving, James Fenimore Cooper and John Russell Lowell. The least famous of these is Whittier. I include him because of his continued recognition as a hymn writer. However, were he to be excluded from the "great" group the result (see below) is not substantially affected.

The pattern is similar to the above but more pronounced:

No great writers were firstborn; 14 great writers were laterborn; 81 of the remaining men and women of letters were firstborn; 156 of the remaining men and women of letters were laterborn.

	firstborn	laterborn
great	0	14
other	81	156

Chi squared = 5.5875, 1 df, 1 tailed, p<.01

The hypothesis was thus supported in the two more selective comparisons. It is most strongly supported in the most selective comparison. In fact when the great writers are removed from the creative group used in comparison two, the effect is no longer evident, thus one can conclude that the final analysis is the important one.

	firstborn	laterborn
cr - gr	8	19
other	73	137

Chi squared = 0.0984, 1 df, 1 tailed, p<.4, not significant

2.3.2.4. Family size

As I have pointed out above, such a pattern could be a consequence of family size rather than of birth order per se, since if great writers tended to come from larger than average families for the sample, proportionally more laterborn would be great writers, regardless of other variables. However an inspection of the family size for great writers and the whole sample indicates that this is not the case (Median Test).

	family size	
	median or less	more than median
great	9	5
other	140	97

Chi squared = 0.0123, 1 df, 1 tailed, p<.95, not significant

2.3.2.5. Social class

Most members of the sample come from social class 1 or 2 backgrounds. When great writers are compared with the remainder with respect to social class no significant difference was found:

	social class		
	1	2	3,4
great	7	6	1
other	103	93	10

Chi squared = 0.1526, 1df, 2 tailed, p<.9, not significant

2.4. CONCLUSION

One can thus conclude that there is a birth order effect in the above data which is independent both of family size and of social class. This looks interesting but where does it leave the initial idea that exceptional architects are more often laterborn than are merely eminent architects, because they are more orientated to spatial phenomena? Is the idea that

laterborn are more creative than firstborn more satisfactory? In this context the answer is yes: but the possibility that laterborn have a more direct awareness of spatial phenomena should not be forgotten, although it does not seem to be immediately relevant here.

The contrast between "creativity" and "convention" seems useful. I have been using both these words in their colloquial senses. In this sense "creativity" means working outside, or at odds with, a dominant set of ideas. "Convention" means working within, or closely with, a dominant set of ideas. The reality of the firstborn seems to be more conventional. The reality of the laterborn seems to be more creative.

CHAPTER 3

ART, SCIENCE AND REALITY

> Olympus and Parnassus were as real to Geddes as the primeval slime out of which the protozoa had emerged. Mumford (1944)

> I very much doubt if any of us has the faintest idea of what is meant by the reality or existence of anything but our own Egos. ... It is of course possible to obtain consistent use of the word 'reality' by adopting a conventional definition. My own practice would probably be covered by the definition that anything may be said to be real if it is the goal of a type of inquiry to which I personally attach importance. Eddington (1928)

> I read: "... philosophers are no nearer to the meaning of 'Reality' than Plato got ...". What a strange situation. How extraordinary that Plato could have got even as far as he did! Or that we could not get any further! Was it because Plato was so extremely clever? Wittgenstein (1931)

3.1. INTRODUCTION: WHAT SORTS OF REALITY CAN WE CONSTRUCT?

I have suggested that firstborn and laterborn have different realities. In the present chapter everyday social realities are contrasted with cultural realities, and birth order differences are considered from the latter point of view.

3.1.1. The Many Worlds: James

Is it meaningful to use the word "reality" in this way? William James can be of help here. In his "Principles of Psychology" he devotes a chapter to the perception of reality; by this he does not mean the perception of physical reality but the perception of the many different "sub-universes"

which can be thought of as real. He calls these different realities "the many worlds". This thought of James' has been picked up recently by Moscovici (1983) in his discussion of the "consensual universes" of social representation theory. For James the most important of these sub-universes are (1) the world of sense, or of physical "things"; (2) The world of science; (3) The world of ideal relations (logic, maths, ethics, aesthetics) (4) The world of "idols of the tribe" (common illusions or prejudices); (5) The various supernatural worlds of myth and fable; (6) The various worlds of individual opinion; (7) The worlds of madness.

He goes on to say:

> For most ... the "things of sense" ... are the absolutely real world's nucleus. Other things, to be sure, may be real for this man or for that - things of science, abstract moral relations, things of the Christian theology, or what not. But even for the special man these things are usually real with a less real reality than that of things of sense. They are taken less seriously: and the very utmost that can be said for anyone's belief in them is that it is as strong as his "belief in his own senses".

Thus James distinguishes between the world of sense and other worlds which are "real with a less real reality". These other realities can be thought of as of two types, (a) to do with everyday social events, that is to say common illusions and prejudices, individual opinion and madness; (b) to do with exceptionally durable elements of culture, that is to say the world of science, the world of ideal relations and the world of myth and fable.

3.1.2. Objective Contents of Thought: Popper

This latter classification is close to what Popper (1972) has held to be constitutive of the "objective knowledge" of what he calls "world three" :

> ... and thirdly, the world of objective contents of thought, especially of scientific and poetic thoughts and of works of art.

He contrasts this with "world two": the private states of mind, or behavioural disposition of the individual, and world one: the physical world.

James is, however, concerned with subjective rather then objective realities; all the worlds he discusses are parts of Popper's world two, that is to say the world of states of consciousness or behavioural dispositions. Thus, while James can be thought of as laying the foundations for Popper, the three types of world which I have suggested can be derived from James's list should not be thought of as Popper's three worlds. The three types derived from James can be called (1) the world of the reality of the senses; (2) the world of everyday social reality; (3) the world of cultural reality. These worlds are objects of consciousness. This is what makes them realities. They are accessible on this level. We are not of course conscious of the inherent structure of these realities whether this is the process of perception, the prejudices involved in our everyday social activity, or, on a cultural level, the "spirit of the age".

Social reality can be thought of either in terms of Wittgensteinian language games, or Moscovician social representations. Gellner (1964) has linked these two areas by pointing out the similarity between Wittgenstein's later philosophy, and Durkheim's theory of collective representations, upon which Moscovici's work is based. It is interesting to note that Gellner criticizes Wittgenstein's philosophy for the underlying assumption that it constitutes a solution to the problems of philosophy. That is to say: stay within your language game, or "form of life" and the problems cease to exist:

> But plainly it does not constitute a solution at all. It may be true that we cannot stand outside all conceptual systems, all "forms of life", in order to scrutinize some one or all of them: but equally, we cannot fall back into a cosy conceptual cocoon, the language/culture of our "forms of life", with the comfortable reflection that any attempt to transcend it is only based on some kind of error concerning the working of language ... we cannot do this, because there are no such conceptual wombs to crawl back into: the modern world is a Babel of "forms of life", undergoing change with bewildering rapidity.

The particular interest in this passage here is precisely this rapid change in "forms of life" which theorists of social representation recognize. This rate of change helps to distinguish social from cultural realities. It is notable that, earlier in his paper, Gellner explicitly excludes Durkheim from the criticisms he makes of Wittgenstein, realizing that he (Durkheim) is well aware of the importance of change in representation. **Note 3.**

One can thus distinguish social from cultural realities by the rates of change of the constructs associated with them. Moscovici (1983) considers the study of social representations to be the basis of "a science of consensual universes in evolution" which "requires that we revert to methods of observation". It is thus clear that, at least as a starting point, he is concerned with relatively fast rates of change in representation.

However, cultural reality is related to library or gallery type knowledge (Popper's world three). Due to this "objective" element, change in cultural representations is slow.

3.1.3. Rates of Change

This analysis is useful because it distinguishes two rates of change. One is the rate which enables us to talk of periods of time such as "the sixties" and contrast them with "the fifties" or "seventies", one might call this the rate of fashion in any activity. The other is the rate that enables us

to meaningfully contrast, for example, pre- and post- renaissance Europe, that is to say the rate that reflects our evaluation of objective contents of thought. I've distinguished these two rates for my own convenience, but there may well be a continuum between them, ranging from the potentialy highly changable representations of for example an only slightly known person or place, to the relative stability of our evaluation of science.

This reality is is that science is the "real" way of understanding the world. Science as the dominant cultural reality remains, even if it is frequently criticised on an everyday level. This dominance is the key to understanding the concept of "scientism", by which other activities are spuriously validated by association with science. Both art and mysticism have suffered badly from this confusion in the last century or so. The dominance of science is evident from the desire of practitioners in other areas to associate their areas with it, however inappropriately.

3.1.4. A Non-scientific Cultural Reality

For comparison with another cultural reality we can look back to the medieval period. This seems to have been strongly associated with ideas of art and religion, rather than with scientific analysis (see for example Lewis 1964, Leclercq 1962). In such a society it would make sense to give highest reality status to states of religious ecstasy and mythological ambiguity and to consider the "reality of science" as something that had to be coped with, but that was in fact an illusion of relatively little value. The cultural reality is more or less the reverse of the present one. At that time to analyse in today's scientific sense would have been unconventional. But the other side of the coin, the investigation of what one might call "ambiguity" would have been highly conventionalized. This ordered investigation of multiple interpretation is evident in medieval painting, architecture and religion.

One can draw an analogy between the stereotype of the medieval scientist as heretic, and the modern artist as neurotic. Both these words, heresy and neurosis, are applied to people who are choosing not to toe the cultural line when it comes to thinking. Their activities are at best regarded as of dubious value, and at worst as "sick". However the scientist of the middle ages was pursuing what is now a conventional activity, while the artist of today pursues what was once a conventional activity. Both heresy and neurosis are descriptions of an outgroup, of similar social use is these different periods, despite their completely different linguistic meanings.

3.2. BIRTH ORDER AND EMINENCE IN SCIENCES AND ARTS

The research on birth order discussed so far, both my own and that of others, has concentrated on birth order differences with respect to the world of everyday social reality. We have seen that firstborn seem to be more aware of how to successfully fit in, and consequently become more eminent in general, but that, at least with respect to architecture and literature, given a situation in which novel solutions are required laterborn become significantly more represented. On this everyday level, firstborn can be described as more professional while laterborn are more amateur (both words used in Mcluhan's sense).

But what of the world of cultural reality? Different aspects of this type of thinking are differently valued in different societies. At present we live in a culture considerably skewed by an overvaluation of science at the expense of art. Since this is the context for all social comparison, one would expect the firstborn to behave in a way that reflected this dominant cultural view. That is to say, to be more interested in science than in art.

An examination of birth order differences in orientation to cultural rather

than everyday social reality would involve a direct comparison of the birth orders of eminent scientists, as representatives of the dominant cultural reality, and eminent artists, as representatives of the non dominant cultural reality.

3.2.1. Previous Relevant Work

A partial comparison of this type was made by Bliss (1970), who found, as one would expect in the light of the above discussion, that laterborn were more represented among writers than among scientists. More suggestive evidence comes from Exner and Sutton-Smith (1970) who found firstborn to be more effective teachers of science and laterborn of English. However no clear overall picture emerged from a study by Altus (1967) of choice of college major, although laterborn women were found to be more likely to choose art and music.

The picture here is not entirely clear, and, as paradox will have it, seemingly contradictory evidence comes from earlier work by the present author. I found that firstborn students were more likely to be in the arts than science faculties of a university. One might attempt to explain away this result by pointing out that the sample was highly specific (males from two male child families), however such "explaining" would be unsatifying. A more interesting line of thought can be developed by considering the distinction between "arts faculty", a highly traditional institution, and "arts as practiced", which among their better practitioners tend to be anything but traditional.

3.2.1.1. Snow and Waddington

This is an important, but usually ignored, distinction. For example, it is easy to assume that Snow (1956,1959) in his discussion of the "two

cultures" is referring to the same cultural divide that Waddington (1969) refers to in his comparison of painting and physics but this is not the case. Snow's arts faculties are the repositories of tradition, essentially conservative. Waddington's artists are each and every one of them working at the forefront of their discipline, breaking new ground. These two ideas are thus almost antithetical. It is important to realize this. I began (1981) by failing to make this distinction, but my major interest in "arts" here is in arts as done, rather than arts as traditional culture.

3.2.2. Method

My present comparison, carried out from a perspective of both an interest in qualitative distinction between first and laterborn and a consideration of a possible theoretical context for such differences, made use of persons listed in the latest supplement to the Dictionary of National Biography (1981). The scientists (n = 86) were physicists, geologists, engineers, mathematicians, biologists, chemists and doctors of medicine. The artists (n = 54) were musicians, literary figures and visual artists. N = 140. For data see Appendix IV.

3.2.2.1. Hypothesis

It was hypothesized that there would be proportionately more laterborn among eminent artists than among eminent scientists.

3.2.3. Results

52 scientists were firstborn; 34 scientists were laterborn; 19 artists were firstborn; 35 artists were laterborn.

	firstborn	laterborn
art	19	35
science	52	34

Chi squared = 7.500, 1 df, 1 tailed, p<.005

The hypothesis was thus supported.

3.2.3.1. Family size

This effect is not due to artists tending to come from larger families than scientists, as the median test below shows:

	family size	
	median or less	more than median
art	29	25
science	51	35

Chi squared = 0.2267, 1df, 1 tailed, p<.35, not significant

3.2.3.2. Social class

The majority of the sample come from social classes 1 and 2. There is no significant difference in social class of the artists and scientists.

	1	2	3&4
art	28	15	11
science	36	29	21

Chi squared = 1.353, df 2, 2 tailed, p<.7, not significant

It should be noted again that, in keeping with the birth order and eminence literature, despite the greater number of laterborn among artists, in absolute terms firstborn are still over-represented. (The actual ratio of firstborn to laterborn in the artists group is about 1:2, while the expected ratio based on average family size is about 1:4).

3.2.3.3. First and youngest

Further analysis of the data yields more interesting information, namely that the birth order difference observed is mostly accounted for by a predominance of firstborn and onlies in science and a predominance of youngest-born (excluding onlies) in arts. The intermediate born seem to be much less important, a phenomenon first noted by Galton (1875). It should be noted that onlies behave here as first rather than youngest born. There are few onlies in the arts group.

	Only	First	Inter	Youngest
art	3	16	18	17
sciences	15	37	25	9

3.2.3.4. Early behaviour of first and youngest

Observations in a recent study by Davie et al (1984) provide an important indication of precursors of this effect in child social behaviour, the three groups referred to are Only, Eldest and Youngest children:

> Family position ... had a more potent influence than either social class or sex on social interaction between the subjects and both adults and other children. Youngest children received far less attention from adults and spent far more time playing and talking to other children than the other two groups. Only children received most adult attention but Eldest children, despite the fact that they, like Youngest children, had siblings, tended to be closer to Only children in terms of the amount of adult attention they received. Fathers, in particularly, ignored their Youngest children, concentrating their attention on older siblings, when they returned from work in the evenings or at the weekends. While receiving less adult attention, Youngest children spent far more time than the other two groups playing and talking to other children. Youngest children tended to 'tag' along with older children and take part in activities which depended on the initiation of the older child, such as involving them in taking turns and following simple rules. This often led to irritation in the older child and the Eldest children interacting in turn with their younger siblings showed more physical and verbal aggression than did the other two groups. Parents, in turn, told off Eldest children most, partly attributable to these siblings' disputes

but also because of their more 'laissez-faire' attitude to youngest children, who showed a happy-go-lucky attitude to life, laughing more and weeping less than the other two groups.

3.2.4. Women and Men

Another interesting feature of the data derived from the Dictionary of National Biography is that the pattern of activity of men versus women mirrors that of first versus laterborn. That is to say women are much more represented in arts than they are in science. The figures are as follows:

	men	women
arts	43	11
science	86	0

This fits in well with the suggestion that the arts are at present the non-dominant cultural reality, clearly the dominant reality is both scientific and male; white also of course: it seems no coincidence that one of the few areas where black excellence is recognised is music.

3.3. SUPPORTING EVIDENCE

Since completing this study I have discovered useful support in a study of Nobel Prize winners, carried out by Clarke and Rice (1982). The birth order effects they report are very similar to my own study, arts winners being more often laterborn than science winners.

3.4. WHERE SHOULD WE GO FROM HERE?

Instead of enabling us to come to an easy conclusion, these findings leave us facing a fundamental epistemological question, namely: What is the relationship between the ways of thinking typified by art and the ways of thinking typified by science? Or to put it another way: how is the

non-dominant cultural reality related to the dominant cultural reality, on a psychological level?

We know that there is a birth order difference between those eminent in arts and sciences, but we don't know what this means because we have no proper conception of the links between these activities which reflect fundamental ways of thinking.

CHAPTER 4

THE NEED FOR A COMPREHENSIVE MODEL OF WAYS OF THINKING

Both of them thought:
"How many areas of specialization there are in
the world, and how broad each specialization is!"
The night was morose and foggy.

Bely (1903)

4.1. INTRODUCTION

4.1.1. The Problem

The problem which seems to be emerging is this: science is the dominant "objective content of thought" to use Popper's (1972) phrase, the dominant "ideal reality" to use James' (1890) phrase and the dominant "cultural reality" in my own phrase. This has been emphasized by Barzun(1964) who has pointed out that despite our ready recognition of art and science as constituting together the intellectual leadership of our civilization: "One power only, and that one science, dominates the culture". But neither art nor science are objects of serious study in mainstream pscyhology. Nevertheless, since science is the dominant cultural reality, it is easy to assume that the best analogy for mental life is scientific life. Science is uncritically adopted as the model for cognition. Problem solving, hypothesis testing. This is an example not of science but of scientism. This is quite distinct from a truly scientific view which tries to discover what thought is like by scientific means, without the accompanying assumption that what those means will reveal will be a process which mirrors the scientific method.

The problem can be dealt with if we consider both science and art

seriously within mainstream psychology, rather than assuming the former and ignoring the latter. The resulting psychology will be the beginnings of a consciously comprehensive "science of mental life". We need this.

The present chapter deals further with the problem, the next chapter suggests a solution.

4.1.2. Models of Man

Some idea of the problem, the implicit acceptance of science as a model for thought and the ignoring of art as a possible model, can be inferred from a book of papers collected from a British Psychological Society conference in Cardiff, entitled "Models of Man" (Chapman and Jones, 1980). Publication information for this book said that it "... captures the dilemmas and controversies confronting the student of behaviour" and that it "... emphasizes the plurality of presentday psychology". The review magazine 'Contemporary Psychology' called it "... an impressive assessment of the current state of the art", while 'Social Biology' said of it "... a labour of love and scholarship ... here laid before us in concise and lucid english is the structure and substance of the psychology which has evolved since it was founded by Wundt".

It is thus clear that the book is intended, and has been accepted, as a proper reflection of contemporary psychology. It is, in fact, a good book and it is in this light that its omissions must be seen. If a book is good, its omissions are meaningful. In 372 pages of text from 33 authors, the "person as artist" is, quite simply, not modelled. **Note 4.** The implicit assumption is that a model of artistic activities has no important part to play in a broad consideration of human behaviour. In contrast a strong current of "man the

problem solver", i.e."man the everyday scientist" runs through the book. The last thing I would want to imply here is that this current of thought is inappropriate; the point is that in itself it does not provide an adequate model, or set of models, of human behaviour.

Paradoxically this does not reflect a lack of interest in art among psychologists, and indeed a later well attended conference in the same location testifies to this interest, see, for example, Crozier and Chapman (1983), but what is lacking (and was seen to be lacking at this conference) is any unified school of thought which has some conception of what art is and some idea of how to relate this to conceptions of other ways of thinking.

This state of affairs is discussed by Granger (1979) who begins by commenting that "the psychology of art receives scarcely any attention in our university courses..." but it is "...of central importance to the study of man". One can only agree with both statements, and perhaps reinforce the latter by pointing out that this central importance has been recognized by not only Barzun, quoted above, but among others by J Z Young (eg Young 1978), to whom Granger refers, and Freud (1930). In this review he points out that there has been general failure by psychologists and philosophers to define the work of art. Granger suggests that it is:

> ...little wonder ... that no one has yet come up with a crisp answer to the question, what is a work of art

because of the "bewildering variety of objects" which can be referred to as such. Quite so, but such definition remains the key point. While it is true that bewildering variety makes definition difficult, it also draws attention to the need for such definition. If we had an acceptable definition of art

bewilderment would vanish but variety would remain.

At present we view art like a photograph which despite its clarity confuses us because it has been taken in close-up. We must take a wider view to make sense of the phenomena confronting us. The problems of what art is, and what art objects are, will not be solved unless we think of all arts together, and further, consider these artistic productions as manifestations of ways of thinking, just as are scientific theories. Only such a view will enable us to see the structure of the problem and only then will we be able to give a useful definition.

What is needed is a general model of ways of thinking, which includes both art and science. Hudson (1966,1968) has provided a background for any such work in his discussion (a) of the different cognitive styles of school pupils specializing in arts and sciences, and (b) of stereotypes of artists and scientists. My own thinking owes much to Hudson for he created the conditions for it within psychology. However it is not a direct elaboration of Hudson's work.

4.2. A BIAS EXPLORED

4.2.1. Art Divorced from Cognition

Our assumptions are by no means easy to pin down. The primary, and eminently reasonable one, is that the study of cognition is central to psychology. Do we then consider that cognition is related to science but not to art? Clearly we are not so simple minded about it. However what we do assume is that the idea of art has little to contribute to a general model of cognition. It is assumed that what goes on in painting or literature can tell us nothing important about the mind.

Naturally we would deny that we held any such assumptions: nevertheless we do. The form of the assumption is this (a) we assume that cognition is about gaining knowledge about reality. (b) we assume that the most important method of gaining knowledge about reality is science (c) we assume in the light of the above that science-like processes are the best model for cognition. **Note 5.**

The upshot of this is that when we apply our models of cognition to art they are by no means fully relevant. This is because ideas appropriate to the study of art, particularly ideas which depend on multiple interpretation of information such as ambiguity and metaphor, have been written out of our models of cognition at an early stage. Thus art seems like something floating on the edges of thinking. It is certainly on an edge, but the edge is that of theory, not of thinking.

Reference to the contents page of the thick reference work, "psychological abstracts" can help us to explore this further. There is a section devoted to "literature and art", but this comes under the enigmatic heading of communication systems. There is no question of it being "cognitive". Things that do come under a "cognitive" heading are learning, memory, hypothesis testing etc. That is to say the sorts of things which are salient in scientific thought. But there are further problems for any serious psychology of art. First of all in the section called "literature and art", the contents are predominantly literary: there is little visual art, and no music (which is classed with auditory perception), secondly, at least one major journal which takes the psychology of art seriously (Leonardo) is excluded from psychological abstracts. We thus seem to assume that art and cognition should be classified in different places: this is where we reveal our dominant cultural reality; we come unstuck before we've begun.

4.2.2. The Study of Children's Drawings as an example of Scientism in Psychology

One such area in which this scientism can be clearly seen is the study of children's drawings. Rather than being considered as art, these are likely to be considered as reflections of intelligence or problem solving. There is much argument in psychology between the proponents of a specific problem solving approach to the human mind, and the proponents of the idea of a the validity of a general intelligence. The argument is obscured, or perhaps created, by the different methodologies typical of the opposing groups; however it itself obscures what is, from a general point of view, a more important point, namely that both schools make broadly the same assumptions about what constitutes human thought: it is to do with a problem solving ability, whether this is reflected in a standardized IQ test composed of many tasks or the investigation of a single task.

Since what is salient is either a "general intelligence" or "problem solving" it is not surprising that children's drawings are commonly conceived of as either useful indices of intelligence (Goodenough 1926, Harris 1974), or as examples of problem solving (Goodnow 1977).

It is paradoxical that a task with such a strong component of what one might call "artistic intelligence", should be seen only as a precursor to "scientific intelligence", a step on the road to logic, and that as soon as this can be tested in a problem solving way, the possibility of "artistic intelligence" becomes background noise. **Note 6.**

4.2.3. Taking Art Seriously: Kellogg

This failure to consider one whole side of human cognition (cf Sperry's comment referred to in chapter one) has practical implications for such tests, for example Kellogg (1970) makes the point, with reference to the "Draw a man" test that in different drawings the child has different intentions (odd that such an obvious point has to be made), and that consequently the scorable properties of the drawing vary. While an artistic view can cope with the idea that the same child will want to produce different types of drawing of the same subject (an idea coped with even better by a comprehensive model of ways of thinking, see below), the scientistic assumption underlying the test is that all drawings will be attempts to produce a verisimilitudinous rendering of a human being. Such renderings are more appropriate to scientific depictions such as anatomy photographs, than they are to art.

Kellogg also discusses the "Easel age test" which again makes use of primarily artistic products to measure intellectual development. Its developer, Lantz, points out that " special effort has been made to avoid turning the Easel age scale into a measure of artistic ability". Why was this special effort made? Why was the artistic ability of the child thought to have nothing to do with its intellectual growth? As Kellogg (p 262) says: "The child teaches himself art at the same time as important brain growth occurs".

There are other interesting examples of this assumed division between intelligence and art, which have historical importance (ie a part in forming our contemporary assumptions), for instance Terman (1919) remarks with reference to Binet's Aesthetic Comparison Test that:

> One might suppose that aesthetic judgement would be relatively independent of intelligence. Certainly no one could have known in advance of experience that intellectual retardation would reveal itself in weakness of the aesthetic sense about as unmistakably as in memory, practical judgement, or the comprehension of language. But such is the case. The development of the aesthetic sense parallels general mental growth rather closely.

This is interesting, first of all for what it says about the relationship of aesthetic sense and intelligence, and secondly for its clear statement of the assumption underlying most psychological thinking about artistic phenomena, namely that "one might suppose that aesthetic judgement would be relatively independent of intelligence". Had one ever really looked at the works in any major gallery, one might tend not to suppose any such thing, but nevertheless the implication that art is not really worth taking seriously, not a central part of cognition, seems to be as pervasive today as it was when Terman was writing.

Kellogg however does take the artistic aspects of children's drawings seriously. For her the child's main concerns are with aesthetic questions such as balance and symmetry. She is interested in what makes aesthetic sense, not the so called conceptual sense of imitation or crude representation.

4.2.4. The Inappropriate Separation of Science and the Aesthetic

But herein lies a problem. While essentially aesthetically good notions like balance, symmetry and homeostasis tell one a great deal about what constitutes good art (see, for example, Klee 1953), they tell one equally what constitutes good science. A great problem solution such as Einstein's general relativity is no less aestheticly pleasing than a Cezanne still life. Indeed Kaufmann (1977) has even considered it to have aesthetic "validity" over its competitors:

> It should, however, be pointed out that, mathematically, Einstein's theory is extremely simple and beautiful. The competing theories are not. If beauty and simplicity are in some way a measure of validity, we may continue with confidence in assuming Einstein was right.

A stimulating discussion of the importance of beauty in science, specifically with reference to Einstein's general relativity, can be found in Dirac (1981). In this extract, entitled 'The test of Einstein', Dirac goes further than Kaufmann, holding that the primary test of a scientific theory is its beauty, a point he also made strongly (Dirac 1963) with reference to Schrodinger's wave equations. He says of Einstein:

> He was guided only by the requirement that his theory should have the beauty and the elegance which one would expect to be provided by any fundamental description of nature. He was working entirely from these ideas of what nature ought to be like and not from the requirement to account for certain experimental results.

and later:

> ... one has an overpowering belief that its foundations must be correct quite independent of its agreement with observation.

It would be difficult to state the central importance of beauty to scientific thinking with greater commitment. If one needs any further evidence of this importance, one need only cite the emphasis on the aesthetic nature of mathematics by Poincare (1914) and Hardy (1940).

It is, however, unfortunately true that, culturally, we are not encouraged to appreciate the beauty of science, but this is a function of our contemporary cultural reality, not of beauty. Thus aesthetic criteria unite art and science rather than uniquely specifying art. It might therefore be argued that Kellogg is studying something more like visual thinking than "art" (cf

Arnheim below). Kellogg's confusion of artistic and aesthetic is important because it is a confusion we all take for granted. I am suggesting here that science is an aesthetically based activity, just as art is. Any distinction between the two must be made on other grounds.

4.2.5. The Confaltion of Art and Visual Thinking: Arnheim

Another researcher who has taken the artistic importance of children's drawings seriously is Ruldolf Arnheim. However he seems most concerned with visual versus verbal thinking in general, with visual art as a prime example of the former. He is less concerned with how art differs from non-art. For example he says (1969, p295):

> Thinking calls for images, and images contain thought. Therefore the visual arts are a homeground for visual thinking.

While one can accept this conclusion, Arnheim, specifically interested in painting as he is, like Kellogg, risks conflating "art" and "visual thinking", or "visual form" when he advocates

> ... a psychological and educational approach that recognizes art as visual form, and visual form as the principle medium of productive thinking. Nothing less will serve to free art from its unproductive isolation.

One can only respect Arnheim's intention here: namely to encourage us to take visual thinking more seriously. But his assertion that all productive thinking is visual and that art is a prime example of visual thinking, suggests that he sees art as some sort of model of, or aid to, the productive process in science. "Art, then, approaches the means and ends of science very closely ..." He thus implicitly justifies the role of art by

association with science. Art becomes a sub-process of science, rather than both being subsumed by a model of human thought.

The point that Arnheim makes, that visual thinking can be of great value to science, is a good one, but it is not the point which he claims to be making, namely that art per se can be of great value to science. This conflation does however draw attention to an important problem, touched on above: not only do we neglect art, we also fail to take visual thinking seriously. Since neither activity claims our full attention, and they have points of contact, it is easy to conflate the two. But they are clearly not one and the same thing. This reinforces the need for a general model of ways of thinking.

4.2.6. Geometry and Algebra: Davie

A discussion of the development of the trend away from serious visual thinking can be found in Davie (1961). Here he discusses the conflict between the mathematical traditions of the universities of Scotland and England in the eighteenth and nineteenth centuries. He encapsulates the struggle by quoting Sir William Hamilton (the Scottish Philosopher, not the Irish mathematician):

> The mathematical process in the symbolical method (i.e. the algebraic) is like running a rail-road through a tunnelled mountain; that in the ostensive (i.e. the geometrical) like crossing the mountain on foot. The former carries us, by a short and easy transit, to our destined point, but in miasma, darkness and torpidity, whereas the latter allows us to reach it only after time and trouble, but feasting us at each turn with glances of the earth and of the heavens, while we inhale health in the pleasant breeze, and gather new strength at every effort we put forth.

A recent contribution to this discussion is to be found in Paterson (1984). The latter comments:

> ... the physical position of the point on a page may for formal purposes be equivalent to two cartesian coordinates, but formalism is only one way of looking at mathematics and the equivalence may not necessarily be sustained for the purposes of teaching, or the application to science, or investigating the philosophical basis of mathematical thought.

and later:

> The writings of the Scottish geometers might benefit modern mathematics in three areas: the psychology of learning and doing mathematics, the application of mathematics to science, and the elucidation of the nature of mathematical knowledge.

The growing interest in a return to a more visual approach to mathematics is clear in a number of places, including Pappert's work with the computer controlled line-drawing 'turtle', and also a recent issue of New Scientist, in which two articles, Dixon (1985) and Kavanau (1985), are devoted to a consideration of this problem.

As evidence of our present underexposure to such visual thinking one can cite the surprise and wonder with which many people greeted Jacob Bronowski's (1973) visual demonstration of Pythagoras' theorem. We are no longer used to such a visual approach to thought, but one suspects that the Edinburgh mathematicians of the Enlightenment, and for that matter their contemporary, Robert Adam, would have been less taken aback. That such an approach can be successful has been recently demonstrated even in groups whose previous experience of mathematics has been bad. An interesting article on this topic is White (1985).

It doesn't matter for Arnheim's purposes that he tends to conflate art and visual thinking, since his emphasis is on the visual in general rather than the artistic in general. However it makes a great deal of difference to anyone wanting to examine the idea of art more broadly.

4.2.7. Goodnow: Art and Guilt

These criticisms should not obscure the fact that these authors at least take children's drawings seriously. In contrast the consideration of children's drawings as art is overlooked by most psychologists because we are unused to taking art seriously. This point can be further clarified by considering what Goodnow writes in the conclusion to her book. Although like Arheim and Kellogg she takes the artistic importance of children's drawings seriously, she feels compelled to justify this interest. She writes:

> how can such sources of pleasure be part of 'science'? I have tried to convince you that you should feel no guilt. Graphic work is truly 'visible thinking'. The features it displays – thrift, conservatism, principles of organisation and sequence – are features of all problem-solving whether by children or adults.

The interest of this passage lies in the author's implicit awareness that in order to have anything taken seriously within contemporary psychology it is both necessary and sufficient to imply that it is a type of problem solving. Art must be squeezed into a scientistic mould so that it can be taken seriously. Goodnow is up against the dominant cultural reality and it shows.

One can also draw attention to her use of the words "pleasure" and "guilt", since these bear on this same problem of scientism. She implies that as scientists we may feel guilty at working with subject matter as pleasure-giving as are children's drawings. This guilt may lead us to conclude that children's drawings are scientifically irrelevant.

There is clearly no logic here, but I think we know what she means: but why do we know what she means? This question can draw attention to

some of our uncritical assumptions about human thought. Goodnow feels that she must justify pleasure by bolstering it with the "reality" of science. One must conclude that scientists aren't "really" meant to enjoy themselves. Pleasure is not part of the dominant cultural reality. Of interest here is Einstein's description of his own "education" in science:

> One had to cram all this stuff into one's mind, whether one liked it or not. This coercion had such a deterring effect that, after I had passed the final examination, I found the consideration of scientific problems distasteful to me for an entire year .... It is a very grave mistake to think that the enjoyment of seeing and searching can be promoted by means of coercion and a sense of duty.

One might question whether it was ever the intention the promote enjoyment. It would be interesting to explore these ideas further in terms of Freud's deliberate theoretical separation of "pleasure" and "reality". The durability of Freudian theory despite its critics, may indicate that it is an unwitting re-statement of our assumptions about cultural reality. It strikes a cultural chord, and is thus felt to be of value even if we have rational misgivings about it.

4.3. THE NEED FOR A MODEL OF WAYS OF WAYS OF THINKING

Until psychologists have something coherent to say about things like literature and painting as well as things like logic, and can talk about both in the same context, the notion that psychology is a science of mental life in any complete sense rings somewhat hollow.

4.3.1. Towards a General Model

If this is taken seriously, it becomes possible to develop a new perspective on ways of thinking such as art and science.

This is, in Bateson's (1979) phrase, a "perspective on perspectives". Such a perspective is essential for any coordinated study of ways of thinking. If general enough it will also bear on the problems that Bateson refers to at the end of his last book, namely the nature of the sacred and the beautiful. It is a perspective on ways of thinking which are "equally simple" for human beings as a species.

4.3.2. The Principle of Equal Simplicity

The "principle of equal simplicity" is a useful heuristic introduced by Nicolas Bernstein (1967) to enable one to comment on the nature of a system by observing what tasks it can do with equal ease, and what tasks it finds equally difficult to perform.

To take one of his examples: if a drawing system can only draw circles of one radius, that is to say circles of one radius are "equally simple" for it to draw, then one can infer from these products that this system is probably more like a template than it is like a set of compasses, since a template is characterized by the production of circles of one radius, while a set of compasses is characterized by the production of circles of any radius.

Taking the idea further, another drawing system in addition to the template is characterized by the production of circles of equal radius. This is the ellipsograph. What can be produced with equal simplicity with this system are ellipses of identical circumference. One can make a decision between template and ellipsograph by noting whether or not it is equally simple for the system to produce ellipses other than circles.

Bernstein uses this principle when he infers, for example, that the

control for the circle describing ability of the human arm in any orientation with equal simplicity must be based on a centrally held conception of space not on a motor image in the muscles. Only such a conception could enable all these movements to be made with equal simplicity.

The principle has general applicability. For example, since human beings find it simple to add two numbers but not four thousand, a computer which can add two numbers or four thousand numbers with equal competence is not an adequate model of this human mental process. It doesn't make the right mistakes. The tasks that it finds equally simple are quite different from those which humans find equally simple. Or again, human beings find the interpretation or production of a range of inexact diagrams equally simple. Computers at present require metrical exactitude for interpretation and production of diagrams. Again, what is equally simple for them is different from what is equally simple for human beings.

Turning to ways of thinking, one can comment that just as it is equally simple to describe circles in different orientations, it is equally simple at least initially to think in a variety of different ways.

One would expect these different ways of thinking to be substantially reflected in our institutions of further education. The point is that artistic thought on the one hand and scientific thought on the other are equally simple modes of human thinking.

4.3.3. Constructing the Viewpoint

How can we construct such a perspective on ways of thinking? The honest answer is: by wondering about it. I use this phrase to de-emphasise any idea of simple logical progression of thought.

The development of the theory is from spatial model to precise terminology rather than vice versa. The dictionary only became useful at an advanced stage. In Bateson's words:

> ... (if we) could say how they are related, we could perhaps say what the words mean

This is an attempt to say how words to do with art and science are related.

4.3.4. Polya's Paradox

The model to be proposed may seem unfamiliar due to its generality. If any justification of this generality is needed, Polya (1957) has provided it:

> The more ambitious plan may have more chances of success. This sounds paradoxical. Yet, when passing from one problem to another, we may often observe that the new, more ambitious problem is easier to handle than the original problem. More questions may be easier to answer than one question. The more comprehensive theorem may be easier to prove, the more general problem may be easier to solve.

This comment is particularly appropriate here: it is not possible to understand art fully, without reference to science and vice versa.

In developing the model I found that I was dealing with what looked like fundamental ways of thinking, or ways of giving meaning to phenomena, which were substantially typified by arts and sciences.

I was no longer dealing directly with arts and sciences. it is important to make this point. However the most convenient and potentially useful way of imagining the model is as a model of arts and sciences.

CHAPTER 5

A MODEL OF THE RELATIONSHIPS BETWEEN ART AND SCIENCE

> For Truth, like Einstein's universe, looks different according to where one is standing. This means that science does not confute literature, or even clash with it. The two are simply different ways of viewing the world. Martin (1975)

> The order that our mind imagines is like a net, or like a ladder, built to attain something. But afterward you must throw the ladder away, because you discover that, even if it was useful, it was meaningless. Eco (1983)

> To be an atheist is to maintain God. His existence or his non-existence it amounts to much the same on the plane of proof. Thus 'proof' is a word not often used among the Handdrata, who have chosen not to treat God as a fact, subject to either proof or to belief: and they have broken the circle and go free. LeGuin (1969)

5.1. INTRODUCTION: BACKGROUND TO THE MODEL

At the end of chapter three I said that the finding of a difference in birth order between those eminent in art and those eminent in science had left me facing a fundamental question, namely "what is the relationship betwen art and science?" But had I not been interested in answering this question I would probably not have noticed it as a question. So: why was I interested in answering it? What was my background to asking it? The following paragraphs, introducing the model, give some clue.

5.1.1. Koestler and Hesse

Some years ago I studied painting at art school. During this time I became increasingly interested in the nature of art. Painting seemed to be a way of understanding one's position as a human being in and of the universe, or just simply understanding the universe. In this respect it seemed to be very like science.

I was attracted to Koestler's (1959) discussion of the aesthetic aspects of science in "The sleepwalkers" and for similar reasons I was interested in the fictional game described by Hesse (1943). This involved all types of intellectual activity. In its most advanced form each move in the game is a cue for contemplation of the relationships between the different disciplines. While tracing Hesse as an antecedent to my own thought I re-read his description of the history of this game, which gives context to general approaches to ways of thinking:

> How far back the historian wishes to place the origins and antecedents of the Glass Bead Game is, ultimately, a matter of his personal choice. For like every great idea it has no real beginning; rather it has always been, at least the idea of it. We find it foreshadowed, as a dim anticipation and hope, in a good many earlier ages. There are hints of it in Pythagoras, for example, and then among Hellenistic Gnostic circles in the late period of classical civilization. We find it equally among the ancient Chinese, then again at the several pinnacles of Arabic-Moorish culture; and the path of its prehistory leads on through Scholasticism and Humanism to the academies of mathematicians of the seventeenth and eighteenth centuries and on to the Romantic philosophies and the runes of Novalis's hallucinatory visions. This same eternal idea, which for us has been embodied in the Glass Bead Game, has underlain every movement of Mind towards the ideal goal of a universitas litterarum, every Platonic academy, every league of an intellectual elite, every rapprochement between the exact and the more liberal disciplines, every effort towards reconciliation between science and art or science and religion. Men like Abelard, Leibniz, and Hegel unquestionably were familiar with the dream of capturing the universe of the intellect in concentric systems, and pairing the living beauty of thought and art with the magical expressiveness of the exact sciences.

Hesse is writing in the person of a cloistered academic at this point, and indeed the whole book is very much the view from the ivory tower. But the very popularity of the book is an indication of the everyday importance of the ideas.

It was with this background and these interests that I started to study psychology. I was not intentionally studying the relationships between ways of thinking such as art and science however the possibility of such relationships was always at the back of my mind. As I've mentioned, I was interested in Hudson's work on convergent and divergent thought. But these ideas have the disadvantage of offering a one dimensional solution to the art/science distinction. Thus while one can distinguish art from science in an interesting way, the problems of distinguishing maths from physics or music from painting remain. Perhaps for this reason I was more attracted to two dimensional solutions such as Piaget's "circle of the sciences".

5.1.2. Piaget's Circle of the Sciences

Piaget was keenly aware of the importance of a theory of knowledge to psychology. He took the view that in order to understand the cognitive structures of the mind we need a proper epistemology, however he regarded only science as of interest from this point of view, and as I've indicated this is dealing with only part of the problem.

Piaget (1972a) points out that sciences are normally thought of as progressing from maths to physics to biology to psychology (or sociology as in Comte's hierarchy of the sciences), but that the two extremes, mathematics and psychology, seem to be drawing together to form "a kind of circle". He sees psychology as an attempt to explain why the development of intelligence ends in the highly logical activity of formal operational thought. He answers this question by proposing that thought somehow enables mathematical reality, in much the same way as biological reality enables any form of psychological process, or physical reality enables any form of biological organism, or mathematical reality enables

physical reality. (Whatever that "way" may be). **Note 7.**

Precisely how one should think of the relationship between the mathematics of the mind and the mathematics which seems to underpin physical reality is problematic, but one should not let this obscure the usefulness of the circle of the sciences as a heuristic for exploring thinking.

While Piaget's circle only refers to part of the epistemological problem, his example, that of creating a conceptual unity from seemingly disparate elements, was most helpful to me. In the light of the model to be discussed here it becomes possible to suggest a related circle of the arts. See below.

5.1.3. Waddington's "Behind Appearance"

Another thinker I found helpful early on was C.H. Waddington. His interest in the relationship between art and science emerges first in "The scientific attitude" (1941), and receives proper consideration in "Behind appearance" (1969). The latter is subtitled "a study of the relations between natural science and painting in this century". In it he considers both natural science and non-figurative painting to be complementary investigations of what lies behind appearance. He regards these two areas as linked by identifiable features and claims that there is a "dialogue between painting and science about the nature of the external world". He concludes his book with these words:

> We have been led, by a consideration of one apparent discontinuity in human experience, that between painting and natural science, to recognize that there is a continuity between them after all, and that this continuity extends out into wider fields .... the conclusion we have come to is that man is an Argus with innumerable eyes, all yielding their overlapping insights to his one being, that struggles to accept them in all their variety and richness.

I wanted to see this variety and richness within one coherent framework.

5.2. THE MODEL OF WAYS OF THINKING

5.2.1. An Initial Insight

Things began to fall into place when I started trying to map the activities in which I was interested onto a three dimensional shape, namely a cube. There's nothing special about a cube here (indeed I have used a sphere as a more ideal expression of the model), except that it's a good tool for thought: it helps to keep one's thinking straight because it has edges and corners. Why I started using this three dimensional structure I don't know, however it may be related to the fact I had been thinking of art/science differences with respect to hemispheric specialization, and had just been using Bogen's (1969) propositonal/appositional distinction to try and sort them out. It may be that my thinking of a three dimensional structure like the brain carried over into my thinking on art and science in general.

I mention all this to try and avoid the usual practice of pretending that present work is the logically necessary outcome of all that has preceded it. The pattern of autobiography in this case seems more helpful than the pattern of logic.

5.2.2. Planning a Library

There are substantial difficulties in communicating an unfamiliar model, but suppose you were faced with the task of designing a general library, so that the inter-relationships of the areas of thought covered by that library

were reflected in the structure of the building itself. The design would only be satisfactory if it enabled people to progress from one subject area directly to any other closely related subject area. It would not be satisfactory if people could not go directly from, for example, social science to, on the one hand, history, and to biology on the other. Similarly it would not be satisfactory if people could not go easily from music to painting or to literature.

The question is this: what shape would such a library be? The answer is: the same shape as a coherent model of ways of thinking. It is interesting to reflect that since the model to be proposed is three dimensional, such a library could in fact be built. I hope it will be.

Schopenhauer helps to put such a library in perspective:

> As the biggest library if it is in disorder is not as useful as a small but well-arranged one, so you may accumulate a vast amount of knowledge but it will be of far less value to you than a much smaller amount if you have not thought it over for yourself; because only through ordering what you know by comparing every truth with every other truth can you take complete possession of your knowledge ...

The proposed model or library is a way of comparing every truth with every other truth.

In examining the diagrams and descriptions below keep this "coherently related library" analogy in mind. Imagining a journey round such a library may be of particular help. Bear in mind that the library will have a highly efficient stair, escalator and lift system connecting nearby areas to each other. Thus in your journey ignore gravity, which would otherwise bias the structure of the library by making it more easy to travel horizontally than vertically.

5.2.3. The Development of the Model

I have said that the initial insight was that a three dimensional model had an explanatory power in some way appropriate to the problem of relating the arts and sciences. What are these "dimensions"?

I approached this problem by giving working labels to the surfaces of the cube. note (7). I eventually became more aware of the precise nature of the model. I was then able to give more precise labels to the surfaces. But in a real sense these labels are provisional. They are to meet necessity. The model does not originate in them. **Note 8.**

They represent a coherent group of approaches to meaning. One can call them elements of thinking. They are characterized by the following concepts: **analysis, ambiguity, development, space, resemblance** and **form.**

Analysis is closely involved in what we call sciences. Each work depends on being interpreted in only one way. Typical analytical activities are biology, social science, mathematics and physical science.

Ambiguity is very much involved in art; each work has many possible appropriate interpretations. Typical activities concerned with ambiguity are music, plastic arts, mythology and literature.

Development is to do with what one might call a timespace, or following Waddington, a chreod, rather than a spacetime. The irreversible order of events is of paramount importance. Novels, studies of development, chess, and biographies do not make sense backwards. Activities typifying this element of thought are social sciences, history, literature and games.

Space is to do with potential reversibility and the implications of of such

multi-directionality. Even time is thought of in this radically spatial way in physics, for example its treatment as a dimension, or the backward time of Feynman diagrams. Typical activities are plastic art, physical science, design and depiction.

Resemblance is to do with, not so much what something is, but what it is like, that is to say it is to do with a relation external to the thing. Activities which depend heavily on this concept are history, biology, depiction and mythology.

In contrast, **Form** is do do with internal relations. The relations with such a formal work count for more than what it is like. This element of thinking is typified by the activities of design, music, games and mathematics.

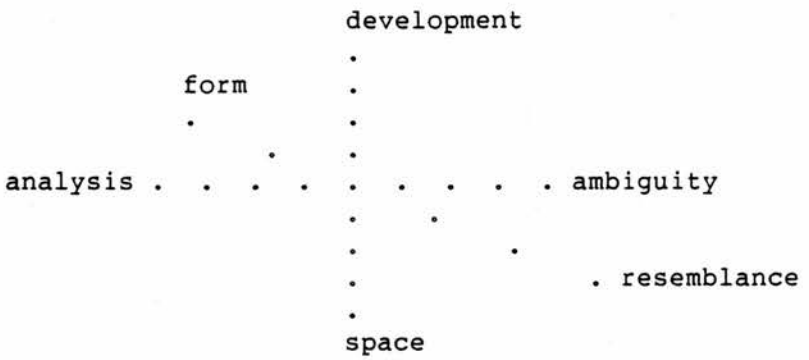
These concepts can be seen as three sets of complementarities or polarities. These are the dimensions of the model. They can be called categories of meaning. These three categories are:

(1) **Definitional**: one or many interpretations (analysis vs ambiguity)

(2) **Directional**: irreversible or reversible (development vs space)

(3) **Relational**: internal or external (form vs resemblance)

The convention adopted here is that the development/space polarity is represented vertically, the analysis/ambiguity polarity is represented from left to right, and the resemblance/form polarity is represented from front to back.



This structure makes sense of a substantial body of ways of thinking. These are most accurately described by the concepts which characterise them (eg "thinking about development and ambiguity") however each way of thinking is also typified by an identifiable approach to knowledge, an identifiable activity. Thus thinking about development and ambiguity is typified by the production of literature. Similarly, thinking about form and analysis is typified by the production of mathematics.

5.2.4. Categories of Meaning

I shall now consider each category of meaning in turn. This will enable the reader to appreciate the model part by part, so that the complete model, in which all three categories of meaning are brought together, will be more fully understood.

5.2.4.1. Definitional

The definitional category of meaning is reflected in the analysis/ambiguity polarity. The concept of analysis is underpinned by the idea that phenomena can only be interpreted in one way. Each has only one true meaning. In contrast ambiguity is underpinned by the idea that every phenomenon is interpretable in many different ways. Ambiguity thus implies

multiplicity, not vagueness, of interpretation. One is thus offered a choice of type of definition with respect to any phenomenon: does it have meaning by virtue of singularity of definition? Or does it have meaning by virtue of multiplicity of definition? Singularity of definition is typified by what we call science. Multiplicity of definition is typified by what we call art. While in science f=ma is an infinitely repeatable singular definition, in art there are an infinite number of different definitive interpretations of each work, none of which can be repeated.

It is only because the listener, reader or spectator is an interpreter that one can talk about unrepeatable interpretation, otherwise one might argue that a recording, or a reproduction was a repeat interpretation. But the interpretation is a construction of the mind of the experiencer, and it will be different every time the "same" record is put on, or every time the same pictorial reproduction is looked at. This is useful to consider because it shifts the idea of interpretation away from the work itself onto the experiencer of the work of art, science or whatever, which is where it belongs. Note that the creator of the work is also an experiencer.

This is not to say that the appreciation of such things are simply matters of of individual taste: it is to say that they are matters of individual interpretation. There's no point in listening to Stravinsky or reading Einstein if you cannot follow (i.e interpret) at least some of the transformations made. But while understanding Einstein you are aiming for one repeatable interpretation, in understanding Stravinsky you are aiming for an infinite number of related interpretations. These could be called individual productions. In contrast the scientific interpretation is (potentially) a mass production. Note that this is not a question of implications. Einstein's theories have no doubt infinite implications, but these depend on

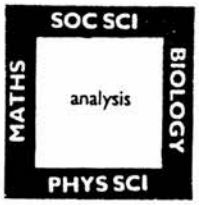
understanding them in precisely defined ways.

This contrast between analysis and ambiguity also helps to sort out the problem of change in art and science. In art these changes are called stylistic, in science they are called paradigmatic. In art change comes about when there is a failure of ambiguity, eg when a style becomes the expected convention. In science they come about when there is a failure in analysis. Thus paradigm change and style change are similar processes, but they depend on completely different starting assumptions, style change on the assumption that meaning is a property of ambiguity, paradigm change on the assumption that meaning is a property of analysis. It is interesting to note that it is just such failures (conflicts in) analysis which Piaget sees as critical to cognitive development. Perhaps we should begin to look in addition for failures of ambiguity as similarly critical to cognitive growth.

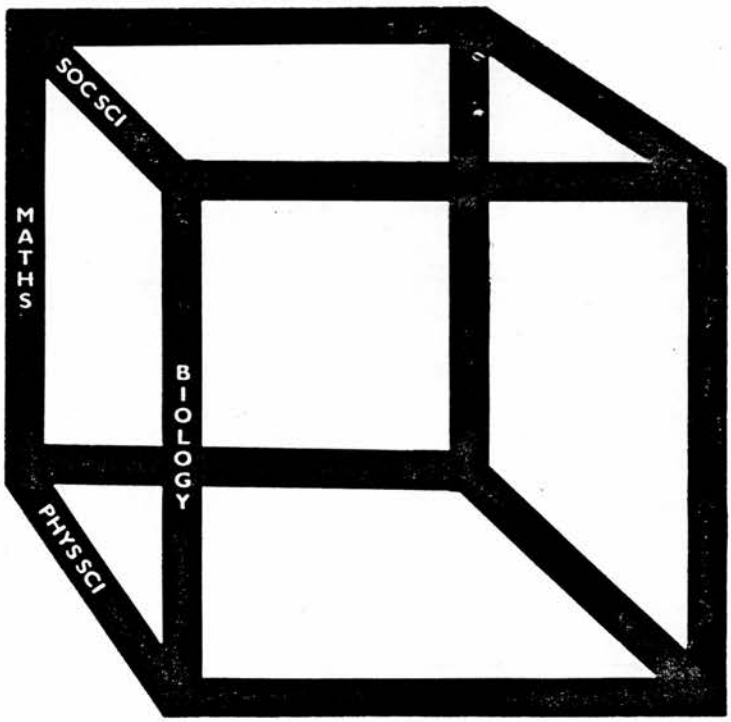
The two surfaces of the model linked by the definitional category of meaning (analysis and ambiguity) appear below. Each surface should be looked at as a whole: a group of four activities characterized by one concept. To pursue the above analogy further, each surface can be considered a floor, wall or ceiling of the library.

ANALYSIS

The "concept of analysis" surface (meaning as a property of single definition) unites physical science (analysis/space), mathematics (analysis/form), social science (analysis/development) and biology (analysis/resemblance). **Note 9.**



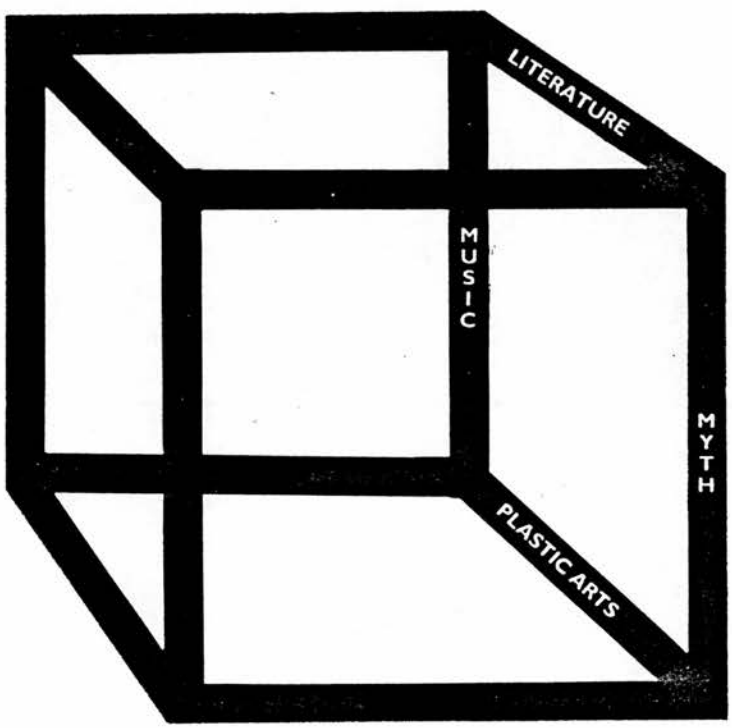
The diagram below shows how this group of activities can be placed as the left hand surface of the model (following the convention suggested above).



AMBIGUITY

The "concept of ambiguity" surface (meaning as a property of multiple definition) unites plastic arts (ambiguity/space), music (ambiguity/form), literature (ambiguity/ development) and myth (ambiguity/resemblance).

The following diagram shows how this surface is placed as the right hand surface of model:



5.2.4.2. Directional

The directional category of meaning is reflected by the development/space polarity. Development is underpinned by the idea of a single irreversible direction. It does not make sense to talk about reversing the sequence of development (if you can reverse the sequence it isn't development). In contrast space is underpinned by the idea of complete reversibility. The contrast here is between activities in which time (or something time-like) is salient and activities in which space (or something space-like) is salient.

Where time-like order is salient any spatial arrangement can only be understood if its temporal significance is clear. Meaning is a property of irreversible sequence. Things that are appropriately viewed in this way include melodies, literature, histories, games, social science, programs and rhythms. They can all usefully be thought of as inherently to do with development (giving something time-like, conceptual priority) rather than space.

In activities in which space is salient for example physical science, design, geometry or painting, temporal questions are best understood in terms of space. This is most clear when one considers time from a physicist's perspective: not only has it been considered just another space-like dimension since Newton's day, it is now even considered to be reversible, for example in Feynman diagrams, or bi-directional as in Stannard (1966). Thus development can be considered as uni-directional, while space is multi-directional. One is thus again offered a choice: either a phenomenon can be considered meaningful by virtue of its uni-directionality, or by virtue of its multi-directionality.

Early on in the development of the model I used the distinction between spatial and temporal, rather than between concept of space and concept of development, however I found this to be unsatisfactory because the separation of space from time did not seem to exist. What did seem to exist were things in which temporal properties only made sense with reference to space, for example Einstein's theory of relativity, and other things in which spatial properties only made sense with reference to time, for example a book, an embryo, or an algorithm. The latter occupy what might be called a timespace rather than a spacetime, and I therefore characterised them as developmental since this word implies a making sense of the activity of a system with reference primarily to temporal rather than spatial features.

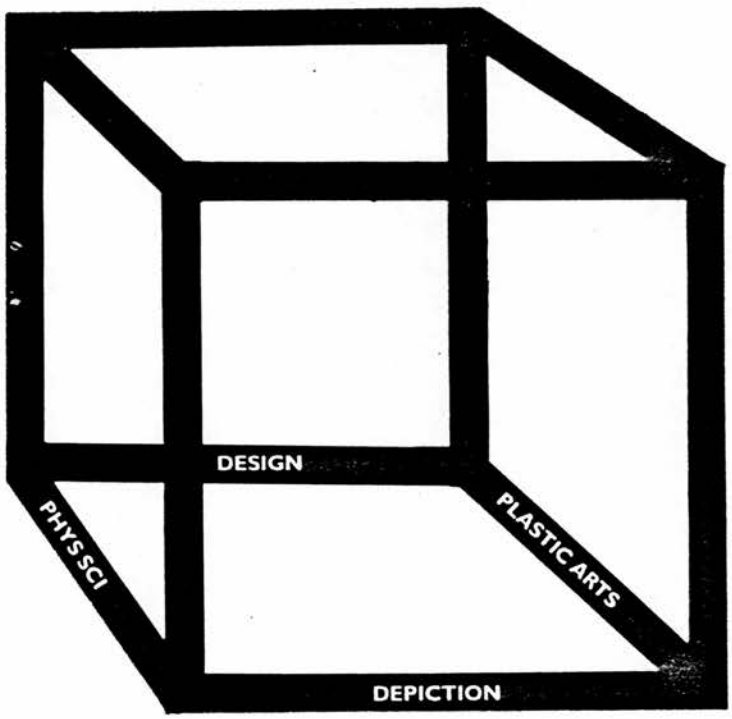
If I reverted to the use of temporal versus spatial I would find it difficult to cope with, for example, Waddington's (eg 1975) topological idea of the chreod (necessary path of development) since there would be immediate pressure to classify this as spatial rather than temporal. This would be unsatisfactory, because the idea refers to development, not space. The fundamental idea of a chreod is the journey. The geography is only relevant with respect to this.

The two surfaces linked by the directional category of meaning (space and development) appear below.

SPACE

The "concept of space" surface (meaning as a property of reversible direction) unites physical science (space/analysis), design (space/form), plastic arts (space/ambiguity) and depiction (space/resemblance).

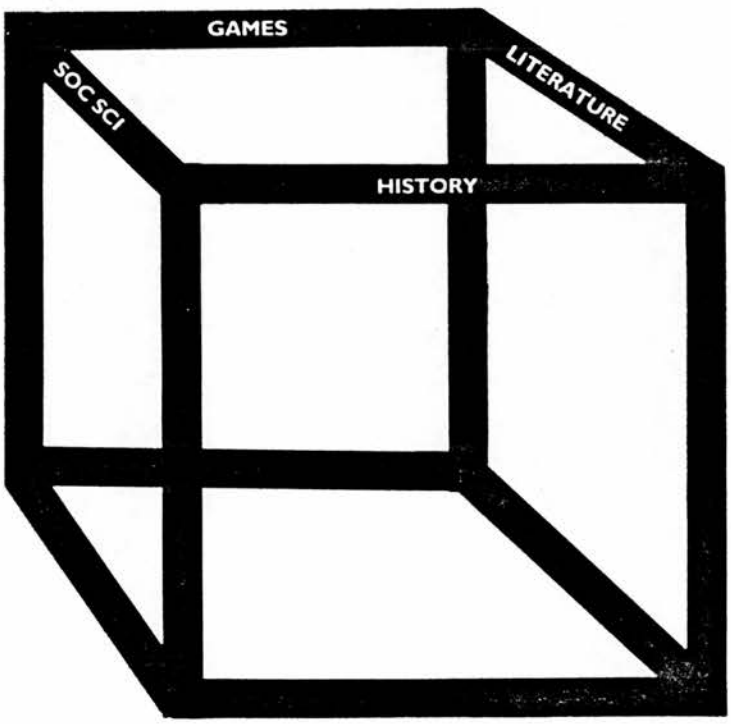
This surface is positioned on the model like so, as the lower surface:



DEVELOPMENT

The "concept of development" surface (meaning as a property of irreversible direction) unites social science (development/analysis), games (development/form), literature (development/ambiguity) and history (development/resemblance).

This surface is placed on the model as a whole, as the upper surface, thus:



5.2.4.3. Relational

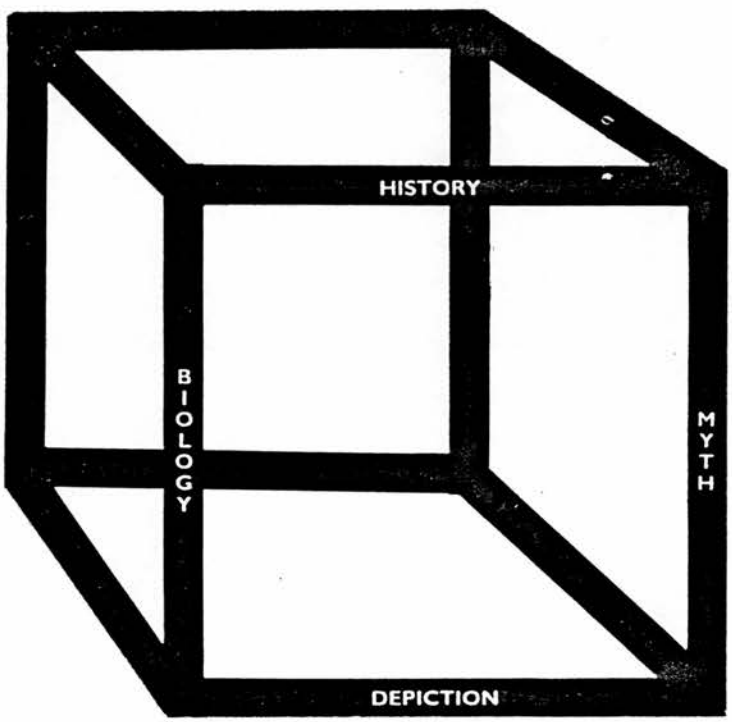
The relational category of meaning is reflected by the form/resemblance polarity. The concept of form is underpinned by the idea of internal relations. It is a concentration on what is going on inside the boundaries of the phenomenon. In contrast the concept of resemblance is underpinned by the idea of external relations. What is internal to the phenomenon is taken for granted. What is important is how the phenomenon relates to something external to it. Again one is offered a choice: is this phenomenon meaningful by virtue of its internal relations, or is it meaningful by virtue of its external relations?

The two surfaces of the model characterized by the relational category of meaning (form and resemblance) appear below.

RESEMBLANCE

The "concept of resemblance" surface (meaning as a property of external relations) unites history (resemblance/development), myth (resemblance/ambiguity), depiction (resemblance/space) and biology (resemblance/analysis).

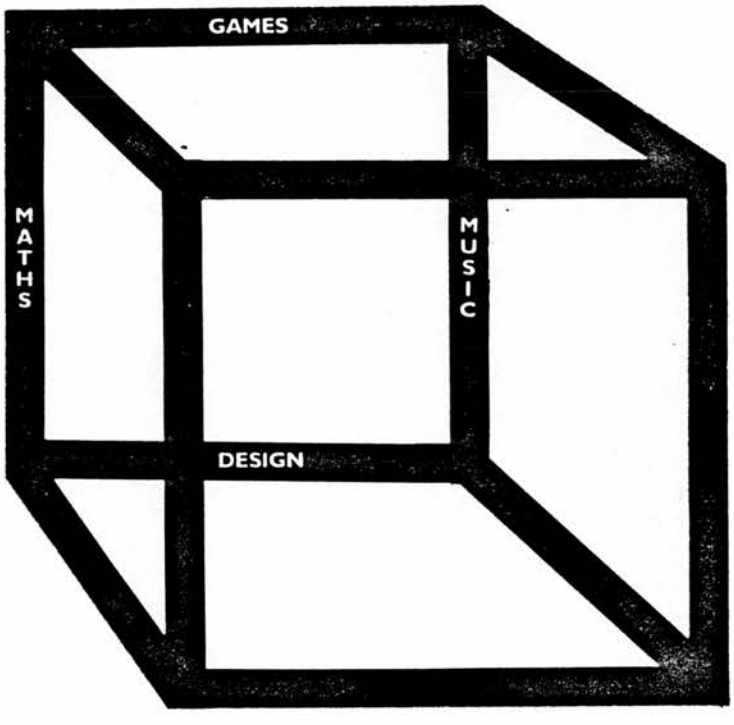
This group of ways of thinking is positioned on the model, as the front surface, as shown below:



FORM

The "concept of form" surface (meaning as a property of internal relations) unites Games (form/development), Music (form/ambiguity), Design (form/space) and Mathematics (form/analysis).

The 'form' surface is positioned on the model (back surface) as shown below:



5.2.5. One and Many

For each category of meaning there seems to be a choice between two possible approaches to meaning. In each case this choice seems to be

between something unique and something infinite; i.e. analysis implies a unique interpretation, ambiguity implies infinite interpretations; development implies a unique direction, space implies infinite directions; form implies a unique set of relations, resemblance implies infinite sets of relations.

5.2.6. Summary of Areas Typifying Ways of Thinking

Biology is centred on ideas about single definition (analysis) and external relations (resemblance).

Physical science is centred on ideas about single definition (analysis) and multiple direction (space).

Mathematics is centred on ideas about single definition (analysis) and internal relations (form).

Social science is centred on ideas about single definition (analysis) and single direction (development).

History is centred on ideas about single direction (development) and external relations (resemblance).

Mythology is centred on ideas about multiple definition (ambiguity) and external relations (resemblance).

Depiction is centred on ideas about external relations (resemblance) and multiple direction (space).

Plastic art is centred on ideas about multiple definition (ambiguity) and multiple direction (space).

Design is centred on ideas about internal relations (form) and multiple

direction (space).

Music is centred on ideas about mutliple definition (ambiguity) and internal relations (form).

Literature is centred on ideas about multiple definition (ambiguity) and single direction (development)

Games are centred on ideas about single direction (development) and internal relations (form)

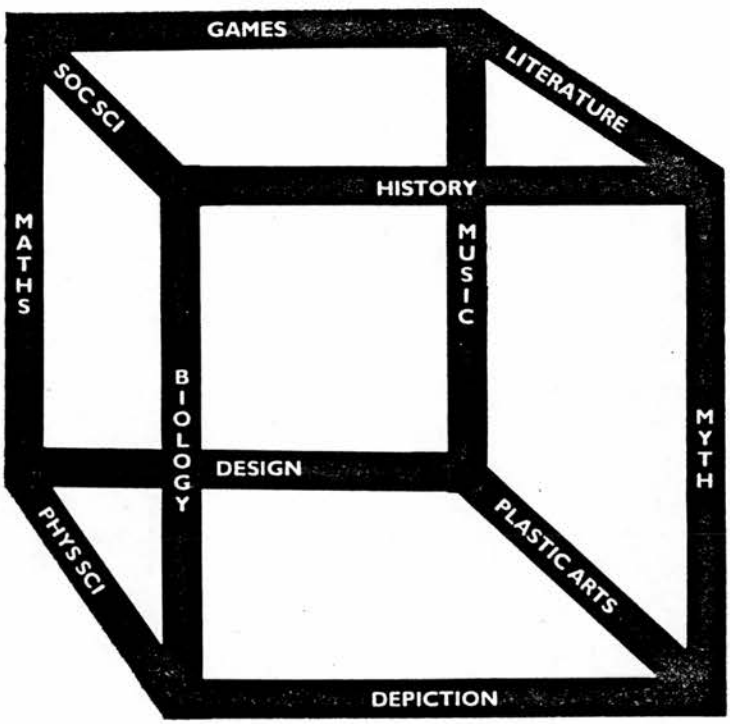
5.2.7. Objections

One might raise objections here. For example: surely there's a great deal of external relation (resemblance) in much music, for example Mahler? True enough: the point with respect to the model is that music can, with a high degree of meaning, be concerned with internal relations (form) and multiple definition (ambiguity), for example Bach's "Art of Fugue", while other activities are less likely to be so concerned. Similarly, biology can, with a high degree of meaning, be concerned with external relations (resemblance) and single definition (anlaysis), eg taxonomy. Other activities are less likely to be so concerned.

Ways of thinking are thus, one might say, epicentres for particular subject areas. They are helpful in sorting out one from another, but they do not bind the thinker. They provide an epistemological home.

5.2.8. The Model

We can now bring these activities together in a diagram of the complete model:



5.2.9. Making Sense of Controversies

Note that the model can contribute to making sense of controversies about the nature of certain activities. For example history relates as strongly to literature as it does to social science. It thus makes sense that there are controversies between historians of literary and sociological orientations. Marwick(1970) makes this controversy plain in his discussion of Trevelyan:

> Returning again to the question of whether history is art

> or science, Trevelyan concluded, rather as Thierry had done before him, and as contemporaries like Stuart Hughes have agreed since, in this fashion: 'Let us call it both or call it neither, for it has an element of both.'

Macaulay versus Marx, so to speak. This controversy is illustrated in an entertaining way by Graves (1936) in an imaginary conversation between the Roman historians Livy and Pollio. The former mythologizes history, the latter scientizes it.

History also relates as strongly to biology as it does to myth. In these terms one can make sense of the controversy between Darwinian claims about the early history of the world and those of creationists such as for example Tytler (1862), who refers to 4004 BC as the date of creation of the world, as though this were the same type of event as the execution of Charles the first.

The creationist view is mythological, with reference to the model, in the same sense as the evolutionist view is biological. They both make sense of questions which bear on history, but they do not attempt to answer the same question, even though these questions can be stated in the same words. A problem arises when proponents of one view think that it answers questions posed by the other. As, for example, when a creation myth is thought to answer a scientific question, or when a scientific theory is thought to have shown that a myth is stuff and nonsense. These are simply errors of classification. An interesting example is given by Kelves (1984):

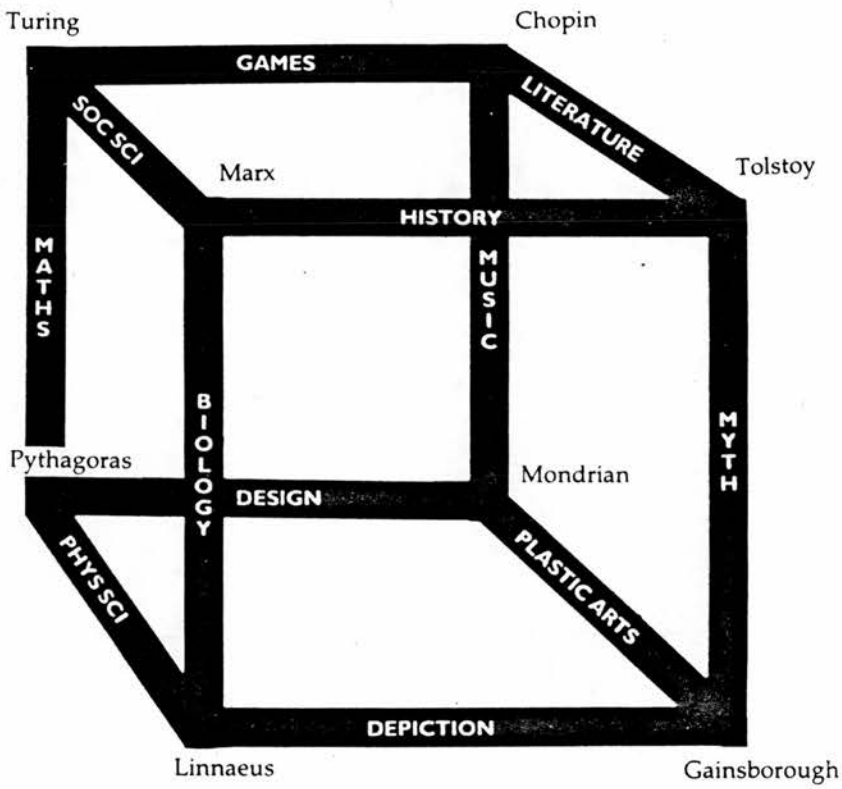
> To Galton's mind, the scientific doctrine of evolution destroyed the religious doctrine of the fall from grace.

note 10.

Similarly it makes sense that social science should be concerned both

with problems of formal logic and games, as in cognitive science, but also be concerned with issues impinging directly on history, as in sociology, and biology as for example in ethology or neuropsychology. The other activities on the model can be considered in a similar way. For example design relates as strongly to physical science as to plastic art, and literature relates as strongly to myth as to music (c.f. Levi-Strauss 1978).

It is helpful to include here another diagram of the model on which have been placed names of representative thinkers:



I would not want to take this naming of the cube too far because it encourages distortion. Most thinkers avoid neat positioning. For example the corner named "Mondrian" only represents Mondrian at his most well known

stage of development. In his earlier work he was much more concerned with resemblance, closer to the point named "Gainsborough" above. Nevertheless as an exercise in gaining familiarity with the model such naming is worthwhile.

5.2.10. The Model as an Analytical Tool

In the light of the above comment about Mondrian, it is clear that one can see the model as a tool for the analysis of the development and scope of ways of thinking in a particular individual. For example, Leonardo was engineer, plastic artist and anatomist, and these activities can be seen as substantially covering the "space" (lower) surface of the model. On the other hand Michelangelo was best known as poet and plastic artist: with reference to these achievements the "ambiguity" (right-hand) surface is more appropriate. Similarly the "form" (upper) surface, with its characteristic activities of maths, games, music and design strikes one as a good starting point for the consideration of Wittgenstein, who as well as being concerned with logic and games, studied as an engineering student at Manchester University and took a keen interest in later life in both architecture and music.

These are clearly preliminary analyses, but they demonstrate the potential use of the model with respect to biographical understanding. It's use with reference to biases inherent within particuar societies is similar. That is to say its use with respect to the analysis of dominant cultural realities (see chapter eight for further discussion of this).

5.2.11. The Model, William James, and Popper's Three Worlds

I originally approached the model much as James (1890) approached his "realities" or "many worlds". That is to say from the point of view of the subjective states of consciousness of the individual, what Popper has referred to as "world two". however it has become increasingly clear that the model reflects properties of Popper's "world three" also. That is to say it is, on the one hand, a model of ways of thinking or types of consciousness, and on the other it is a typology of what Popper has called "objective contents of thought". It is thus no accident that Popper thinks of world three knowledge as potential library knowledge, and that I found myself employing a library as a useful explanatory analogy for the model. An interesting gloss on the objectivity of library knowledge in found in Eco (1983):

> Until then I had thought each book spoke of things, human or divine, that lie outside books. Now I realized that not infrequently books speak of books: it is as if they spoke among themselves. In the light of this reflection, the library seemed all the more disturbing to me. It was then the place of a long, centuries-old mumuring, an imperceptible dialogue between one parchment and another, a living thing, a receptacle of powers not to be ruled by a human mind, a treasure of secrets emanated by many minds, surviving the death of those who had produced them or had been their conveyors.

Specific bodies of objective knowledge would not come into being without particular ways of thinking, but a way of thinking gives rise to a typical activity: that's all. It does not give rise to a specific body of knowledge, for example Newtonian mechanics or Beethovenian symphonic development, it does not even imply that developments somewhat like these will happen. These developments should only be considered in terms

of the whole model. They can only be understood when the culturally dominant ways of thinking are understood (ie how the ways of thinking on the model are selectively valued). For example to understand Beethovenian symphonic development, it is necessary to understand Romanticism, which cannot be understood without reference to the Industrial Revolution and Renaissance and the differential evaluation of ways of thinking during these periods.

What one can say is that knowledge of this or that type is the product of an activity centred on thinking in this or that particular way. Any particular body of knowledge will have the values placed on the ways of thinking in the whole model, both contemporary and historical, as its context. Neither a purely individual nor a purely cultural analysis will do. A body of knowledge will not be properly explicable without a consideration of cultural context but since it will relate to a fundamental way of thinking it will not be fully explicable simply as a function of this context. Thus the ways of thinking typified by painting and literature exist despite the inadequate support structures for them in our present profoundly scientistic culture. The alienation evident in the work of painters and writers at present is a function of these inadequate support structures. The alienation is not intrinsic to the activities per se. It is however intrinsic to the activity as performed in a society in which the dominant objective knowledge is science.

5.2.12. Provinces of Meaning

A consideration of the value that a person assigns to ways of thinking helps to make clear the relationships between those ways of thinking and the activities which typify them. A person who values certain ways of

thinking will consider activities which typify these as central to the meaning of his or her world view.

Thus someone who gives high value to thinking about form and ambiguity will find that an activity typifying this way of thinking, music, yields information central to the meaning of his or her world view. For another person physical science may provide the template for "reality" or "the world". For others it may be history, or literature or mathematics or biology or myth or depiction or design or social science or games. There is of course no reason to limit the basis of one's world view to one activity; indeed it was a dissatisfaction with such an approach which led me to the model in the first place. Such a pluralistic view leads to incommensurabilities between realities which one should simply accept. This acceptance can be justified because it can be seen to have a context, i.e. the model.

A system of such incommensurable realities based on the insights of James has been suggested by Schutz (1945). He refers to these as finite provinces of meaning upon each of which we may bestow the "accent of reality":

> ... we call a certain set of our experiences a finite province of meaning if all of them show a specific cognitive style and are - with respect to this style - not only consistent in themselves but also compatible with one another.

Schutz's view is useful but implies a rigidity of boundaries between cognitive styles, or finite provinces of meaning, which in the light of the continuous relationships between ways of thinking on the model, I would reject. Thus incommensurabilities of ways of thinking are a function of distance of separation on the model, rather than a function of crossing

some definite boundary between provinces of meaning.

One can also now see how the dominant cultural reality can be reflected in the views of individuals within it. If the institutions of a society provide a selective evaluation of ways of thinking such that some are given high levels of support, others little, this filtered view will be the world view with which any individual within that society will have to cope. However it will not be the only possible view. I have suggested in chapter three that firstborn are more responsive to such dominant world views. These can now be interpreted as selective evaluations of the set of possibilities inherent in the model. The particular world view we have at present is centred on "concept of analysis". Science is taken as the most real content of thought.

5.2.13. A Further Consideration of each Typical Activity

5.2.13.1. Physical Science

On the model the way of thinking typified by physical science is most closely related to those typified by mathematics, design, depiction and biology. Bear in mind what this means in terms of the library analogy: from physical science one can move with equal ease to mathematics, design, depiction or biology. It is, cognitively speaking, equally simple to go from physical science to any of these other ways of thinking.

Physical science is given position on the model by "concept of analysis" and "concept of space". The distinctive meaning of physical science is a function of these two concepts. It is bounded, on the "concept of form" side, by mathematics and design, and on the "concept of resemblance" side, by biology and depiction. Physical science thus bridges the gap between

form and resemblance. The area of activity is both in possible formal worlds and in observation. Events of significance include on the one hand suggestions that the universe evolved from "literally nothing" but a set of axioms as speculated by Guth and Steinhardt (1984), and, on the other, observational feats such as those of Babylonian astronomy or Tycho. On the one hand these activities are form driven, on the other hand they are resemblance driven. Physical science necessarily unites the rationalist and the empiricist, and this dichotomy will manifest itself in any discussion of the "true nature" or "true role" of the activity. (This is equally true of social science, see below).

5.2.13.2. Mathematics

The way of thinking typified by mathematics is most closely related to those typified by physical science, design, games and social science.

Mathematics is given position on the model by "concept of analysis" and "concept of form". The distinctive meaning of mathematics is a function of these two concepts. It is bounded on the "concept of space" side by physical science and design, and on the "concept of development" side by social science and games. Mathematics bridges the gap between space and development. This seems to be the distinction between cardinal and ordinal number, or between geometry and topology on the one hand and the irreversible sequences of the algorithm on the other. There is also perhaps a link between this edge of the model and the three Bourbaki mathematical "parent structures": algebraic structures, order structures and topological structures, discussed by Piaget (1972b). Certainly something like order is associated with development, something like topology is associated with space, and something like algebra seems to be the central discipline of mathematics. My understanding of this is limited, but it might be a starting

point for a consideration of Piaget's contribution to cognitive theory, and also a starting point for a consideration of the model from this well established point of view.

5.2.13.3. Games

The way of thinking typified by games is most closely related to those typified by mathematics, social science, literature and music.

Games are given position on the model by "concept of development" and "concept of form". The distinctive meaning of games is a function of these two concepts. They are bounded on the "concept of analysis" side by social science and mathematics and on the "concept of ambiguity" side by literature and music. Games bridge the gap between analysis and ambiguity. Both the most purely analytical chess problem and the most ambiguous, multi-definable spectacle (for example cricket or American football) are games in this sense. It is interesting to note that chess is both multi-definable like a work of art, that is to say capable of an infinite number of correct games, but especially as it progresses it becomes mono-definable like science, that is to say there comes a point at which there is only one right move, one right answer to the problem. In contrast games such as football, or a sport such as skiing never become mono-definable. A different move is always possible at any point.

5.2.13.4. Music

The way of thinking typified by music is most closely related to those typified by literature, games, design and plastic arts.

Music is given position on the model by "concept of form" and "concept of ambiguity". The distinctive meaning of music is a function of these two concepts. It is bounded on the "concept of development" side by literature

and games and on the "concept of space" side by design and plastic arts. Music bridges the gap between development and space. Its essentially developmental characteristic is irreversible sequence: for example rhythm or improvisation. It also has an essentially space-like characteristic. This is at its minimum in rhythm, and at its maximum in a complex harmonic structure. To take an analogy from an activity on the opposite side of the "form" surface, mathematics: rhythm is to music as ordinal number is to mathematics, while harmony is to music as geometry is to mathematics.

A work of music which well reflects the music label on the model is Bach's "Art of Fugue". Perhaps Beethoven's late quartets also. But what about the works of Mozart, Brahms, Monteverdi, Wagner etc? My purpose in labelling part of the surface of the model "music" is to indicate a way of thinking which reflects an essential property of music which is not an essential property of the other typical activities on the model. But most of what we refer to as music has many non-musical elements. For example the combination with literature in opera, or the intended evocation of relatively specific imagery in programme music such as Beethoven's sixth symphony, or Vivaldi's "Four Seasons". The idea of essential music which I am putting forward here is close to Pater's (1873) emphasis of music's purely formal properties, and to Schopenhauer's rejection of "imitative music". It is interesting to note that Schopenhauer had little admiration for Wagner despite the latter's admiration for him (see Gardner 1963, p234). The point is that something typifying thinking about of form and ambiguity which involves both "concept of development" and "concept of space", is more likely to be a piece of music than any thing else. **note 11.**

5.2.13.5. Design

The way of thinking typified by design is most closely related to those typified by mathematics, music, plastic arts and physical science.

Design is given position on the model by "concept of form" and "concept of space". The distinctive meaning of design is a function of these two concepts. It is bounded on the "concept of analysis" side by mathematics and physical science, and on the "concept of ambiguity" side by music and plastic arts. Design bridges the gap between analysis and ambiguity. On the one hand design is analysis driven, form follows function in its most radically "rational" sense; on the other hand it is ambiguity driven and architecture is appropriately described as frozen music. This is again a necessary unity, but this dichotomy will always emerge in debates about the true role of design. One can exemplify this by comparing chair designs from the Bauhaus and by Charles Rennie Mackintosh. Both these chairs are beautiful, but the Bauhaus chair is a carefully analysed scientific construction completely without ambiguity. It is, to paraphrase le Corbusier, a machine for sitting on. In contrast the Mackintosh is almost wholly a work of art. It is capable of an infite number of interpretations. It's fuction (in the broad sense) is imprecise. It is considered a good chair, even if it's uncomfortable. It's multiplicity of interpretations encourages the free range of ambiguous thought, while the Bauhaus chair answers a design brief with precision.

5.2.13.6. Plastic Arts

The way of thinking typified by plastic arts (here defined as painting and sculpture) is most closely related to those typified by music, design, depiction and myth. Plastic arts are given position on the model by "concept of ambiguity" and "concept of space". The distinctive meaning of

plastic arts is a function of these two concepts. The activity is bounded on the "concept of form" side by music and design, and on the "concept of resemblance" side by myth and depiction. Plastic arts bridge the gap between form and resemblance. The appropriate area of activity is on the one hand the investigation of formal properties as in non-figurative art, but on the other hand the use of resemblance as in figurative or representational art. The gap is thus bridged between a Mondrian and a portrait by Gainsborough. Arguments within the activity will often be about the relative merits of form and resemblance.

5.2.13.7. Myth

The way of thinking typified by myth is most closely related to those typified by literature, history, depiction and plastic arts.

Myth is given position on the model by "concept of resemblance" and "concept of ambiguity". The distinctive meaning of myth is a function of these two concepts. It is bounded on the "concept of development" side by history and literature, and on the "concept of space" side by plastic arts and depiction. Myth bridges the gap between development and space. It's area of activity is both the production of the developmental phenomenon of the epic, or historical novel, and the spatial phenomenon of the icon. The balance between icon and epic will play an important part part in disputes about myth. For example, christianity experienced a period of iconoclasm, and there are still strong tensions between those who make use of the iconography of myth and those who favour its narrative aspect.

5.2.13.8. Literature

The way of thinking typified by literature is most closely related to those typified by myth, history, music and games.

Literature is given position on the model by "concept of ambiguity" and "concept of development". The distinctive meaning of literature is a function of these two concepts. It is bounded on the "concept of form" side by music and games, and on the "concept of resemblance" side by history and myth. Literature bridges the gap between form and resemblance. This could be taken as the distinction between on the one hand the deep response possible to a poem in a language one does not understand, and on the other hand the historical novel or epic. One would expect many discussions between schools of form-orientated writers and schools of resemblance-orientated writers.

5.2.13.9. History

The way of thinking typified by history is most closely related to those typified by literature, myth, social science and biology.

History is given position on the model by "concept of development" and "concept of resemblance". The distinctive meaning of history is a function of these two concepts. It is bounded on the "concept of analysis" side by social science and biology. It is bounded on the "concept of ambiguity" side by myth and literature. History bridges the gap between analysis and ambiguity. It's area of activity includes both ambiguous epic and analytical census. Debates about the true role of the activity will often reflect this dichotomy, literary and mythological on the one hand, and scientific on the other. This can be characterised as the Macaulay/Marx debate. Also see above "Making sense of controversies".

5.2.13.10. Social Science

The way of thinking typified by social science is most closely related to those typified by history, biology, mathematics and games.

Social science is given position on the model by "concept of analysis" and "concept of development". The distinctive meaning of social science is a function of these two concepts. It is bounded on the "concept of resemblance" side by biology and history, and on the "concept of form" side by mathematics and games. Social science bridges the gap between resemblance and form, just as does physical science, however the subject matter which enables this bridging is development rather than, as in the case of physical science, space. On the one hand social science deals with the empirical constraints of creating a structure to resemble a particular situation, for example a census or a case study, on the other hand it deals with the possible worlds of algorithms. Marx vs Turing. Also see above "Making sense of controversies".

5.2.13.11. Biology

The way of thinking typified by biology is most closely related to those typified by history, social science, physical science and depiction.

Biology is given position on the model by "concept of resemblance" and "concept of analysis". The distinctive meaning of biology is a function of these two concepts. It is bounded on the "concept of space" side by depiction and physical science. It is bounded on the "concept of development side" by history and social science. Its area of activity is concerned both with space and with development. Both with on the one hand taxonomy and anatomical description, and on the other with embryology and evolution. Linnaeus vs Darwin.

5.2.13.12. Depiction

The way of thinking typified by depiction is most closely related to those typified by myth, plastic arts, biology and physical science.

Depiction is given position on the model by "concept of space" and "concept of resemblance". The distinctive meaning of depiction is a function of these two concepts. It is bounded on the "concept of analysis" side by physical science and biology, and on the "concept of ambiguity" side by myth and plastic arts. Depiction bridges the gap between between analysis and ambiguity. Both an identity photograph and a portrait by Imogen Cunningham are depictions. Both an anatomy drawing and a religious icon are depictions. A depiction, despite our present tendency to conflate the visual with the artistic, is not necessarily art. Beloff (1984) makes this point concisely:

> In one sense a photograph promises reality and truth and scientific precision. And in another it is in the domain of art.

5.3. LOOSE ENDS

5.3.1. The Thinker not the Thing

I mentioned above the primary importance of the interpreter. This can be considered with reference to Beloff's remark. The same photograph can have both scientific and artistic aspects. This is an important point to consider with reference to the model. What you get out of an artifact such as a photograph depends on the way you think about it. A portrait by can be thought of as a work of art. It can also be thought of as a way of identifying the sitter. It is not that the portrait is both an artwork and a means of identification; rather what the portrait is depends on how you use it, on how you think about it. However certain artifacts are tailored to certain ways of thinking, that is to say they are produced by a certain way

of thinking and are best understood by that way of thinking. For example a simple linear composition by Mondrian is best considered in an ambiguous, formal, spatial way. But clearly it could be thought of as a stylized resemblance of scaffolding. The things which are not tailored to any way of thinking are those of the natural world. As Blake said: "Nature has no Outline, but Imagination has". This is perhaps, a key to understanding the model. It is a model of what we can imagine.

5.3.2. Unimaginables

But what happens when we can't imagine something, yet still feel that it's there? How can we feel its there if we can't imagine it? We can only do this if we regard it as a context. That is to say something which gives sense to our thought but by virtue of this cannot be made sense of by our thought.

Such ideas seem odd (although they have superficial analogies with Russell's theory of logical types and Godel's theorem) however they reflect the meaning we give to similarly odd words such as God, Om, Tao and Zen. "God in whom we live and breathe and have our being", sums the idea up quite well. What is God if not a way of identifying context for thought? Wittgenstein in his "Notebooks, 1914–1916" takes this view when he says: "The meaning of life, i.e. the meaning of the world, we can call God" (p73).

The totality, and hence mystical. The unimaginable context: what you understand when you have thrown away the ladder of theory. To quote from the Tractatus:

> 6.54 My propositions serve as elucidations in the following way: anyone who understands me eventually recognizes them as nonsensical, when he has used them as

> steps to climb up beyond them. (He must, so to speak, throw away the ladder after he has climbed up it.)
>
> He must transcend these propositions, and then he will see the world aright.

This notion of God is mystical not mythical. These notions are distinct, although a myth may lead to God just as may a work of theoretical physics; see in this connection Capra (1975). A mythical god is a type of thought, not a context for thought. A mythical god can be the figure of fun or tragedy. A mystical God is not a figure. "I am that I am" is a way of indicating this, as is "In the beginning was the word, and the word was with God and the word was god", as is the imaginary book of the Sufis which they call "In it what is in it" (see Shah 1968). A context, not a jovial personage. To return to Wittgenstein: "How things stand, is God." (Notebooks, p79).

5.3.3. Library, School and Encyclopaedia

To return to the library analogy: in the light of the model one can now imagine moving round the library and finding each area coherently connected to its neighbours. For example one can go from music to literature to history to psychology to biology to physics to maths to design. Each area leads into its neighbours. Since most activities have an accompanying literature, the library is a good analogy for the model, however one could expand the analogy by extending the notion of the library into that of a general resource centre. Extending the notion of library is useful because it begins to make clear the possibilities inherent in the model with respect to the development of a properly integrated theory of education. One can regard this resource centre as a model for a school or

university.

This organizational system reflects closely the meaning of "encyclopaedia" given by Chambers Twentieth Century Dictionary as "The circle of human knowledge" from the greek en=in, kyklos=circle, paidia=education. No doubt Piaget was aware of this connotation when he talked about the circle of the sciences, especially since his fellow French speaker Diderot in his definition of "encyclopaedia" translates "paidia" as "connaissances" that is to say knowledge or learning. In this context of general learning it is interesting to reflect that the Encyclopaedia Brittanica has its origins in an intentionally generalist tradition of education, that of Scotland. The model can be regarded as a series of circles of knowledge; a programme for a complete encyclopaedia.

5.3.4. Circles of Science and of Art

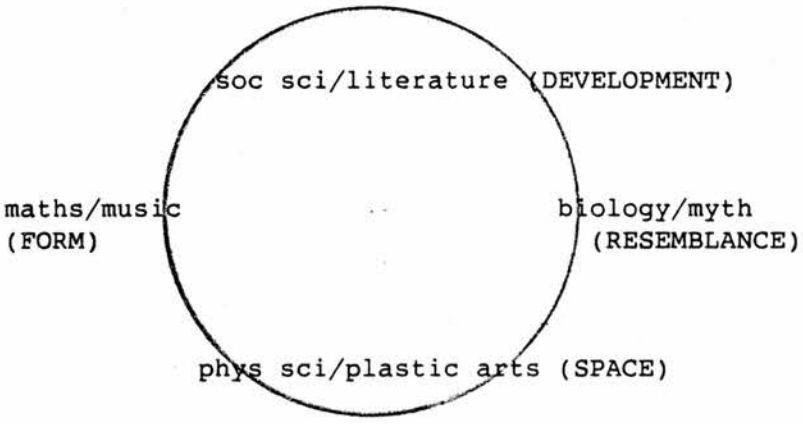
Taking Piaget's work as an example its interesting to rethink the model in this radically encyclopaedic way.

Piaget's circle of the sciences corresponds to the "concept of analysis" surface of the model. Similar circles can be made from the other surfaces. There are three pairs of these, which are iso-conceptual with reference to four of the concepts but differ on the other two. For example the circle of the sciences is iso-conceptual to the circle of the arts with respect to form, resemblance, development and space, but differs in that its context is "concept of analysis", while that of the circle of the arts is "concept of ambiguity". It should be noted that music, often held to be that condition of art to which all arts aspire, not only by Schopenhauer and Pater, but also by Andrei Bely in his essay "The Forms of Art":

> If we place the fine arts in their order of perfection we arrive at the following five principle forms: architecture, sculpture, painting, poetry, music.

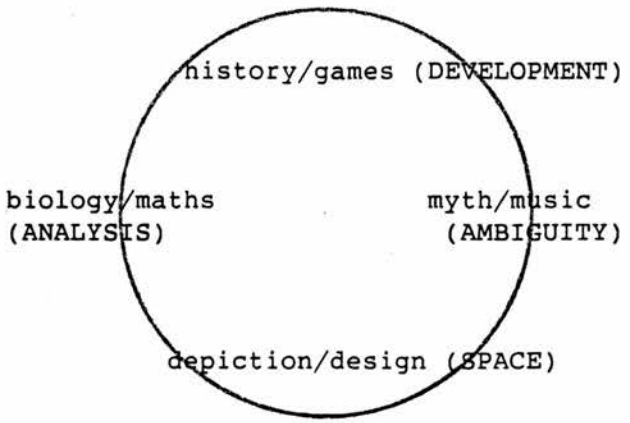
is iso-conceptual with mathematics, popularly conceived of as "the queen of the sciences", e.g. Levy (1947).

Taken together these two circles are as follows



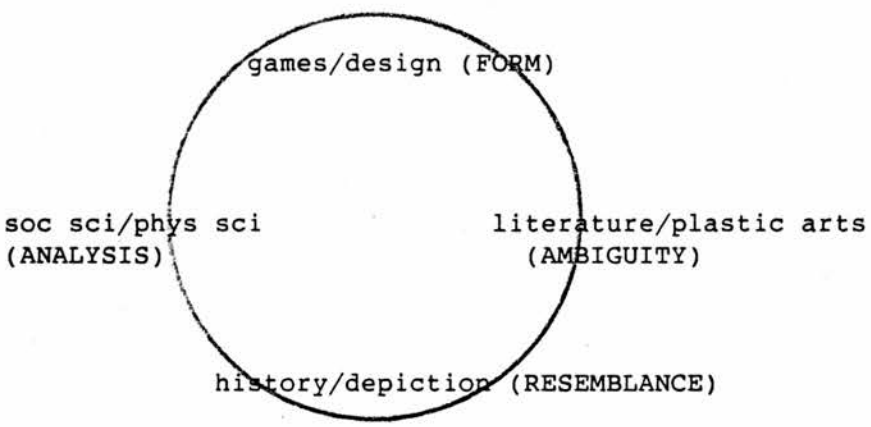
The terms on the left of each pair make up Piaget's circle of the sciences. The terms on the right make up another circle, dominated by concept of ambiguity, which is iso-conceptual with reference to development, space, form and resemblance.

Similar iso-conceptual circles can be put together for the two other pairs of surfaces. The resemblance and form surfaces are iso-conceptual with reference to analysis, ambiguity, space and developement. An expression of this is:



The terms on the left of each pair compose the resemblance surface, the terms on the right the form surface.

The same can be done for the development and space surfaces. These are iso-conceptual with reference to resemblance, form, ambiguity and analyisis.



The terms on the left of each pair compose the development surface, the terms on the right the space surface.

5.3.5. Meditation and Patrick Geddes

There is, however, one element missing from the library. This is the area devoted to the consideration of unimaginables. These could be characterized by the act of the Zen master who hits his pupil. He knows

what he is not talking about. As Wittgenstein (1922) says: "It is not how things are in the world that is mystical, but that it exists." A "how" problem can be interpreted. A "that" problem cannot be so treated. It is neither interpretable nor uninterpretable. To approach it on the level of interpretation is not appropriate. In the centre of the library one could set aside an area for the contemplation of these things which indicate context. A place where, to quote Neil Gunn, "the last metaphysical button fades on the viewless air". The appropriate activity here would be meditation or prayer. It is interesting to note that Patrick Geddes had just such an area in his Edinburgh teaching institution, the Outlook Tower. Boardman (1978) reports that Geddes often said that it should be an Inlook Tower as well, and that the "meditation cell" was the beginning of this.

5.3.6. Burnet: the Most Important Side of Knowledge

The significance of the model is reflected in a statement by John Burnet, the early twentieth century classical scholar and educationalist, quoted by Davie (1972):

> The most important side of any department of knowledge is the side on which it comes into touch with every other department. To insist on this is the true function of humanism.

The model can be of use to those who, with Burnet, see an awareness of connections between activities as essential to an education true to the potential of the mind.

CHAPTER 6

DEMONSTRATION OF THE COHERENCE OF THE MODEL

> Break the pattern which connects the items of learning and you necessarily destroy all quality. Bateson (1979)

INTRODUCTION

The purpose of this chapter is to methodically demonstrate the coherence of the model. In part one it is considered that certain activities involve certain concepts more than they do others. This is obvious; but the point of this section is to show that this obviousness holds throughout the model. That is to say that the model still makes sense when examined closely. Part two demonstrates that if the organization of the model is changed, it no longer makes sense. Part one is thus a positive demonstration of the coherence of the model, part two demonstrates the same by negative means.

6.1. PART ONE

Each way of thinking can be thought of as a viewpoint which makes sense of phenomena with reference to certain concepts only. It has been pointed out above that each way of thinking, or rather, each activity typifying that way of thinking, is closely related to some other ways of thinking, and more distantly related to others. This does not mean that a user of a particular way of thinking will not think it appropriate to explain all phenomena with reference to that way of thinking. "All phenomena" will necessarily include the productions of other ways of thinking. But the methods of one way of thinking will have at best limited applicability to the products of other ways of thinking. Such explanations must inevitably lose

credibiltiy as their methods become inappropriate.

For example a geometrical analysis of the composition of a painting (eg Thomas 1969, Macdonald 1977) tells you about geometry and tells you that it is possible to find rules of composition within the work. However it tells you nothing about the meaning of the work to either the artist or the viewer. Even if, let us suppose, it were possible to produce a set of scientific criteria which would reliably identify paintings likely to produce this meaningful experience, these criteria cannot give us any indication of this meaning. The meaning of an artwork cannot be reduced to scientific criteria. One can however describe the type of meaning appropriate to an artwork by scientific criteria: while this tells one how it means, this very information (eg that art is multi-definable) will indicate that this meaning cannot be reduced to a scientific meaning.

Similarly the meaning of a scientific work cannot be reduced to any artistic criterion we might use to approach it. For example a lifting gear may satisfy a criterion of artistic worth: it might be appropriately thought of as a high-tech Brancusi, but this ambiguous meaning, cannot be thought adequate to explain its scientific purpose. The scientific laws relating to its construction and use cannot be thought of as appropriately reducible to any artistic criteria used to judge it.

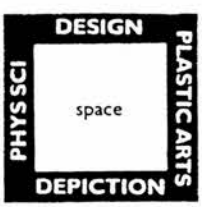
However, this analysis also draws attention to the similarities between the gear assembly and a sculpture. How can these similarities be coped with? Referring back to the model, both the gear assembly, a product of physcial science, and the sculpture, a product of plastic art, are related to "concept of space". It thus makes sense that they have this evident similarity. They share "concept of space" with design and depiction. Design

is distinguished from depiction in being characteristed by concept of form, rather than concept of resemblance. Thus any attempt to explain design in terms of criteria of resemblance will not constitute an adequate explanation, while any attempt to explain depiction in terms of purely formal criteria will fail similarly.

These considerations answer objections that every activity has something to do with all the concepts. This is true, but only to a certain extent. The point is that each activity is more to do with some concepts than others. To repeat the phrase used in chapter five, each activity has an "epistemological home". These epistemological homes are best considered as obvious, and it is worth considering this obviousness further. The following systematic consideration has value as a demonstration but is somewhat repetitive. The reader should bear this in mind and approach it accordingly. Some readers may prefer to use it as a resource that can be referred back to should questions arise.

6.1.1. Space

To consider again the surface of the model defined by concept of space. This surface involves the ways of thinking typified by design, plastic arts, depiction and physical sciences.



Depiction is opposed to design on the dimension of resemblance versus form, and physical sciences are opposed to plastic arts on the dimension of

analysis versus ambiguity. It is obvious that criteria of resemblance are more central to the understanding of depiction than they are to the understanding of design. Similarly it is obvious that formal criteria are more central to the understanding of design than they are to the understanding of depiction. Turning now to physical sciences and plastic arts: it is obvious that analytical criteria are more central to the understanding of physical sciences than they are to the understanding of plastic arts. Similarly it is obvious that criteria of ambiguity are more central to the understanding of plastic arts than they are to the understanding of physical sciences.

6.1.2. Development

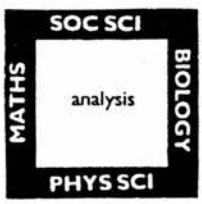
Consider now the surface of the model defined by concept of development. This involves the ways of thinking typified by history, literature, games and social sciences.

History is opposed to games on the dimension of resemblance versus form. Social sciences are opposed to literature on the dimension of analysis versus ambiguity. It is obvious that criteria of resemblance are more central to the understanding of history than they are to the understanding of games. Similarly, it is obvious that formal criteria are more central to the understanding of games than they are to the understanding of history. Turning now to social sciences and literature: it is obvious that analytical criteria are more central to the understanding of social sciences than they are to the understanding of literature. Similarly, it is obvious that criteria of

ambiguity are more central to the understanding of literature than they are to the understanding of social sciences.

6.1.3. Analysis

Now consider the surface of the model defined by concept of analysis. This involves the ways of thinking typified by physical sciences, biology, social sciences and mathematics.



Social sciences are opposed to physical sciences on the dimension of development versus space, biology is opposed to mathematics on the dimension of resemblance versus form. It is obvious that developmental criteria are more central to the understanding of social sciences than they are to the understanding of physical sciences. Similarly, it is obvious that criteria of space are more central to the understanding of physical sciences than they are to the understanding of social sciences. Turning now to biology and mathematics: it is obvious that criteria of resemblance are more central to the understanding of biology than they are to the understanding of mathematics. Similarly, it is obvious that formal criteria are more central to the understanding of mathematics than they are to the understanding of biology.

6.1.4. Ambiguity

Next consider the surface defined by concept of ambiguity. This surface involves the ways of thinking typified by literature, mythology, plastic arts

and music.

Literature is opposed to plastic arts on the dimension of development versus space, mythology is opposed to music on the dimension of resemblance versus form. It is obvious that developmental criteria are more central to the understanding of literature than they are to the understanding of plastic arts. Similarly, it is obvious that criteria of space are more central to the understanding of plastic arts than they are to the understanding of literature. Turning to mythology and music: it is obvious that criteria of resemblance are more central to the understanding of mythology than they are to the understanding of music. Similarly, it is obvious that formal criteria are more central to the understanding of music than they are to the understanding of mythology.

6.1.5. Resemblance

Consider now the surface of the model defined by concept of resemblance. This involves the ways of thinking typified by history, mythology, depiction and biology.

History and depiction are opposed on the dimension of development versus space, biology and mythology are opposed on the dimension of analysis versus ambiguity. It is obvious that developmental criteria are more central to the understanding of history than they are to the understanding of depiction. Similarly, it is obvious that criteria of space are more central to the understanding of depiction than they are to the understanding of history. Turning to biology and mythology: it is obvious that analytical criteria are more central to the understanding of biology than they are to the understanding of mythology. Similarly it is obvious that critiera of ambiguity are more central to the understanding of mythology than they are to the understanding of biology.

6.1.6. Form

Lastly consider the surface of the model defined by concept of form. This surface involves the ways of thinking typified by mathematics, design, music and games.

Mathematics is opposed to music on the dimension of analysis versus

ambiguity, games are opposed to design on the dimension of development versus space. It is obvious that analytical criteria are more central to the understanding of mathematics than they are to the understanding of music. Similarly, it is obvious that criteria of ambiguity are more central to the understanding of music than they are to the understanding of mathematics. Turning to games and design: it is obvious that developmental criteria are more central to the understanding of games than they are to the understanding of design. Similarly, it is obvious that criteria of space are more central to the understanding of design than they are to the understanding of games.

6.2. PART TWO: COHERENCE OF THE MODEL DEMONSTRATED BY SHOWING THE EFFECTS OF DISTORTION

In the course of explaining the model in conversation, it has on occasion been suggested that it is possible to make any set of ideas look consistent in a three dimensional structure, regardless of how they are positioned with respect to one another. This is not true, but in the light of this criticism it seems necessary to demonstrate this. I introduced this chapter with Bateson's comment: "Break the pattern which connects the items of learning and you necessarily destroy all quality". This demonstration is precisely such a breaking of the pattern, with its consequent loss of quality.

One can do this by distorting the model by placing ways of thinking inappropriately within it.

This can be done most easily by substituting ways of thinking for their direct opposites on the surfaces of the model. Thus mathematics can be transposed with either music (across the "form" surface), or biology (across

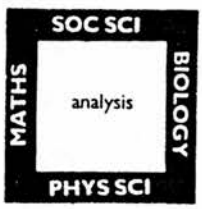
the "analysis" surface). To take another example, literature can be transposed with either plastic arts or social sciences.

Each possible cross surface transposition appears below. In each case I will present a diagram of the original coherent surface of the model, and beside it a diagram of the conceptually incoherent surface resulting from the transposition of ways of thinking. This constitutes a demonstration of the coherence of the model. If already convinced of the coherence of the model, the reader may prefer to go straight to chapter seven.

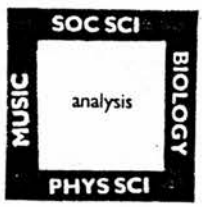
Mathematics transposed with Music

If mathematics is transposed with music, on the "concept of analysis" surface of the model, coherence is replaced by incoherence:

coherent



incoherent



On the "concept of ambiguity surface":

coherent

incoherent

Mathematics transposed with Biology

If mathematics is transposed with biology, on the "concept of form" surface:

coherent

incoherent

On the "concept of resemblance" surface:

coherent

incoherent

Music transposed with Mythology

If music is transposed with mythology, on the "concept of form" surface:

coherent

incoherent

On the "concept of resemblance" surface:

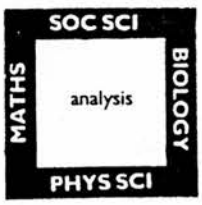
coherent

incoherent

Biology transposed with Mythology

If biology is transposed with mythology, on the "concept of analysis" surface:

coherent



incoherent

On the "concept of ambiguity" surface:

coherent

incoherent

History transposed with Depiction

If history is transposed with depiction, on the "concept of development" surface:

coherent

incoherent

On the "concept of space" surface:

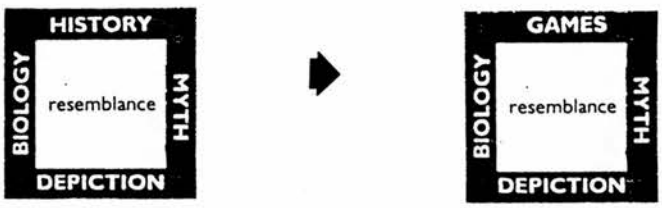
coherent

incoherent

History transposed with Games

If history is transposed with games, on the "concept of resemblance" surface:

coherent incoherent



and on the "concept of form" surface:

coherent incoherent

Depiction transposed with Design

If depiction is transposed with design, on the "concept of resemblance" surface:

coherent incoherent

and on the "concept of form" surface:

coherent incoherent

Design transposed with Games

If design is transposed with games, on the "concept of space" surface:

coherent

incoherent

and on the "concept of development" surface:

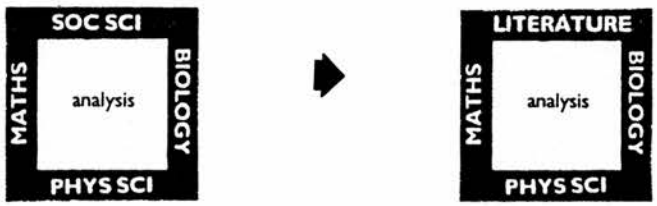
coherent

incoherent

Literature transposed with Social Science

If literature is transposed with social sciences, on the "concept of analysis" surface:

coherent incoherent



and on the "concept of ambiguity" surface:

coherent incoherent

Literature transposed with Plastic Arts

If literature is transposed with plastic arts, on the "concept of development" surface:

coherent

incoherent

and on the "concept of space" surface:

coherent

incoherent

Social Science transposed with Physical Science

If social science is transposed with physical science, on the "concept of development" surface:

coherent incoherent

and on the "concept of space" surface:

coherent incoherent

Physical Science transposed with Plastic Arts

If physical science is transposed with plastic arts, on the "concept of analysis" surface:

coherent incoherent

and on the "concept of ambiguity" surface:

coherent incoherent

The above comparisons, each of a coherent surface with an incoherent surface (the latter being the coherent surface with one change), speak for themselves.

CHAPTER 7

AN INITIAL APPLICATION

7.1. THE MODEL AS INTERPRETATIVE AND PREDICTIVE TOOL

I have shown that the model has structural coherence. Each activity is uniquely defined by its neighbours. One cannot swop them around and still have a sensible model.

But what can one do with the model? It's importance is as a general interpretative tool, that is to say a way of ordering information, much, or all, of which may already be to hand should one care to look for it. The model is an intitial attempt to order an area. Most models are not of this type. They deal with, and comment upon, areas which have already been ordered. A useful analogy for my own work is the Ptolemaic view of the cosmos. An initial ordering of the data which sets up useful limits (not necessarily the only limits) for subsequent discussion. It is usual to date modern cosmology from Copernicus but the Ptolemaic theory set the limits for the Copernican discussion and this is the point. Ptolemaic theory is the intitial cognitive tool in the area of scientific cosmology. The model can be used in a similar way with respect to ways of thinking.

I will consider in the next chapter the use of the model with respect to biographical, educational and cultural analysis, but it is appropriate here to demonstrate its use on a smaller scale, with reference to data already referred to.

7.2. FAMILY STRUCTURE RELATED TO THE MODEL

At the end of chapter two I pointed out the need for a model of art and science to make sense of the birth order differences found among those in the Dictionary of National Biography. We now have such a model and it suggests that the best description of this difference is in terms of firstborn favouring meaning as a function of analysis, while laterborn, particularly youngestborn, favour meaning as a function of ambiguity. This is a difference in evaluation of definition. Firstborn value single definition, youngestborn value multiple definition.

However we can go further than this and begin to use the model as a tool to make sense of another major family structure variable, family size. The model takes us away from a one dimensional view of the relationships between ways of thinking. As well as having analysis/ambiguity, we also have resemblance/form and space/development.

In dealing with the data from the Dictionary of National Biography, I noticed that the family sizes of literary figures seemed larger than those of some of the other groups. On its own this piece of information might have gone relatively unremarked. However in the context of the model, it began to make sense, since it seemed likely that one would have much more opportunity to think about "development" (e.g. the irreversible social consequences of actions) in a large family than in a small one. By the same token, and getting back to one of my original interests, space, in a small family, "space" might well be more salient simply because there is less opportunity for thinking about these developmental systems. It thus seemed plausible to suggest that those eminent in disciplines represented on the "concept of development" surface of the model would tend to come from

larger families than those eminent in disciplines represented on the "concept of space" surface of the model.

There is a problem in the data here, namely that very few social scientists (identified as such) appear in the Dictionary of National Biography (1981), in fact I could only get full data on four of them. Thus the "concept of development surface" would be lacking one of its main components in any comparison. I resolved this somewhat by comparing "concept of space" with disciplines "tending towards concept of development": i.e. biology, music and mathematics as well as social science and literature. History was excluded from this group, because it was not used in the original comparisons between arts and sciences in chapter three, and I wanted to use precisely the same set of data for the present comparison. For the same reason architecture was excluded from the "space" group. Both these categories have few members, so whether or not they are included in the comparison makes little practical difference.

7.2.1. Hypothesis

It was hypothesised that members of the "concept of space" group would have, in general, smaller family sizes than members of the "tending towards concept of development" group.

7.2.2. Results

To test this hypothesis a median test was carried out:

```
t to d = "tending to development"
```

median family size = 4.

	family size median or less	family size more than median
t to d	42	42
space	38	18

Chi squared = 3.6762, 1 df, 1 tailed, $p<.05$

The hypothesis is thus supported. Further analysis suggests that the effect is mainly evident in laterborn rather than firstborn. Whether or not onlies are included in the firstborn group there is no interesting looking pattern. In contrast, in the laterborn group and in its two sub-divisions, intermediate, and youngest, those "tending to development" are represented disproportionately in larger families.

firstborn

	family size 1,2,3,4	family size 4+
t to d	26	10
space	27	7

firstborn (excluding onlies)

	family size 2,3,4	family size 4+
t to d	18	10
space	18	7

laterborn

	family size 2,3,4	family size 4+
t to d	16	32
space	11	11

Intermediate (laterborn but not youngest)

	family size	
	2,3,4	4+
t to d	11	20
space	6	6

Youngest (not onlies)

	family size	
	2,3,4	4+
to to d	5	12
space	4	4

This family size effect is not an artifact of differing social class between the two groups as the table below shows:

	Social class		
	1	2	3,4
t to d	39	27	18
space	25	19	12

Chi squared = 0.0560, 2df, 2 tailed, not significant

I have implied that the effect is present in both arts and sciences, and it can be seen from the table below that this is indeed the case, although the numbers in the space category for Art are unfortunately small:

Art

	family size	
	1,2,3,4,	4+
t to d	21	20
space	7	3

Science

	family size	
t to d	1,2,3,4	4+
	21	20
space	26	13

7.2.3. Discussion

The interesting finding here is that while the hypothesis is supported by a comparison of all in the concept of space category versus all in the tending to concept of development category, further analysis suggests that this effect is mainly due to laterborn. However, unlike the case above (Chapter 3) with respect to eminence in art and science, youngestborn seem to behave very much as do intermediates.

Thus the two family structure variables of family size and birth order seem to be differentially important to the development of ways of thinking. Family size is important to later born, large families facilitating thinking about development, small families facilitating thinking about space. Birth order is important to first and youngestborn, firstborn tending to develop ideas of analysis, youngest born tending to develop ideas of ambiguity. Thus first and youngest seem to be distinguishable on the basis of the model's definitional pair of concepts, but laterborn as a whole seem to be distinguishable on the basis of the directional pair.

As has been noted, firstborn seem to become supporters of the dominant cultural reality. Youngest seem to become supporters of the non-dominant view. Does this mean that the youngest is some sort of natural rebel? Perhaps a permitted or even encouraged rebel. The youngest may be the focus of encouragement for those activities which are known to be important but cannot be admitted as such in the context of the dominant reality. The firstborn is the focus of all that can be overtly valued.

What is emerging about intermediates is that they do not seem to be focuses for the encouragment of a particular world view. Firstborn seem to

have a cultural identity thrust upon them. Youngest seem to be encouraged to pick up the (highly important) cultural left-overs. Intermediates do not seem to be encouraged to do anything to the same extent. Salient information for them is influenced by the size of group (family) they are in.

CHAPTER 8

DIRECTIONS FOR FUTURE RESEARCH

> The solution which I am urging, is to eradicate the fatal disconnection of subjects which kills the vitality of our modern curriculum. There is only one subject matter for education, and that is Life in all its manifestations. Whitehead (1932)

8.1. IMPLICATIONS: BIOGRAPHICAL AND CULTURAL

The model can be used as a tool for biographical and cultural analysis, both in the study of an individual or culture at any one time and also in the study of the development of individuals and cultures.

An individual or culture can be represented as a biased version of the model. A good way of doing this is to imagine the model as expanded in some directions and attenuated in others. In addition to this expression of cultural or individual emphasis, some parts of the model may also be more or less differentiated than others.

8.1.1. Cultures

For example the present western cultural model is strongly expanded in the "analysis" direction, but is attenuated with respect to "ambiguity". In addition it is only within the last two centuries that social sciences have become properly differentiated from other sciences on the one hand, and literature on the other. And despite the fact that arts are at present attenuated, they are nevertheless highly differentiated. That is to say we have many carefully distinguished arts all of which are inadequately supported. In contrast to the modern view, the culture of classical Greece seems to exhibit both a high level of differentiation of activities but also

relatively little bias. However there does seem to be a neglect of the area where "space", "analysis" and "resemblance" come together on the model. This point is bounded by physical science, depiction and biology. It is thus of interest that the philosopher who opens the Hellenistic age, Artistotle, made a unique contribution in biology, and the culture of ancient Rome was noted both for its physical science and for it's accuracy of portraiture. At the same time, although the arts remain differentiated as they were in Greece, there is a substantial attenuation. Rome made a significant contribution in civil engineering. It's art is significant only as a development of that of Greece.

One can thus envisage cultural development as a kind of pulsation of the model. Different parts are differentiated and/or emphasized at different times. Greece: most activities both differentiated and emphasized. Rome: taking up this differentiated position, but emphasizing the least emphasised in that position. In terms of the model one can see the Romanesque and Gothic periods as times of re-emphasis of ambiguity; science is in abeyance, but myth and plastic arts are of high importance.

The Renaissance is a time of expansion of both the arts and sciences. But this expansion is driven by a cultural re-appraisal of analysis. We can characterize one of the contributions of the Renaissance in one phrase: accurate depiction. This is normally thought of as intrinsicly to do with art, but clearly it is not (c.f. comments in Chapter 5 about the conflation of art and visual thinking). A work of art can certainly be a depiction, but so also can a work of science such as an anatomy drawing. The great invention of the Renaissance, perspective, is an aid to depiction, not an aid to art. The paradox of perspective is that we think of it as enabling the Renaissance flowering of art, but it is as relevant, if not more relevant to science. It

allows one to take precise, different, points of view. It allows you to analyse, select with respect to specific criteria. Perspective does not make art any better, it simply makes it different; a change in style. But perspective does make science better since it is a tool for analysis, and implies other similar tools. The Renaissance can thus be considered, in terms of the model, as a movement away from the concern with ambiguity in the Medieval period, towards the present situation in which the highest cutural value is accorded to analysis. In these terms it is easy to consider the modern era as starting with the Enlightenment.

8.1.2. Biographies

I have little to add here to the comments I made above with respect to the use of the model as a tool for biographical analysis, but it important to note this potential use. A brief further discussion of Leonardo is, however, of interest. He was very much the painter/scientist, and explicitly rejected the notion of himself as a man of letters (i.e. he did not see his contribution as having much to do with a substantial part of the developmental surface of the model).

> I am fully aware that the fact of my not being a man of letters may cause certain arrogant persons to think that they may with reason censure me ...

Leonardo's "Notebooks" quoted by Bronowski(1961)

Thus to return to the point made in Chapter 5, one can get good initial access to the works of this painter, engineer and anatomist by considering the concept of space surface of the model.

This consideration of culture and biography is only a starting point based on my own limited knowledge, a suggestive, rather than a definitive,

analysis. The important thing is that the model is being used to order information in an interesting way. Given a deeper knowledge of history and biography, the resulting fuller analyses will be at the very least stimulating.

8.2. TOWARDS APPLICATION: USE IN EDUCATION

The model seems to imply a view which accepts a set of linked ways of thinking, irreducible to one another, which can be differently valued by different cultures, (or subcultures, or individuals). This differential evaluation might be called the representation of knowledge or truth or reality of that particular group or person. One can thus, perhaps, begin to understand other cultures (or individuals), because the possibilities of that culture (or individual) are inherent in one's own culture (or self), although the value system (or reality) may be quite different. Berlin (1981) has called such an approach "pluralistic".

One would expect that a model of relevance to cultural and individual differences in thinking would be of relevance to education: this it is. It can be used in curriculum design.

Such a view is in accord with Hirst's (1969) comment that "there is, atleast to some extent, a map of knowledge", however it is stronger in that qualification seems unnecessary. Again one could agree with Hirst that:

> the logical demarcations that (the map of knowledge) ... shows cannot but be helpful in providing our pupils with an idea of the range of human understanding and therefore some perspective on human pursuits.

At the very least the model provides such a perspective.

The model is the basis for a coherent theory of education. It will be a theory of education with which one will be able to make sense of, not only

a "map of knowledge", but also contemporary educational practice because it is also a model of different evaluations of knowledge truth or reality.

It can be used to suggest courses of action. For example, if we want to expand the perspective of "the narrow minded boffin reared on a restricted diet of science and mathematics" or "the arts man, blank in his incomprehension of the scientific outlook" (both quotes from Hirst's 1969 article), we can contextualize arts for the scientist and science for the artist by using the model. For example, art can be made meaningful to the physicist by leading him or her to it via a consideration of design or depiction, holding what I've called "concept of space" constant. One can move easily from Newton to Telford to Adam to Michelangelo.

Giving a physicist a lecture on painting or literature without providing this context may be interesting to the physicist, but it is unlikely to seem relevant since "the pattern which connects the items of learning", to use again Bateson's memorable phrase, will not be discernible.

Similarly the student of literature can be introduced to a social science such as sociology or psychology or economics, via history or games, keeping concept of development constant. For example: Tolstoy to Trevelyan to Marx. Or taking the "games" route: start with a writer concerned with form and ambiguity such as Mallarmee, then consider a formal game (eg chess) then the nature of an algorithm then cognitive psychology.

One might also begin to create an awareness of the distinction between, on the one hand, literary and mythological approaches to history, and on the other, social scientific approaches, by comparing "Apocalypse Now", "Rambo" and "The Deerhunter" with documentary treatments of the same

war. The more analytical view is clearly no alternative to the ambiguities of the literary/mythological approach of the cinema, yet both are related by the idea of history. In addition distinctions can be drawn between the relative mythological and literary value of the different films.

Educationally speaking the important point is not that these transformations can be made, since intuitively that has always been the case, but that they can be explained in terms of varying some concepts while keeping others stable. One is no longer following a track in darkness.

Contextualizing subjects for specialists in other disciplines is thus both easier to carry out and easier to make sense of, if one makes use of the model. The critical point is that such methods will enable the student to see that he or she could participate as a thinker in at first sight unfamiliar areas of knowledge, and could begin to make some preliminary sense of what specialists in those fields are doing. This enables a respect for other areas of thought based on an understanding of them as parts of a unified field of knowledge, rather than a respect for them based, at best, on a mystified implicit relativism and, at worst, an ignorance based on the assumption that they are irrelevant, or not "thought" atall.

The model can also be used to help cope with biases about the nature of knowledge encountered during teaching. To give an example from my own experience: during a seminar, an industrial design student seemed sceptical of the worth of social science. On discussion it emerged that he did not regard anything as "real" unless it was a physical object, a more or less exact depiction of one, or a report about its properties. Clearly the topics with which psychology deals did not satisfy his criteria of reality. But by his own admission nor did the paintings of Van Gogh, which distorted

exact depiction too much.

By using the model it was possible to see that his idea of "the real" made perfectly coherent, though limited, sense. On the evidence of this conversation, his idea of reality was strongly concerned with "resemblance", "analysis" and "space". The sort of science he found convincing was physics, the sort of art tended towards depiction. Instead of being confused in the face of his scepticism about social science, it was possible see his position in context. This made the difference between having a discussion and having an argument.

Peters (1983) states the need for an alternative to or a revision of Hirst's "forms of knowledge" as a basis for the curriculum as a whole, and goes on to say that "without such a theory modern discussion of the core curriculum ... seems very ad hoc ... ". The model can contribute to a resolution of this state of affairs.

CHAPTER 9

CONCLUSION AND EPILOGUE

> (He) let his mind drift about in time, encompassing past, present and future and forming it into a whole - a pattern. He was suspicious of pattern, disliking shape, for he did not trust it. To him, life was chaotic, chance-dominated, unpredictable. It was a trick, an illusion, of the mind, to be able to see a pattern to it. Moorcock (1965)

9.1. CONCLUSION

Three points of importance emerge from this thesis; the first is empirical, the second theoretical and the third practical.

(1) The empirical point is this: There is evidence that eminent laterborn, in particular youngestborn, have a different world view from eminent firstborn. One characteristic of this view is an orientation to the non-dominant cultural reality of the arts as practiced; in contrast the view of the firstborn is orientated to the dominant cultural reality of the sciences. This finding satisfies one of my intial aims, that is to say to demonstrate that laterborn can be thought of as actively different from firstborn, rather than passively less. I am not claiming to understand how birth order differences in ways of thinking arise, although I have made certain suggestions with respect to early experience. I do, however, claim that important birth order differences exist, and that laterborn manifest positive abilities if you care to look for them. Birth order is, therefore, a good variable to use in the understanding of plurality of thinking (c.f. cross-cultural research).

(2) The theoretical point is this: The ways of thinking that are typified by the arts and sciences are coherently related and a model of this plurality is presented. I am not claiming that the model of art and science corresponds

to any other organization, whether anatomical, physiological, linguistic or social. Such links or the lack of them remain to be explored. But there are two obvious routes of such exploration: (a) anatomical/physiological: Is the model reflected in, for example, hemisphere differences? (b) linguistic/social: Is the model a description of a language game in the broadest sense? I remain without commitment on these points. We need such a model as a prerequisite for an adequate consideration of high level cognition and cultural realities. The model provides only a beginning but as such is highly important.

(3) The practical point is this: The model has considerable implications for what we should be learning and how we should be learning. Essentially: the model provides a starting point for a coherent curriculum.

9.2. EPILOGUE

> Let aa tochts be lichthooses
>
> Jamieson (1985)

The final sentence of the above section is the end of this thesis as a considered work. But thought does not stand still simply because one has defined the extent of a particular document. I therefore include here some recent thinking about the model which might turn out to be fruitful.

9.2.1. Perception, Language and Consciousness

If one considers space and development as essentially to do with coordinate systems, one begins to wonder whether they might have something to do with what seems to be "given" in perception. We seem to understand both space and development a quasi-perceptual way. We can imagine perceiving examples: whether the space of a field, or the

development of a flower. Less immediate spaces and developments such as the space of physics or the development of a novel nevertheless seem linked to these examples. One might thus characterise this polarity as quasi-perceptual.

Similarly consider form and resemblance. On the one hand gestalts, on the other, similarities. Organizing by whole and by analogy. This polarity seems to be quasi-lingusitic in the same sense that the preceding one is quasi perceptual. It may reflect puzzling distinctions such as that between syntax and semantic.

The final polarity, analysis/ambiguity might to be of a higher order than the other two. One might suggest that perception and language are manipulative systems. Several writers have noted the connection between what we call objects and what we call symbols. Bronowski (1972) refers to the hand as "the cutting edge of the mind", strongly implying a connection between the manipulation of objects and symbols. The significance of the etymology of the word "manipulation" is clear. Fischer (1963) notes that "language came into being together with tools". This third polarity enables one to interpret these manipulations (or constructions) of symbol and object or event. But perhaps these manipulations would have no point without the possibility of different interpretations. This polarity might be considered the polarity of meaning, use or practice. Perhaps it should be called consciousness.

I think this is on the right lines. Consciousness is perhaps usefully considered in two ways: firstly as a level on which language and perception are interpreted (considered for their non-immediate significance). Secondly as an awareness of self and other. These two ideas exist together in the

context of the model, since (a) the third polarity is the way of interpreting the other two but (b) the interpretation depends on the distinction between analysis and ambiguity, which can be considered in terms of the distinction between self and other. Ambiguity enables one to blur the distinction between self and other. In such a view, the self has conceptual priority over the other. This is perhaps what "empathy" means. Analysis enables one to precisely distinguish self from other, and by virtue of this fact to consider self as an other. In such an view, the other has conceptual priority over the self. One might call such a view "objective". Thus both analysis and ambiguity depend on the relationship between self and other.

9.2.2. The Materials of Childhood

Two points emerge from this: (1) The analysis/ambiguity dichotomy may be of the highest order on the model. (2) The four neutral subjects between the analysis and ambiguity polarity seem to provide the materials of childhood: history (stories both factual and mythological), design (building blocks), depiction (crayons), games (games). This looks very interesting. The implication is that space/development and form/resemblance give us access to (let us create) the world, while analysis/ambiguity can give that construction meaning in terms of what one might call, on the one hand, self-consciousness and on the other hand, objective-consciousness.

9.2.3. Empiricism, Rationalism, Classicism and Romanticism

It seems possible to make sense of words like empirical, rational, classical and romantic all at once (two by two it would be of little import since they are contrasted pairwise already). Essentially then: The edge

labelled biology can be called empirical: (analysis/resemblance). That labelled maths can be called rational: (analysis/form). That labelled music can be called classical: (ambiguity/form). That labelled mythology can be labelled romantic: (ambiguity/resemblance). This seems to be getting nearer to a satisfactory way of labelling the model. The arts and sciences are good labels in the meantime, but the model should be able to cast light on them without having to use them as labels as well.

9.2.4. A Closing Note

Finally, and with reference to the thesis as a whole, a seventeenth century motto quoted by Jung (1954) seems appropriate:

> I inquire, I do not assert; I do not here determine anything with with final assurance; I conjecture, try, compare, attempt, ask....

APPENDICES

I. BIRTH ORDER AND VIDEO GAMES

INTRODUCTION

There is evidence in the literature compatible with the view that there exist birth order differences in something like a spatial or perceptual ability. One of the earliest and most striking reports consistent with this view is that of Schachter (1959) who reported that laterborn fighter pilots were more successful in combat than were their firstborn colleagues. He explains this finding in terms of his affiliation/anxiety hypothesis, suggesting that the firstborn performs less well than the laterborn when isolated in an anxiety provoking situation because of a need to affiliate to reduce his anxiety, resulting from early experience , while the laterborn, with no such need, is able to reduce his anxiety in isolation and is thus able to function more effectively in this situation.

But one can also interpret Schachter's findings by proposing that laterborn have higher spatial or perceptual ability , and that it is this which enables them to perform better the complex spatial manipulations required of the fighter pilot in combat. Wiedl (1978) and Koch (1954) have noted a perseptual speed advantage in youngestborn, and Stewart (1967) found them to be more field independent, an ability which Vernon (1979) identifies with his "spatial and visualization" factor. Bassett et al (1978) found that laterborn children performed significantly better on tasks of visuo-motor coordination and figure/ground discrimination. Similarly Wiedl (1978) found that lastborn were more interested in visually complex stimuli than were firstborn.

A coda to these studies is my own honours dissertation (1981). On the

Embedded Figures Test the result was in the hypothesised direction, laterborn having a lower mean EFT score indicating that they were more field independent, but the difference between firstborn and laterborn means was not significant. However an interesting trend was evident within the firstborn group: those of more than three years spacing from their sibling seemed to be more field independent than those of less than three years spacing from their s ibling. I suggested an explanation of this based on the hypothesis that large spacing firstborn have more opportunity to play with their fathers having gained some initial spatial competence, than do small spacing firstborn. This idea was suggested by Carlsmith's(1964) finding that father absence led to decreased mathematical ability (which demands a high level of spatial ability).

The advent of video games as a common recreational activity has provided an opportunity to study groups of people engaged in an activity, similar in spatial manipulation terms to that of a fighter pilot, but with neither the danger nor the isolation. I designed a questionnaire asking for detailes of birth order, family size, father's occupation, and self rated ability at video-games and pinball. Pinball was asked about because of it's similarities and differences with video-games, and because it was readily available to the video-games players questionned.

METHOD

Subjects

These were male undergraduate students at Edinburgh University. N = 130. For data see Appendix V.

The composition of the sample was: 22 firstborn of more than three

years spacing,38 firstborn of less than three years spacing, and 71 laterborn. Of this last group, 6 were last born with a spacing of more than 7 years from their closest sibling: these were not used due to the difficulty in classifying them.

Procedure

About 190 copies of the questionnaire, were handed out by the author in the games room of Teviot Row Union, on five occasions during the lunch hour (when the room is crowded and the available games are in continuous use),two of these occasions were during the autumn term of 1981 and three were during the spring term of 1982. An effort was made to get a questionnaire to every person in the room at this time: this was of course not po ssible, but this effort ensured that self selection of subjects either by experimenter or subject, was kept to a minimum. Each person was asked to complete the questionnaire on the spot and return it to the author: since each questionnaire was short, this was a reasonable request in spite of the location. 159 copies were returned (all but three on the spot), of which 137 were made use of. Of the remaining 22, 10 were incomplete in essential birth order details, 8 were twins, and 4 were completed by women (there was no intention by the author to limit the study to men, but for whatever reason, the venue was an almost exclusively male domain.

Hypotheses

(1) That laterborn would rate themselves more highly on video games ability than would firstborn.

(2) That firstborn with greater than three years spacing from their next sibling (if any) would rate themselves more highly on video games ability

than would other firstborn.

(3)That firstborn and laterborn would differ in their self-rated ability at pinball.

(4) That firstborn with greater than three years spacing from their next sibling (if any) would differ from other firstborn in self rated ability at pinball.

RESULTS

Hypothesis (1) was supported. A Mann-Whitney U test yielded a z score of 2.3241, p=.01, 1 tailed.

Hypothesis (2) was supported. A Mann-Whitney U test yielded a z score of 1.81, $p<.05$, 1 tailed.

Hypothesis (3) was supported. A Mann-Whitney U test yielded a z score of 2.18, $p<.05$, 2 tailed.

Hypothesis (4) was not supported. A Mann-Whitney U test yielded a z score of 0.66, $p<.6$, 2 tailed, not significant.

The support for hypothesis (1) could be an artifact of family size (laterborn coming from larger families than firstborn. However a Mann Whitney U test comparing the rated video-games ability of those with median family size or less (1 to 3) with those of greater than median family size, indicates that this is not the case. U = 1406.5, z = 0.69, p = .24, 1 tailed, not significant. Similarly with hypothesis (2). A Mann-Whitney U test comparing the rated pinabll ability of those with family size of median or less with those of greater than median family size, yielded a z score of .13, p = .09, 1 tailed, not significant.

DISCUSSION

The support for the hypothesis that laterborn consider themselves better at video games than do firstborn, lends weight to Schachter's finding that laterborn fighter pilots perform better in combat. However it suggests that this is a reflection of a greater spatio-perceptual ability on the part of laterborn, rather than, as Schachter suggested, better performance when anxious and isolated.

However it should be pointed out that the suggestion that firstborn perform less well as fighter pilots because they have less good spatio-perceptual ability than laterborn, does not exclude the possibility that firstborn also perform less well because they are more in need of affiliation to reduce their anxiety.

On the face of it there seems no reason to suppose that both these variables are important, however it is interesting to note Bing's(1963) finding that both "anxiety arousal in cautiousness training" and "less permissiveness with object experimentation" were found to be related to high verbal ability in children. Several studies have shown that firstborn have higher verbal ability than laterborn (eg Koch 1954, Altus 1962, Breland 1974, Macdonald 1981), we can thus speculate that this verbal pre-eminence of the firstborn may be related to early experience with the mother which involves both anxiety arousal and less object experimentation . It is reasonable to assume that object experimentation has a fundamental role to play in the development of spatial abilities: one could thus expect the firstborn to be more anxious and less spatially able, making him a less successful fighter pilot from two points of view.

Similar discussion is relevant to the findings of Nisbett(1968) and

Helmreich(1968) with reference to laterborn preferential participation in in dangerous sports and deep-sea diving respectively. Both of these activities are clearly less dangerous if the individual involved in them has both high spatial ability and low anxiety when required to act in isolation. of course, deciding what isolation is, is far fronm straightforward. For example, Nisbett is talking about dangerous team sports , and it may seem unreasonable to regard the players as acting in isolation. This is a fair point, which would tend to lead one to favour the the spatial ability hypothesis alone in this case.

A further variable of interest here is the perception of pain. Schachter(1959) showed that firstborn are less tolerant of pain than are laterborn, both reporting electric shocks as more painful, and discontinuing the experiment at lower levels of shock. As Nisbett has pointed out "...it is possible that firstborns are more sensitive to pain...(but)... a more cautious interpretation is to say that their reaction to the electric shock provides behavioural evidence that firstborns are more fearful than laterborns. .... . It seems safe to conclude that firstborns are more frightened by the prospect of physical harm than are laterborns, and it is plausible to infer that they avoid dangerous sports for this reason." Thus firstborn either feel pain more, or are more fearful of its imagined consequences. Pain perception does not seem to be a simple phenomenon, so it may well be the case that feeling pain more and being more fearful of its imagined consequences are the same thing. One might say that pain has more "meaning" for firstborn. Whatever the case, this greater pain salience for firstborn could be the result of what Bing calls "anxiety arousal in cautiousness training".

Hypothesis (2) yielded the tantalizing finding that there was a birth order difference in self-rated ability at pinball, but opposite to that found for

video games. Firstborn considered themselves to be very much better. The result indicates that pinball and video-games are indeed quite distinct activities. Chance plays a much larger part in pinball. In video-games the re-inforcement depends primarily on skill. In pinball it depends on both skill and chance. Pinball has a variable schedule of re-inforcement. One can speculate that firstborn are more responsive to such variable schedules. But why? Rothbart (1971) has noted that mothers are more anxiously intrusive into the performance of firstborn children. Such disruption might play a part in convincing the firstborn that the world is full of chance disruptions, as is pinball. Note that this is quite different from not having control over the world. This suggestion may or may not be worth taking seriously. In retrospect I very much regret not asking subjects about whether or not they played fruit-machines, since this could throw some light on the suggestion here.

The finding with respect to hypothesis (3) that firstborn with more than three years spacing to their next sibling (if any) rate their video-games ability higher than do other firstborn, supports the idea derived from Carlsmith that early father interaction fosters spatio-perceptual ability. No such effect is evident for pinball. This is interestingly consonant with the idea expressed above that the higher self-rated ability of firstborn at pinball may be related to the greater anxious intrusiveness by mothers into the performance of firstborn. Both firstborn groups would be open to such intrusion.

Conclusion

These results are interesting, as are the ideas they have given rise to, but at present both ideas and results should be treated as a useful basis for

further research rather than of substantial interest in themselves.

II. DATA FROM COLVIN 1978

The following list refers only to those architects for whom Colvin gives birth order data. The form of the data given in the dictionary is given in brackets immediately following the birth order category of the architect. These two categories are "PFB" (possibly firstborn) and "DLB" (definitely laterborn). This bracketted information is of a very straightforward form, for example "(1s)" means that the dictionary entry was "first son" or something close to that wording. Similarly "(2s)" represents the wording "second son" etc. "(Ys)" refers to the wording "youngest son", while "(ys)" refers to "younger son". "(sh)" refers to "son and heir" while "(eb)" refers to "elder brother". Both these last are considered as possibly firstborn. Similarly "(es)" refers to "eldest son", "(os)" to "only son". Any inspection of the list reveals Colvin's interest in sons rather than children. The rest of the key is as follows: yob = year of birth; cols l,w = columns in the dictionary devoted to life and work respectively: when life and work are not separate a composite figure is given; b order = birth order; f occ = father occupation, followed in brackets by whether that occupation is architect (A), or architect related (AR).

N = 188

name	yob	cols l,w	b order	f occ
Adam J,	1732	- 1.5 -	DLB (3s)	architect (A)
Adam J,	1721	1.0, 2.0	PFB (1s)	architect (A)
Adam R,	1728	6.5,11.5	DLB (2s)	architect (A)
Aikin E,	1780	- 1.0 -	DLB (Ys)	doctor
Akroyd J,	1556	- 1.5 -	PFB (1s)	mastermason (AR)
Alexander A,	d1637	- 0.3 -	PFB (1s)	earl
Archer T,	1668	1.3, 2.3	DLB (Ys)	landed
Bacon C,	1734	- 0.8 -	DLB (ys)	sculptor (AR)
Barry C,	1795	3.0, 3.5	DLB (4s)	stationer
Basnett C,	1784	- 0.3 -	PFB (os)	?
Bastard T,	1686	- 0.5 -	PFB (1s)	architect (A)
Bastard J,	1688	- 0.5 -	DLB (ys)	architect (A)
Bastard W,	1689	- 0.5 -	DLB (ys)	architect (A)
Benson W,	1682	- 1.8 -	PFB (1s)	iron merchant

Billing R,	1785	- 0.3 -	PFB (1s)	?
Billing R,	1815	- 0.3 -	PFB (1s)	architect (A)
Billing J,	1815	- 0.3 -	DLB (ys)	architect (A)
Billing A,	1816	- 0.3 -	DLB (ys)	architect (A)
Blore E,	1787	2.0, 8.0	PFB (1s)	lawyer
Bonomi I,	1787	0.8, 3.0	PFB (1s)	architect (A)
Booth W,	1797	- 0.3 -	DLB (ys)	architect (A)
Brerewood F,	1699	- 0.5 -	DLB (ys)	draper
Brettingham M,	1699	3.0, 3.0	DLB (2s)	mason (AR)
Brettingham M,	1725	- 2.0 -	PFB (1s)	architect (A)
Brettingham R,	1696	- 0.3 -	PFB (1s)	mason (AR)
Brown J,	d1876	0.3, 2.0	DLB (2s)	merchant
Bruce W,	1630	4.0, 2.5	DLB (ys)	landed
Bryce J,	1805	- 0.5 -	DLB (ys)	builder (AR)
Burton D,	1800	1.5, 7.0	DLB (10s)	builder (AR)
Busby C,	1788	1.3, 1.0	PFB (1s)	musician
Buxton J,	1685	- 0.8 -	PFB (sh)	squire
Burlington	1695	4.0, 4.0	PFB (sh)	earl
Byres J,	1734	- 3.0 -	PFB (1s)	laird
Campbell C,	1676	3.5, 3.0	PFB (1s)	laird
Carter E,	d1663	- 1.0 -	DLB (ys)	K's wks (AR)
Chute J,	1701	- 1.5 -	DLB (5s)	landed
Cockerell C,	1788	5.0, 5.0	DLB (2s)	architect (A)
Cubitt L,	1799	- 1.0 -	DLB (Ys)	?
Cubitt T,	1788	- 3.0 -	PFB (1s)	?
Cundy T,	1765	1.0, 1.5	PFB (1s)	landed
Cundy T,	1790	- 1.0 -	PFB (1s)	architect (A)
Dance G,	1741	3.3, 3.0	DLB (5s)	architect (A)
Edwards W,	1719	- 1.3 -	DLB (Ys)	farmer
Elger J,	1801	- 0.3 -	DLB (ys)	?
Elliot A,	1760	- 1.0 -	PFB (1s)	carrier
Elliot J,	1770	- 1.0 -	DLB (ys)	carrier
Elliot A,	d1843	- 0.3 -	PFB (ss)	architect (A)
Elmes H,	1814	1.5, 1.0	PFB (os)	architect (A)
Emmett W,	1671		PFB (1s)	master brklay (AR)
Erskine J,	1675	- 4.0 -	PFB (1s)	earl
Etty W,	1675	- 1.0 -	DLB (3s)	architect (A)?
Finden T,	1785	- 1.0 -	PFB (1s)	architect (A)
Foster J,	1787	1.0, 1.0	DLB (2s)	architect (A)
Frederick C,	1709	- 0.5 -	DLB (2s)	landed?
Gandy J,	1773	2.0, 1.0	PFB (eb)	steward
Gandy J,	1787	1.0, 0.5	DLB (yb)	steward
Gibbs J,	1682	4.5,11.5	DLB (ys)	merchant
Gibson G,	(c19	- 1.0 -	PFB (1s)	architect (A)
Gill W,	1679	- 0.5 -	PFB (1s)	colonel
Good J,	1778	- 1.0 -	PFB (1s)	clergyman
Graham H,	1795	- 0.3 -	DLB (3s)	clergyman
Gray G,	d1778	- 0.5 -	DLB (ys)	colonel
Greenway F,	1777	- 1.0 -	DLB (Ys)	mason (AR)
Grey T,	1781	- 0.2 -	PFB (1s)	earl
Gutch G,	1790	- 0.8 -	DLB (5s)	clergyman
Gwilt G,	1775	- 1.0 -	PFB (1s)	surveyor (AR)
Gwilt J,	1784	1.5, 1.0	DLB (ys)	surveyor (AR)
Hakewill H,	1771	0.5, 2.0	PFB (1s)	painter (AR)
Hakewill G,	....	- 0.3 -	DLB (ys)	painter (AR)

Hakewill J,	1778	- 1.0 -	DLB (2s)	painter (AR)
Hall J,	1769	- 0.25 -	DLB (3s)	surveyor (AR)
Hardwick P,	1792	1.0, 2.0	DLB (ys)	?
Haycock E,	1790	0.5, 3.0	DLB (2s)	architect (A)
Haycock J,	1759	0.5, 1.0	DLB (2s)	builder (AR)
Henderson J,	1813	- 0.25 -	PFB (1s)	builder (AR)
Herbert H,	1689	1.5, 2.0	PFB (1s)	earl
Hiorne F,	1744	1.0, 1.0	PFB (1s)	architect (A)
Holland H,	1745	2.0, 3.5	PFB (1s)	masterbuilder (AR)
Hope T,	1769	- 2.0 -	PFB (1s)	merchant
Humphrey C,	1772	- 2.0 -	PFB (1s)	joiner (AR)
Hutchinson H,	1800	- 0.5 -	DLB (ys)	architect (A)
Inwood C,	1799	- 0.3 -	DLB (2s)	architect (A)
Inwood E,	1803	- 0.3 -	DLB (3s)	architect (A)
Inwood H,	1794	0.5, 0.5	PFB (1s)	architect (A)
James J,	1692	4.0, 3.0	PFB (1s)	clergyman
Jenkins J,	(c19	- 0.3 -	DLB (ys)	clergyman
Jenkins W,	d186	- 0.5 -	PFB (1s)	?
Jerman E,	1668	2.0, 1.0	PFB (1s)	surveyor (AR)
Jerningham E,	1774	- 0.5 -	DLB (Ys)	landed
Jupp R,	1728	- 2.0 -	DLB (Ys)	master carp (AR)
Jupp W,	d178	- 0.5 -	PFB (eb)	master carp (AR)
Jupp W,	d1839	- 0.3 -	PFB (1s)	master carp (AR)
Keene T,	1754	- 0.5 -	PFB (1s)	landed
Kirby J,	1716	- 1.3 -	PFB (1s)	literary
Lapidge E,	1779	1.0, 1.0	PFB (1s)	gardener
Latrobe B,	1764	- 1.0 -	DLB (2s)	clergyman
Liddel T,	1800	- 1.0 -	DLB (2s)	baron
Loudon J,	1783	- 3.0 -	PFB (1s)	farmer
Machell T,	1647	- 1.5 -	DLB (2s)	landed
Mackenzie D,	1800	- 0.5 -	DLB (2s)	architect (A)
Mackenzie W,	1856	0.3, 0.5	PFB (1s)	architect (A)
Maddox G,	1802	- 0.5 -	PFB (os)	?
Malton J,	d1803	- 0.75 -	DLB (1s)	dr thr (AR)
Malton T,	1748	- 0.75 -	PFB (1s)	dr thr (AR)
May H,	1621	3.0, 2.0	DLB (7s)	landed
Monck C,	1779	- 1.0 -	DLB (3s)	landed
Montague J,	1690	- 1.0 -	PFB (sh)	duke
Mountague J,	1776	- 0.3 -	DLB (yb)	city official
Mountague W,	1773	- 0.8 -	PFB (eb)	city official
Mountain C,	1773	0.3, 1.0	PFB (os)	architect (A)
Mylne R,	1633	- 2.5 -	PFB (1s)	master mason (AR)
Mylne R,	1733	5.0, 6.0	PFB (1s)	master mason (AR)
Mylne T,	d1763	- 2.5 -	PFB (ss)	master mason (AR)
Mylne W,	1734	- 1.0 -	DLB (2s)	master mason (AR)
Mylne W,	1781	- 1.0 -	DLB (2s)	master mason (AR)
Nixon W,	1810	- 0.5 -	PFB (1s)	clerk of wks (AR)
Norris R,	1750	- 1.0 -	PFB (1s)	surveyor (AR)
North R,	1653	- 2.5 -	DLB (6s)	lord
Palmer J,	1785	0.5, 0.5	DLB (4s)	humble
Papworth J,	1775	4.0, 5.0	DLB (2s)	stuccoist (AR)
Parkyns T,	1662	- 0.8 -	PFB (sh)	baronet
Party W,	1758	- 1.0 -	DLB (ys)	mon mason (AR)
Playfair J,	1755	1.5, 2.5	DLB (4s)	clergy
Playfair W,	1790	2.5, 3.5	DLB (ys)	architect (A)

Pilkington R,	1789	- 0.3 -	DLB (ys)	architect (A)
Pilkington W,	1758	0.5, 1.0	PFB (es)	?
Pitt T,	1737	- 2.0 -	PFB (os)	landed
Platt G,	1700	- 0.5 -	DLB (3s)	architect (A)
Platt J,	1728	1.0, 1.0	PFB (1s)	architect (A)
Plowman T,	1805	- 0.25 -	PFB (1s)	architect (A)
Pocock W,	1779	1.0, 1.5	PFB (1s)	carpenter (AR)
Potter R,	1795	- 0.3 -	PFB (1s)	architect (A)
Pritchett J,	1789	1.0, 2.5	DLB (4s)	clergyman
Rennie J,	1761	2.0, 1.0	DLB (ys)	farmer
Repton G,	1786	0.5, 2.0	DLB (4s)	architect (A)
Revett N,	1720	- 2.8 -	DLB (2s)	landed
Rickman T,	1776	4.0, 5.0	PFB (1s)	apothecary
Robinson R,	1734	- 0.5 -	DLB (yb)	?
Robinson T,	1702	- 3.0 -	PFB (1s)	landed
Salmon R,	1763	- 1.0 -	DLB (Yb)	builder (AR)
Samwell W,	1628	1.0, 0.5	PFB (1s)	rich
Sandby T,	1721	- 3.5 -	PFB (1s)	landed
Sharp R,	1793	0.5, 0.8	PFB (1s)	landed
Sharp S,	1808	- 0.3 -	DLB (yb)	landed
Shirley W,	1722	- 0.5 -	DLB (2s)	earl
Smith J,	1734	- 0.5 -	PFB (1s)	?
Simpson A,	1790	2.0, 3.0	DLB (3s)	merchant
Smirke R,	1780	3.0, 8.0	DLB (2s)	artist (AR
Smith F,	1672	2.5, 4.0	DLB (Ys)	bricklayer (AR)
Smith W,	1661	2.5, 4.0	DLB (2s)	bricklayer (AR)
Smith W,	1705	0.3, 1.0	PFB (1s)	architect (A)
Stavely C,	1759	- 0.5 -	PFB (1s)	surveyor (AR)
Stirling W,	1772	0.5, 1.5	PFB (1s)	architect (A)
Stone J,	1620	- 1.0 -	DLB (3s)	sculptor (AR)
Surplice W,	1771	- 0.25 -	PFB (1s)	builder (AR)
Talman J,	1677	2.0, 2.0	PFB (1s)	architect (A)
Talman W,	1650	5.0, 3.0	DLB (2s)	landed
Tatham C,	1772	3.0, 2.3	DLB (5s)	priv sec
Tattersall G,	1817	- 0.8 -	DLB (ys)	auctioneer
Thomas W,	1800	0.3, 0.5	PFB (eb)	?
Thornhill J,	1675	4.0, 0.0	DLB (Ys)	landed
Thorpe J,	1565	- 1.0 -	DLB (2s)	master mason (AR)
Townesend W,	1668	2.0, 3.0	DLB (2s)	master mason (AR)
Tracy C H,	1778	- 1.0 -	DLB (3s)	ironworks owner
Trevor R H,	1706	- 0.8 -	DLB (3s)	lord
Trubshaw C,	1715	- 1.0 -	PFB (1s)	mason (AR)
Trubshaw J,	1777	2.0, 1,0	PFB (1s)	mason (AR)
Trubshaw T,	1802	0.3, 1.0	PFB (1s)	mason (AR)
Tyrrell C,	1775	- 0.5 -	DLB (5s)	solicitor
Vanburgh J,	1664	7.0, 4.5	DLB (2s)	merchant
Welch E,	1806	1.0, 1.0	PFB (eb)	?
Welch J,	1810	0.5, 1.0	DLB (yb)	?
Westmacott W,	1780	- 1.0 -	DLB (Ys)	sculptor (AR)
Wightwick G,	1820	3.0, 1.5	PFB (os)	landed
Wing J,	1728	- 1.5 -	PFB (es)	mason (AR)
Wing J,	1756	0.5, 0.3	PFB (es)	mason (AR)
Wilkins W,	1778	3.0, 3.0	PFB (1s)	architect (A)
Winde W,	d1722	4.0, 2.0	PFB (es)	landed
Woods J,	1776	- 1.0 -	DLB (2s)	educated

Wyatt J,	1746	6.5, 18	DLB (6s)	builder (AR)
Wyatt S,	1737	2.0, 6.0	DLB (3s)	builder (AR)
Wyatt B,	1745	- 0.8 -	DLB (5s)	builder (AR)
Wyatt B,	1755	- 0.5 -	DLB (2s)	builder (AR)
Wyatt B,	1775	- 0.5 -	PFB (1s)	builder (AR)
Wyatt H,	1789	- 0.5 -	DLB (2s)	builder (AR)
Wyatt J,	1739	- 0.3 -	DLB (4s)	builder (AR)
Wyatt M,	1805	- 0.3 -	PFB (1s)	builder (AR)
Wyatt P,	d1835	0.8, 0.8	DLB (4s)	builder (AR)

III. DATA FROM CLARKE 1916

The key to abbreviations is as above except that "type" refers to the type of literary figure as coded by Clarke, and fam str = family structure (e.g. "m6 of 6" means "the sixth child, a male, of six children"). The number following father occupation is social class as coded by the Office of Population Censuses and Surveys (1980). "C" following this number indicates listing in Chambers Biographical Dictionary (1975). "G" following the "C" indicates "greatness" as discussed in Chapter 2. My abbreviations of Clarke's typology of literary figures are as follows: pp = popular; e = erudite; s = specualtive; pb = publisher; o = orator; n = narrator; a = actor; p = poet; pr = prose-writer; l = librarian; d = dramatist.

N = 251

name	yob	type	fam str	f occ
Mather I,	1639	pp	m6 of 6	clergyman, 1
Mather C,	1663	s,e,pp	m1 of 10	clergyman, 1
Edwards J,	1703	s,pb,pp	m5 of 11	clergyman, 1
Franklin B,	1706	pp,n,s	m14 of 17	tallow-chandler, 3
Bellamy J,	1719	pp	m5 of 11	mine owner, 1
Backus I,	1724	e	m2 of 5	farmer, 2
Otis J,	1725	o	m1 of 13	lawyer, 1
Dickinson J,	1732	pb	m2 of 4	judge, 1
Adams J,	1735	pb	m1 of 13	farmer, 2
Henry P,	1736	o	m2 of 9	surveyor, 1
Bartram J,	1739	n	m1 of 4	botanist, 1
Jefferson T,	1743	pb,n,pp	m3 of 10	planter, 2
Belknap J,	1744	e	m1 of 4	merchant, 2
Emmons N,	1745	pp	m6 of 12	farmer, 2
Murray L,	1745	pp	m1 of 12	miller, 2
Filson J,	1747	e	m2 of 4	farmer, 2
Thomas I,	1749	l	m5 of 5	?
Buckminster J,	1751	pp	m4 of 9	clergyman, 1
Madison J,	1751	pb	m1 of 12	planter, 2
Freneau P,	1752	p	m1 of 5	planter, 2, C
Graydon A,	1752	n	m1 of 4	merchant, 2
Barlow J,	1754	p	m10 of 10	farmer, 2, C
Adams H,	1755	e	f2 of 3	merchant, 2
Marshall J,	1755	e	m1 of 15	planter, 2
Ames F,	1758	o,pb	m5 of 5	physician, 1
Weems M,	1759	pp	m15 of 19	farmer, 2
Alsop R,	1761	p	m1 of 8	merchant, 2
Morse J,	1761	pp	m8 of 10	farmer, 2

Ware H,	1764	pb,s	m9 of 10	farmer, 2
Dunlap W,	1766	d	m1 only	?
Adams J,	1767	pb,o,n	m1 of 4	lawyer, 1
Harris T,	1768	pp	m1 of 3	teacher, 1
Miller S,	1769	e	m8 of 9	clergyman, 1
Ballou H,	1771	pb	m11 of 11	clergyman, 1
Alexander A,	1772	pp	m3 of 9	farmer, 2
Dowse T,	1772	l	m7 of 8	leather-dresser, 4
Porter E,	1772	pp	m5 of 7	judge, 1
Quincy J,	1772	o	m1 only	lawyer, 1
Wirt H,	1772	pr,o,e	m6 of 6	?
Bowditch N,	1773	e	m4 of 7	cooper, 3
Randolph J,	1773	o	m2 of 2	planter, 2
Beecher L,	1775	pb	m1 of 3	blacksmith
Hobart J,	1775	pp	m9 of 9	merchant, 2
Clay H,	1777	o	m7 of 8	clergyman, 1
Allston W,	1779	p	m2 of 3	planter, 2
Paulding J,	1779	pr	m8 of 9	? ,, C
Story J,	1779	s,e	m1 of 11	surgeon, 1
Watson J,	1779	e	m2 of 2	ship-owner, 1
Channing W,	1780	s,o,pb,pp	m3 of 10	lawyer, 1
Key F,	1780	p	m1 of 2	planter, 2, C
Benton T,	1782	n,o,e	m1 of 8	lawyer, 1
Calhoun J,	1782	s,o,pb	m4 of 5	planter, 2
Webster D,	1782	o	m9 of 10	farmer, 2
Irving W,	1783	pr,n,e	m11 of 11	merchant, 2, CG
Savage J,	1784	e	m9 of 11	judge, 1
Spring G,	1785	pp	m3 of 11	clergyman, 1
Woodworth S,	1785	p	m4 of 4	farmer, 2
Jarvis S F,	1786	e	m3 of 3	clergyman, 1
Sargent L,	1786	pb	m7 of 7	merchant, 2
Edwards J,	1787	pb,pp	m3 of 7	farmer, 2
Hale S,	1787	pp	m3 of 14	?
Leslie E,	1787	pr	f1 of 5	watchmaker, 2
Willard E,	1787	pp	f16 of 17	farmer, 2
Cooper J,	1789	pr,e	m11 of 12	farmer, 2, CG
Farmer J,	1789	e	m1 of 3	farmer, 2
Jay W,	1789	pb	m4 of 5	publicist, 1
Sedgwick C,	1789	pr,pp	f6 of 7	lawyer, 1
Turner S,	1790	e	m8 of 8	clergyman, 1
Hayne R,	1791	o	m5 of 14	?
Signourey L,	1791	pp,n,pr,p	f1 only	?
Ticknor G,	1791	e	m1 only	educator, 1
Birney J,	1792	pb	m1 of 2	banker, 1
Payne J,	1792	p,d	m6 of 9	teacher, 1, C
Bedell G,	1793	pp	m4 of 4	business, 1
Goodrich S,	1793	pp,pr	m6 of 10	clergyman, 1, C
Bryant W,	1794	p	m2 of 7	physician, 1, C
Everett E,	1794	o	m2 of 2	clergyman, 1
Robinson E,	1794	e,n,pp	m6 of 10	clergyman, 1
Ware H,	1794	pp	m5 of 19	professor, 1
Harper J,	1795	l	m1 of 6	farmer, 2
Kennedy J,	1795	pr	m1 of 5	merchant, 2
Percival J,	1795	p	m3 of 4	physician, 1, C
Halliburton T,	1796	pr	m1 only	judge, 1, C

Prescott W,	1796	e	m2 of 7	lawyer, 1
Wayland F,	1796	pp,s	m6 of 6	clergyman, 1
Colton W,	1797	n	m3 of 12	weaver, 3
Hodge C,	1797	pp,s	m5 of 5	physician, 1
Lyon M,	1797	pa	f6 of 8	farmer, 2
Weed T,	1797	pb	m1 of 5	carter, 4
Baird R,	1798	e,pb	m12 of 13	farmer, 2
Dix J,	1798	n	m4 of 5	merchant, 2
Hawkes F,	1798	e,pp	m2 of 9	?
Spencer I,	1798	pr,pp	m10 of 11	farmer, 2
Alcott A,	1799	s	m1 only	farmer, 2
Choate R,	1799	o	m4 of 6	farmer, 2
Lowell J,	1799	pa	m1 of 4	merchant, 2
Placide H,	1799	a	m1 of 5	gymnast, 2
Bancroft G,	1800	e	m8 of 13	clergyman, 1
Durbin J,	1800	n	m1 of 5	farmer, 2
Lenox J,	1800	pa	m1 only	merchant, 2
Potter A,	1800	pp	m6 of 7	farmer, 2
Todd J,	1800	pp	m7 of 7	physician, 1
Clarke J,	1801	pp,n	m11 of 11	?
Janney S,	1801	e	m1 of 3	miller, 2
Marsh G,	1801	e,pp	m2 of 6	lawyer, 1
Seward W,	1801	o	m4 of 6	physician, 1
Bushnell H,	1802	s,pp	m1 of 6	farmer, 2
Child L,	1802	pr,pu,pp	f6 of 6	baker, 2, C
Dix D,	1802	pp	f1 of 3	?
Abott J,	1803	pr,pp,e	m3 of 7	land dealer, 1, C
Brownson O,	1803	s,pu	m3 of 3	farmer, 2
Emerson R,	1803	p,pr,s,&c	m2 of 6	clergyman, 1, CG
Hawthorne N,	1804	pr	m2 of 3	shipmaster, 1, CG
Abott J,	1805	pp,e	m4 of 7	land dealer, 1
Garrison W,	1805	pu	m4 of 5	shipmaster, 1
Gould A,	1805	pp	m2 of 8	teacher, 1
Walker J,	1805	s,pp	m2 of 2	farmer, 2
Forrest E,	1806	a	m5 of 7	bank clerk, 2, C
Harper F,	1806	l	m6 of 6	farmer, 2
Simms W,	1806	pr,p	m2 of 2	merchant, 2, C
Willis N,	1806	n,pr,p	m2 of 9	editor, 1, C
Adams C,	1807	e	m3 of 3	lawyer, 1
Chandler E,	1807	p	f3 of 3	farmer, 2
Felton C,	1807	pp	m1 of 3	?
Longfellow H,	1807	p,pr	m2 of 8	lawyer, 1, CG
Whittier J,	1807	p,pu	m2 of 4	farmer, 2, CG
Davidson L,	1808	p	f1 of 3	physician, 1
Gallagher W,	1808	p	m3 of 4	?
Ripley G,	1808	pp	m9 of 10	merchant, 2
Holmes O,	1809	p,pr	m3 of 5	clergyman, 1, CG
Lincoln A,	1809	o	m2 of 3	carpenter, 3
Poe E,	1809	pr,p	m2 of 3	merchant, 2, CG
Winthrop R,	1809	o	m14 of 14	merchant, 2
Burritt E,	1810	pp,pu	m10 of 10	farmer, 2
Clark J,	1810	pp,e,s	m3 of 3	physician, 1
Gray A,	1810	pp	m1 of 8	farmer, 2
Ossoli M,	1810	n,pr	f1 of 7	lawyer, 1, C
Parker T,	1810	pu,o,pp,s	m11 of 11	farmer, 2

Ticknor W,	1810	l	ml of 6	farmer, 2
Toombs R,	1810	o	m5 of 6	planter, 2
Greely H,	1811	pu,e	m3 of 7	farmer, 2
Phillips W,	1811	o,pu	m8 of 9	judge, 1
Porter N,	1811	pp,s	m2 of 2	clergyman, 1
Stowe H,	1811	pu,pr	f6 of 8	clergyman, 1, CG
Sumner C,	1811	o,pu	ml of 9	lawyer, 1
Stephens A,	1812	pu,o	m3 of 8	farmer, 2
Warren W,	1812	a	m5 of 5	actor, 2
Beecher H,	1813	o,pu,pp	m9 of 13	clergyman, 1
Brooks C,	1818	p	m2 of 5	?
Cooper S,	1813	n	m2 of 7	author, 2
Douglas S,	1813	o	m2 of 2	farmer, 2
Judd S,	1813	pu	m2 of 6	merchant, 2
Very J,	1813	p	ml of 6	shipmaster, 1, C
Chapin E,	1814	pp	ml of 3	artist, 2
Gay S,	1814	e	m2 of 3	lawyer, 1
Motley J,	1814	e	m2 of 8	merchant, 2
Putnam G,	1814	l,pp	m4 of 5	lawyer, 1
Yancey W,	1814	o	ml of 2	lawyer, 1
Downing A,	1815	pp	m5 of 5	nurseryman, 3
Cushman C,	1816	a	fl of 5	merchant, 2, C
Daly C,	1816	e	ml of 2	carpenter, 3
Duyckink E,	1816	e	ml of 2	publisher, 1
Howe H,	1816	e	m7 of 7	publisher, 1
Judson E,	1817	pr	f5 of 6	?
Thoreau H,	1817	n,pr	m3 of 4	pencil maker, 2, CG
DeLeon E,	1818	n	m2 of 6	physician, 1
Hill T,	1818	s	m9 of 9	tanner, 4
Abott E,	1819	e	ml of 2	?
Lowell J,	1819	p,pu,pr	m5 of 5	clergyman, 1, CG
Stevens H,	1819	e	m2 of 11	inn-keeper, 2
Whitman W,	1819	p	m2 of 9	carpenter, 3, CG
Bristed C,	1820	n	ml only	clergyman, 1
Cary A,	1820	p,pr	f4 of 9	farmer, 2, C
Dawson J,	1820	pu	ml of 2	bookdealer, 1
Kane E,	1820	n	ml of 7	lawyer, 1
Preston M,	1820	p	fl of 8	clergyman, 1
Raymond H,	1820	pu	ml of 6	farmer, 2
Wallack J,	1820	d,a	ml of 4	?
de Peyser H,	1821	e	ml only	lawyer, 1
Poole W,	1821	pp	m2 of 3	tanner, 4
Cuyler T,	1822	pp	ml only	lawyer, 1
Field H,	1822	n	m7 of 7	clergyman, 1
Frothingham O,	1822	pu,pp	m3 of 3	clergyman, 1
Grant U,	1822	n	ml of 6	farmer, 2
Johnson R,	1822	pr	m5 of 6	planter, 2
Olmstead F,	1822	n	ml of 8	merchant, 2
Angell G,	1823	pu	ml only	clergyman, 1
Coffin C,	1823	n,pp	m3 of 3	farmer, 2
Davidson M,	1823	p	f3 of 3	physician, 1
Lippincott S,	1823	pr,n	f10 of 11	physician, 1
Parkman F,	1823	e,n	m2 of 6	clergyman, 1
Cary P,	1823	p	f6 of 9	farmer, 2
Curtis G,	1824	pr,n,pu	m2 of 5	banker, 1, C

Larcom L,	1824	p	f8 of 9	shipmaster, 1
Dorr J,	1825	p	f1 only	quarry operator
Taylor B,	1825	p,pr,n	m4 of 10	farmer, 2, C
Bowles S,	1826	pu,n	m3 of 5	journalist, 2
Foster S,	1826	p	m3 of 3	merchant, 2, C
Cooke J,	1827	pp	m1 of 2	lawyer, 1
Eddy M,	1827	s,pu,pp	m6 of 6	farmer, 2
Norton C,	1827	e,pp	m3 of 6	scholar, 1
Browne W,	1828	e	m1 only	merchant, 2
Drake F,	1828	e,	m1 of 2	book-seller, 2
Haven A,	1828	pp	f3 of 4	clergyman, 1
Jefferson J,	1829	a	m1 of 2	actor, 2, C
Hayne P,	1830	p	m1 only	naval officer, 1
Florence W,	1831	a	m1 of 7	?
Gilman D,	1831	pt,e	m5 of 9	manufacturer, 1
Victor M,	1831	pr,pu	f3 of 5	?
Winsor J,	1831	e	m2 of 5	merchant, 2
Alcott L,	1832	pr	f2 of 5	teacher, 1, CG
Conway M,	1832	pp,e	m2 of 3	judge, 1
Talmage T,	1832	pp	m12 of 12	farmer, 2
Booth E,	1833	a	m7 of 10	actor, 2, C
Dodge M,	1833	pr,pu	f7 of 7	farmer, 2
Furness H,	1833	e	m2 of 4	clergyman, 1
McCrady E,	1833	e	m2 of 8	lawyer, 1
Stevens B,	1833	e	m10 of 11	inn-keeper, 2
Ward G,	1833	a	f1 only	planter, 2
Abott L,	1835	pp	m3 of 5	clergyman, 1
Adams C,	1835	e	m2 of 4	lawyer, 1
Brooks P,	1835	pr,pp	m2 of 6	merchant, 2
Clemens S,	1835	pr	m5 of 6	merchant, 2, CG
Spofford H,	1835	pr,p	f1 of 6	lawyer, 1
Delmar A,	1836	e,sp	m1 of 3	gov't official, 1
Piatt S,	1836	p	f1 of 2	?
Adams H,	1838	e	m3 of 4	lawyer, 1
Daly A,	1838	d	m1 of 2	?, ,, C
Roe E,	1838	pr	m5 of 6	?
De Leon T,	1839	pr,d	m3 of 6	physician, 1
Denison G,	1839	e	m1 of 2	lawyer, 1
George H,	1839	pu,s	m2 of 10	publisher, 1
Willard F,	1839	pp	f4 of 5	farmer, 2
Baldwin J,	1841	pp	m6 of 6	farmer, 2
Briggs C,	1841	e	m1 of 2	?
Sill E,	1841	p	m2 of 2	physician, 1
Dickinson A	1842	o	m5 of 5	merchant, 2
Fiske J,	1842	s,e,pp	m1 only	editor, 1
Abott C,	1843	pp,n	m4 of 4	banker, 1
Holley M,	1844	pr	m7 of 7	?
Ward E,	1844	pr	f1 of 7	clergyman, 1
Hawthorne J,	1846	pr,n	m2 of 3	author, 2
Lloyd H,	1847	pu	m1 of 5	clergyman, 1
Morris C,	1847	a	f1 only	?
Adams B,	1848	e	m4 of 4	lawyer, 1
Holland E,	1848	a	m3 of 6	actor, 2
Allen J,	1849	pr	m7 of 7	?, ,, C
Crozier J,	1849	s	m5 of 5	farmer, 2

Gillman N,	1849	pu	m1 of 3	lawyer, 1
Field E,	1850	p,pr	m2 of 8	lawyer, 1, C
Grady H,	1850	o	m1 of 3	business, 1

IV. DATA FROM DICTIONARY OF NATIONAL BIOGRAPHY 1981

N = 140

name	cols, fam str, f occ
MUSICIANS	
Barbirolli J,	2.5, m2 of 3, violinist, 2
Dyson G,	2.8, m1 of 3, blacksmith, 3
Hess M,	2.8, f4 of 4, merchant, 2
Ord B,	2.0, m5 of 5, linguist, 1
Scott C M,	2.5, m2 of 2, business, 1
PAINTERS: including film makers, typographers, designers	
Asquith A,	3.0, m2 of 2, PM, 1
Bateman H M,	2.3, m1 of 2, business, 1
Craig G,	3.0, m2 of 2, theatre design, 2
Edwards L D R,	2.0, m8 of 8, doctor, 1
John A E,	4.3, m3 of 4, solicitor, 1
Le Bas E,	2.3, m3 of 3, industry, 1
Morison S A,	3.3, m2 of 3, comm trav, 3
Redpath A,	2.0, f2 of 4, design, 2
Sheridan C C,	3.3, f2 of 3, landowner, 1
Wolmark A A,	2.0, m1 of 5, , 2
Hutchinson W O,	2.5, m5 of 6, business, 1
LITERARY: including journalists, publishers, actors	
Aldington R,	4.5, m1 of 4, solicitor's clerk, 2
Blyton E M,	3.8, f1 of 3, business, 1
Brittain V,	2.0, f1 of 2, paper manuf, 1
Devine G,	1.8, m1 only, bank clerk, 2
Eliot T S,	7.3, m7 of 7, industrialist, 1
Farjeon E,	2.3, f3 of 5, novelist, 2
Forbes J R,	2.0, f1 of 6, landowner, 1
Forster E M,	4.8, m1 only, architect, 1
Foyle W A,	2.0, m7 of 8, grocer, 3
Hodgson R E,	2.0, m6 of 10, coal merchant, 2
Karloff B,	2.0, m9 of 9, revenue officer, 2
Kennedy M M,	2.3, f1 of 4, barrister, 1
Lamburn R C,	2.0, f2 of 3, church, 1
Lane A,	4.0, m1 of 4, architect, 1
Macniece L,	6.0, m3 of 3, church, 1
Maxwell G,	2.0, m4 of 4, colonel, 1
O'Casey S,	2.5, m5 of 5, clerk, 3
Orton J,	2.5, m1 of 4, gardener, 4
Powys J C,	2.5, m1 of 11, church, 1
Ransome A M,	2.5, m1 of 4, prof of hist, 1
Sackville-West V,	3.5, f1 only, baron, 1
Sitwell E,	3.0, f1 of 3, baronet, 1
Sitwell O,	3.0, m2 of 3, baronet, 1
Spring R H,	2.5, m5 of 9, gardener, 4

Unwin S, 3.0, m9 of 9, printer's business, 2
Wadell H, 2.3, m10 of 10, church, 1
Wilson F P, 3.5, m9 of 9, wholesaler, 2
Wilson J D, 4.5, m1 of 6, engraver, 2
Wilson J G, 1.8, m3 of 8, bookbinder, 3
Wolfit D, 3.3, m4 of 5, clerk, 3
Hayward J D, 2.0, m2 of 2, surgeon, 1
Angell R N, 2.8, m7 of 7, grocer, 3
Barry G, 2.3, m4 of 6, church, 1
Bone J, 2.8, m2 of 6, journalist, 2
Christiansen A, 2.0, m2 of 3, master shipwright, 3
Gibbs P A H, 2.8, m5 of 7, civil servant, 1
Robertson-Scott J W, 3.0, m1 of 7, comm trav, 3
Swaffe H, 2.0, m1 of 8, draper, 2

ENGINEERS

Abell L S, 2.5, m1 of 4, JP, 1
Camm S, 4.0, m1 of 12, joiner, 3
de Havilland G, 3.0, m2 of 5, church, 1
Drysdale C V, 2.0, m1 only, doctor, 1
Forbes Sempill W F, 2.3, m1 of 4, soldier, 1
Griffith A A, 3.5, m1 of 3, journalist, 2
Hacking J, 2.0, m1 of 4, engineer, 1
Lanchester G H, 1.8, m8 of 8, architect, 1
Moullin E B, 2.3, m1 only, engineer, 1
North J D, 2.5, m1 only, solicitor, 1
Page F H, 2.0, m2 of 5, master upholst, 3
Pelter W E W, 2.8, m1 of 4, engine manuf, 1
Pippard A J S, 2.0, m1 of 5, building constr, 1
Roscoe K H, 3.0, m1 of 4, engineer, 1
Round H J, 2.5, m1 of 4, registrar (b&d), 1
Southwell R V, 2.8, m2 of 3, company director, 1

PHYSICISTS

Astbury W T, 2.0, m4 of 7, potter, 3
Bowden F P, 3.0, m5 of 6, manager, 2
Darwin C G, 3.3, m1 of 4, FRS, 1
Gray L H, 3.0, m1 only, civil servant, 1
Ryde J W, 1.8, m1 only, colourman, 3
Smith T, 1.5, m1 of 5, teacher, 2
Stoner E C, 2.0, m1 only, cricketer, 3
Tyndall A M, 3.3, m5 of 5, ironmonger, 2
Whiddington R, 2.0, m1 of 3, teacher, 2
Wilson W, 2.0, m1 of 11, farmer, 2

GEOLOGISTS

Fernsides W G, 2.5, m1 of 3, grocer, 3
Hawkins H L, 2.0, m1 only, master baker, 3
Hudson R G S, 4.0, m1 of 6, joiner, 3
Read H H, 2.0, m3 of 4, farmer, 2
Taylor J H, 2.5, m1 only, merchant, 2

MATHEMATICIANS

Aitken A C, 2.3, m1 of 7, grocer, 3
Bescovitch A S, 2.5, m4 of 6, jeweller, 1
Fisher R A, 3.0, m7 of 7, auctioneer, 2
Ingham A E, 1.8, m2 of 5, craftsman, 3
Tichmarsh E C, 3.0, m2 of 4, church, 1

CHEMISTS

Gaddum J H, 3.3, m1 of 6, importer, 2
Hilditch T P, 2.3, m1 of 3, master mariner, 1
Hinshelwood C N, 6.0, m1 only, accountant, 1
Hughes E D, 1.5, m9 of 9, farmer, 2
Ingold C K, 3.5, m1 of 2, , 2
Kenyon J, 2.3, m1 of 7, gardener, 4
Mapson L W, 2.3, m1 only, steward, 3
Partington J R, 2.0, m1 of 3, bookeeper, 2
Peat S, 1.8, m1 of 3, mining engineer, 1
Read J, 2.5, m1 of 2, farmer, 2
Robertson A, 2.5, m1 of 3, farmer, 2
Turner E E, 2.0, m3 of 3, salesman, 3
Turner W E S, 3.0, m2 of 7, working class, 4
Wormall A, 2.0, m2 of 4, printer&lith, 2

BIOLOGISTS

Blackman V H, 3.0, m6 of 6, Doctor, 1
Brown T G, 2.3, m1 of 4, Doctor, 1
Cannon H G, 2.3, m3 of 4, compositor, 3
Cheesman R E, 2.0, m2 of 5, farmer, 2
Colebrook L, 2.8, m5 of 6, farmer, 2
Dale H H, 4.3, m3 of 7, manager, 2
Florey H W, 7.5, m3 of 3, shoemaker, 3
Fox C F, 2.0, m1 of 2, army officer, 1
Glenny A T, 3.3, m3 of 5, stockbroker's clerk, 2
Gregory F G, 3.3, m4 of 8, jeweller, 1
Hammond J, 2.0, m1 of 4, farmer, 2
Henderson D W W, 3.3, m1 only, accountant, 1
Holden H S, 2.0, m1 of 2, clerk, 3
Keilin D, 3.0, m3 of 7, business, 1
Leiper R T, 3.0, m1 of 3, tailor, 2
Martin W K, 1.8, m6 of 9, church, 1
Pearsall W H, 3.5, m2 of 3, teacher, 2
Pumphrey R J, 2.8, m1 only, salesman, 3
Richards F J, 2.5, m3 of 4, butcher, 3
Russell E J, 2.8, m1 of 9, teacher, 2
Slater W K, 2.0, m1 only, manager, 2
Stephenson T A, 2.0, m1 of 3, church, 1
Thoday D, 2.0, m1 of 6, teacher, 2
Tulloch W J, 2.0, m5 of 5, hatter, 2
Wallace T, 2.5, m8 of 9, blacksmith, 3

MEDICAL

Cawthorne T E,	2.0, m1 only, customs official, 2
Dain H G,	2.8, m1 of 6, draper, 2
Fairley N H,	3.3, m3 of 6, bank manager, 1
Gray A M H,	3.0, m1 of 4, doctor, 1
Isaacs A,	2.0, m1 of 4, shopkeeper, 2
Jameson W W,	3.5, m2 of 3, bank manager, 1
Lett H,	1.8, m1 of 8, doctor, 1
Souttar H S,	2.0, m1 only, MP, 1

SOCIAL SCIENTISTS

Duff J F,	2.0, m2 of 4, classical scholar, 1
Piercy W,	2.5, m1 of 4, engineer, 1
Robertson D H,	3.0, m6 of 6, church, 1

V. DATA FROM VIDEO-GAMES STUDY

Key to abbreviations: S = subject; pb = self-rated performance at pinball; vg = self- rated performance at video-games; fs = family structure; sc = social class.

S	pb	vg	fs	sc
Firstborn: small sibling spacing (3 years or less)				
1.	3	3	2	1
2.	3	5	3	1
3.	6	2	5	2
4.	3	4	3	1
5.	6	4	3	1
6.	1	2	4	3
7.	1	6	3	-
8.	4	3	6	3
9.	6	1	2	1
10.	3	3	3	-
11.	5	2	3	1
12.	2	3	3	2
13.	3	6	2	3
14.	4	2	2	1
15.	5	4	4	3
16.	6	5	3	1
17.	5	3	2	1
18.	5	3	2	2
19.	4	3	3	-
20.	4	6	2	1
21.	3	3	4	3
22.	6	6	3	3
23.	3	5	2	1
24.	4	3	2	1
25.	6	6	2	1
26.	6	5	3	1
27.	2	4	2	-
28.	2	6	4	3
29.	4	2	2	1
30.	3	4	2	1
31.	3	6	2	1
32.	6	6	2	2
33.	1	2	2	3
34.	6	6	2	2
35.	6	4	2	3
36.	5	2	3	1
37.	5	5	3	1
38.	3	5	2	1
Firstborn: large sibling spacing (more than three years)				
39.	4	4	2	1
40.	6	4	2	1

41.	2	3	2	1
42.	3	4	2	1
43.	6	6	2	1
44.	5	3	2	1
45.	3	6	3	3
46.	4	2	3	1
47.	4	3	2	1
48.	2	4	2	1
49.	5	2	2	1
50.	4	4	3	3
51.	4	2	2	-
52.	6	2	1	3
53.	6	2	1	2
54.	4	2	1	2
55.	4	6	1	2
56.	3	1	1	2
57.	5	3	1	3
58.	6	2	1	1
59.	5	2	1	3

Youngest: large spacing (7yrs+)

60.	4	6	3	1
61.	6	3	5	2
62.	3	3	4	3
63.	4	2	3	1
64.	5	2	2	3
65.	6	2	3	1
66.	4	2	2	-

Laterborn

67.	3	3	3	2
68.	5	3	3	3
69.	6	2	2	-
70.	6	3	4	2
71.	5	6	3	4
72.	5	6	2	1
73.	3	3	2	-
74.	6	3	2	1
75.	4	2	3	1
76.	6	4	2	3
77.	6	5	4	3
78.	5	6	3	3
79.	4	2	3	3
80.	6	3	2	1
81.	6	3	2	3
82.	6	6	3	1
83.	6	4	2	1
84.	4	2	3	2
85.	3	2	3	2
86.	5	2	3	1
87.	6	3	3	1
88.	6	6	2	-
89.	1	3	2	2
90.	1	2	3	1

91.	4	2	2	1
92.	4	2	2	1
93.	6	3	2	1
94.	6	3	2	2
95.	5	2	2	2
96.	3	3	2	1
97.	6	3	3	2
98.	6	1	4	3
99.	4	2	2	2
100.	2	3	2	1
101.	4	3	2	-
102.	3	4	2	2
103.	3	3	2	3
104.	5	5	3	2
105.	2	6	3	-
106.	6	4	2	2
107.	4	3	5	1
108.	6	3	4	2
109.	2	2	4	1
110.	6	2	3	3
111.	5	3	5	2
112.	6	3	5	2
113.	5	4	5	3
114.	6	4	7	3
115.	6	6	3	-
116.	6	3	4	-
117.	6	3	4	1
118.	3	2	3	3
119.	6	1	5	1
120.	6	2	4	1
121.	2	6	6	3
122.	6	2	5	2
123.	2	2	3	1
124.	4	4	5	2
125.	6	4	5	2
126.	4	2	6	3
127.	2	5	4	1
128.	3	2	5	1
129.	5	3	5	2
130.	6	3	3	1
131.	5	5	3	1
132.	4	5	3	-
133.	6	4	5	2
134.	6	2	3	-
135.	4	2	3	1
136.	6	3	4	3
137.	5	5	4	3

VI. NOTES

1. They take as their model of such a variable, IQ. It is interesting that these authors indicate their interest in a substantially hereditarian view of IQ. In itself this is neither here nor there, however since it occurs persistently in a book devoted to a review of the birth order literature, it is surprising, since it suggests a perspective on birth order, a variable unrelated to genetic considerations, predisposed to undervalue the effect of that variable. This is reflected in the general conclusions of the book which, while not rejecting birth order effects entirely, are cautious to the point of being unhelpful. To do these authors justice, they seem to be reacting to sweeping generalizations about birth order effects (eg general conclusion p242), and in response to such generalizations, caution is indeed appropriate. But the origin of the generalizations, is, according to Ernst and Angst, dynamic or depth psychology and psychiatry. Yet by no stretch of the imagination can most of the studies they review be thought of as involved with such approaches. In their conclusion they come across as wanting to play down birth order effects in order to draw attention to heritability:

> Our survey thus allows us the conclusion that birth order influences on personality and IQ have been widely overrated. This result is in agreement with modern research on the heritability of certain personality variables.

Even if one accepts this conclusion, the implied opposition between birth order effects and the effects of heritability is misleading. There is no necessary opposition here, unless one insists that either genes or environment account for 100% of the variance. This comment thus adds nothing to the argument, yet it is italicized by the authors in a concluding section of their book, and is thus clearly considered by them to be important. It thus reveals the interests of the authors, and, as I've suggested, perhaps this explains the generally negative approach to birth order in the book. Consider in contrast Adams (1972), who in the conclusion to his review article says:

> The promise of birth order research, while thus far seldom fulfilled, can still be glimpsed alongside the difficulties of the foregoing discussion.

While Ernst and Angst imply: "there's something there, but don't bother with it, what you should really be looking at is heritability", Adams implies: "it may be confusing, but there's something there, so consider it further". The former view is patronizing, the latter, interesting.

2. All statistics used in this thesis are non-parametric. The rationale for their use is based on Siegel (1956). The standard significance level of $p<.05$ is used throughout.

3. In defence of Wittgenstein, note that in the quotation that introduces Chapter 3, he takes the view that we are still playing the same language game as was Plato.

4. In the light of the comment in Chapter 3 about the joint cultural domination of on the one hand science, and on the other hand, men, one

should note the bias in the very title of the collection. In this context it is interesting to note that the only contribution which seriously questions this title, that of Beloff, also makes considerable reference to art. The purpose of Beloff's paper is not to provide a model of the person as artist, but rather to make use of art as an index of changing views of men and women. Such a use of art is to be welcomed but it differs from my interest here.

5. For psychologists, the study of thinking has at its centre the notion of "truth versus falsity". Psychologists assume that human cognition must operate with methods similar to those used to investigate it. There are right answers and wrong answers. Right problem solutions and wrong problem solutions. Right deductions and wrong deductions. Right classifications and wrong classifications. Right hypotheses and wrong hypotheses. Right inferences and wrong inferences. Right attributions and wrong attributions. The idea of an "answer" which has meaning in virtue of its ambiguity gets little consideration. The dominant idea is that every question has a true answer. Furthermore it has only one true answer. Some psychologists have attempted to get away from this restriction: notable here are Getzels and Jackson (1963) and Hudson (1966) who made use of open ended tests to investigate "divergent thinking", which was described by Guilford (1959) as: "a type of thinking in which considerable searching about is done and a number of answers will do". Equally notable is the lack of support that this approach has received from the community of psychologists. This is at first sight odd, since this work srikes a chord with many of us, and, to take Hudson as an example, his books, in particular "Contrary imaginations", "Frames of mind" and "Human beings" are in wide circulation. However this lack of support is less odd when we realize that it is being proposed that we work in opposition to the scientistic spirit of the age, in opposition to the dominant reality. But one should also be aware of the persistence of the non-dominant reality. This work does strike a chord with us, even if we subsequently ignore it. Guilford comments on the unexpected strength of interest in his early work on creativity, then qualifies this by pointing out that this interest was most strongly manifested outside psychology. Perhaps this is a useful way to characterize ideas that bear on the non-dominant reality: strong interest is shown in such ideas, but this interest is inadequately supported.

The "reality" which underpins our study of thinking continues an epistemological tradition which can be traced back to Plato's discussion of knowledge and truth in the Theaetetus. Knowledge is here conceived of as unambiguous, precisely explicable.

As Copleston (1946) says

> (for Plato) the object of true knowledge must be stable and abiding, fixed, capable of being grasped in clear and scientific definition....

In contrast, and I quote Copleston again:

> In the tenth book of the Republic, Plato says that artists are at the third remove from truth. For example, there is the specific form of man, the ideal type that all individuals of the species strive to realize, and there are particular men who are copies or imperfect realizations of the specific types. The

> artist now comes and paints a man, the painted man being an imitation of an imitation.

Thus the idea of truth as essentially science-like sets in very early in the history of western theory of knowledge. Art is considered a mere imitation of something that is somehow more real, and thus it is not thought worthy of the same level of epistemological consideration. This approach progresses via Descartes view of knowledge as "clear and distinct" to the rigourous use of symbolic logic in the present century as exemplified by thinkers such as Bertrand Russell.
This respectable lineage reflects the usefulness of this approach. The difficulty with this approach is that because of its extensive area of applicabilty, its limits are not perceived as limits to a way of thinking, but are rather perceived as limits to what can be thought. Any mode of thinking falling outside these limits risks being assumed not to be thinking atall. But by default, not by consideration. H.G Wells has put this nicely:

> The man trained solely in science falls easily into a superstitious attitude; he is overdone with classification. He believes in the possibility of exact knowledge everywhere. What is not exact he declares is not knowledge.

For example, though we may disagree with Plato that art is an imitation of an imitation, painting can still be neatly relegated to the epistemological shadows as a product of "the unconscious mind".
6. Andre Lhote(1953), the cubist painter, in an essay entitled "Intelligence in painting" has criticised these assumptions:

> ... today the opening gambit of any self respecting art critic - or rather, the critic who follows the fashion - is characterised by a fulsome eulogy of intuition, the subconscious and the 'world within'. Intelligence, on the other hand, is subjected to attacks all the more violent in that the part played by instinct is exaggerated, and the fear of being 'literary' is so great even among successful painters that those who owe most to the exercise of that faculty, energetically deny it. Everything one owes to the critical sense, the taste for unexpected syntheses, knowledge of inexhausable wells of tradition, all the technical devices skillfully exploited, in a word intelligence, must be attributed to the unconscious if one want to be taken seriously.

One might argue that Lhote's opinions are biased by his background in early twentieth century painting, and that as fashions in art change, so does the idea of the intelligence or otherwise of the painter. I would suggest, however, that even when art is at its most consciously intellectual, as it was in the early seventies with the growth of minimal and conceptual art (eg the work of Sol LeWitt and Carl Andre), it still tends to be considered a mysterious outpouring of the what Lhote calls "the world within", and the fact that these works do not seem to immediately fit in with this notion,

simply opens them up to another line of criticism. At least in these cases the artists are unlikely to "energetically deny" intelligence, however many other people seem happy to do that for them (witness the furore over the aquisition of an Andre by the Tate Gallery). One is forced to consider that perhaps the best survival strategy for an artist today is to deny thought and emphasize "instinct", that is to say, ignore Lhote's message even if it is true.

7. One might object that surely I mean "mathematics enables us to conceive of physical reality". This certainly seems reasonable, however the further that physics progresses, the more reasonable the alternative view becomes. One might call this the "god is a mathematician" view. This would be close to Heisenberg's view.

An interesting example of this is cited by Dirac (1963). He recounts that Schrodinger created a mathematically elegant equation to describe the quantum mechanical nature of the electron. However the predictions of the equation were not borne out by experimental data, so he was forced to conclude that "God was not a mathematician" after all. The equation which did fit the data was less elegant. However when experimental physicists realized that the spin on the electron had to be taken into account during observation Schrodinger's original equation was seen to work, and God's mathematical credibility was restored.

Dirac comments:

> I think there is a moral to this story, namely that it is more important to have beauty in one's equations than to have them fit experiment.

It thus may not be too far fetched to suggest that something like mathematical reality does indeed enable physical reality, in much the same way as physical reality enables biological reality and biological reality enables psychological reality and psychological reality enables mathematical reality. Support for this point of view comes from one of the most recent cosmological theories. This is the theory of the "inflationary universe" described by Guth and Steinhardt (1984). These authors conclude their paper with the words:

> It is tempting to go one step further and speculate that the entire universe evolved from literally nothing.

By "nothing" is meant: "a state devoid of space, time and matter".The only things that "exist" are physical laws, but these are not physical laws in the usual sense, since they relate to nothing except one another. They are mathematical axioms, not ways to describe physical events. Perhaps then the idea that pure mathematics underlies physics is a good one. Mathematics can be seen here as much more than a descriptive tool. One is put in mind of Koestler's (1959) stimulating discussion on the nature of thought and matter in which he refers to Eddington's comment that "the stuff of the world is mind stuff", and to Jeans' suggestion that "the universe begins to look more like a great thought than a great machine."

Such considerations certainly help to keep Piaget's circle closed.

8. It is useful to list the main terms I made use of while developing the

model. The list that resulted in the final label of "concept of analysis", includes "propositional", " objective", "communicable without remainder" and "concept of agency". The list that resulted in the final label of "concept of ambiguity" includes "appositional", "subjective", "uniquely experienced", "concept of communion" and "concept of ineffability". The list that culminated in "concept of resemblance" includes "real", "pragmatic", "operations with percepts", "representational" and "concept of content". The list that culminated in "concept of form" includes "ideal", "purely operational" and "presentational". The list that resulted in "concept of development" includes "temporal", "intentional", "teleological", "sequential" and "concept of timespace". The list that resulted in "concept of space" includes "spatial", "patterned" and "symmetrical".

It was a considerable length of time from the inception of the model to the point at which I realized that the complementary pairs could be referred to as "definitional", "relational" and "directional", despite the fact that I had always recognized the lack of such categorization as a problem. This time lapse can only be understood if one realizes that although the structure of the model was evident from the beginning, the labelling of the concepts was only obvious in the most approximate way. While the space was clear, the words were not. It was thus not until I had sorted out appropriate words from the large set of words which bordered on the appropriate that I was able to give these labels to the complementary pairs.

9. These subjects are in the same relationship as those of Piaget's circle of the sciences, but it would be misleading to suppose that this surface derives directly from Piaget's work. For a considerable period during the development of the model I considered biology and social science to be subsumable by a new classification which I called "chreodic science", making use of Waddington's word to describe a necessary path of development. This classification has the merit that it can bring all sciences of developing systems, that is to say, roughly speaking, embryology to economics, under one heading. However it eventually became clear that this did too much violence to areas of classical biology such as plant and animal anatomy to be an appropriate way of re-classifying biology. However there is something to be said for renaming social science "chreodic science" or "developmental science", but on balance I decided not to do this at present, because new names create problems of communication. These outweighed the conceptual advantages of the new name.

10. Myth as precursor to science: broadly speaking myths are the realm of magical events. A magical event is a non-scientifically analysable change or connection. This emphasis on magical change is clear in the title of perhaps the most popular repository of myth, Ovid's "Metamorphoses". The view that magical thought is a primitive, misconceived version of scientific thought has been put strongly by Sir James Frazer in "The Golden Bough". It is still part of our scientistic world view, and thus bears further discussion. He comments, for example: "... magic is a spurious system of natural law as well as a fallacious guide to conduct; it is a false science as well as an abortive art". His examples of this spurious system of natural law include: "... rites observed in the morning to help the sun to rise, and in the spring to wake the dreaming earth from her winter sleep ..." But difficulties are evident here. These rites are performed in the morning and in the spring. They are harmonious with, rather than causative of, phenomena. Wittgenstein(1979) has made this point strongly with reference to Frazer's text:

> I read, among many similar examples, of a rain king in Africa to whom the people appeal for rain when the rainy season comes. But surely this means that they do not actually think he can make rain, otherwise they would do it in the dry periods in which the land is "a parched and arid desert". For if we do assume that it was stupidity that once led the people to institute this office of Rain King, still they obviously knew from experience that the rains begin in March, or it would have been the Rain King's duty to perform in other periods of the year. Or again: towards morning, when the sun is about to rise, people celebrate rites of the coming of day, but not at night, for then they simply burn lamps.

A remarkably similar attitude to that of Frazer with respect to mythology is found with respect to literature in Cattell (1965). He considers it to be imperfect methodology for the study of personality. (This is analogous to considering children's drawings as reflecting imperfect methodologies for problem solving - see Chapter 4. They are considered merely as steps on the road to the discursive symbolism of propositional thinking.) Cattell talks about literary (and clinical) approaches to personality as though they inevitably, in the fullness of cultural evolution, would result in his own approach. To Cattell they are only of interest when seen in this historical context. The implication that these approaches are simply primitive attempts to be scientifically objective is an odd position to assume, yet this type of thinking seems to be common among modern scientists. This parallels closely Frazer's attitude to magic discussed above.
Frazer distinguishes magic from religion but he assumes that this also is a primitive attempt to be scientific: "In short, religion, regarded as an explanation of nature is displaced by science." He goes on to make clear that he regards science as a better, rather than simply different, explanation. (Golden Bough, abridged edition, p712). Popper (1976, p59) lets slip similar views:

> Our theories, begining with primitive myths and evolving into theories of science, are indeed man-made, as Kant said. We do try to impose them on the world, and we can always stick to them dogmatically if we so wish, even if they are false (as are not only most religious myths, it seems, but also Newton's theory, which is the one Kant had in mind).

Note the implication that "most religious myths" (one is intrigued to know why he doesn't say "all") are the same sorts of things as "Newton's theory". The assumption that both Cattell and Frazer (and Popper) seem to make is that different sorts of explanation must be better or worse than each other. That is to say it must be appropriate to compare them on some common set of criteria. Thus a different sort of explanation is in fact conceived of as a different level of the same sort of explanation. The thought that these ways of thinking might be providing essentially different sorts of explanation, different sorts of meaning, does not seem to be considered.
It is clear that such an approach allows one to inadvertently remove certain problems by defining them as misconceived methodologies rather than as part of one's subject matter. Since for Cattell literature is an imperfect

methodology of personality which aspires to the condition of his own potentially perfect methodology he does not get as far as asking serious questions about it as a way of thinking.
It is not my intention to criticise Cattell's approach per se. The point is that a view of literature or religion as a pre-scientific method of explanation (a more primitive method, a less good method), rather than of a different type of explanation is a pervasive view in western culture but for the most part implicit. When it is stated, eg by Cattell in the early pages of "The scientific analysis of personality", it is stated almost as a piece of convential wisdom; it is taken for granted as a starting point. It is precisely this starting point which I want to re-examine, because it is the starting point uncritically taken by most of us.
I was interested to discover in Cattell's 1938 book "Psychology and religion", an explicit endorsement of Frazer's view of religion. This is useful to my argument since it provides a definite link between the two thinkers. In addition, while I have used Cattell as an exponent of the view of literature as primitive science, and Frazer as an exponent of the view of myth and religion as primitive science, this book shows that Cattell's view of literature is consonant with his view of religion and also with that of Frazer. Cattell further makes clear that he thinks of literature and religion in the same way by using the poet as an example of a person with: "a naive tendency to project (his) own modes of experience on the outer world", a tendency which in the same passage, he also ascribes to religion. (Cattell 1938, pp17-18)).
11. Levi-Strauss's (1978) analysis of music as consisting of phonemes and sentences, but unlike language and myth having no words, is in accord with the my notion of music at the "development" end of its edge on the model. However I also consider music from a "space" point of view. Levi-Strauss is himself aware of the relatively non-developmental nature of music and myth when compared with literature:

> .... exactly as in a musical score it is impossible to understand a myth as a continuous sequence. This is why we should be aware that if we try to read a myth as we read a novel or a newspaper article .... we don't understand the myth, because we have to apprehend it as a totality ...

This gives an opportunity for an analysis of the ambiguity surface of the model in terms of ideas derived from Levi-Strauss.
The relationship of music and myth to literature (the most obviously language related point on this surface on the model) is in accord with the relationship that Levi-Strauss suggests for language myth and music.
He claims that myth and music develop language in different ways. For him the prime components of language are words, sentences and phonemes, while both music and myth are composed of only two of these components; myth is composed of words and sentences, music is composed of phonemes and sentences. This is an intriguing analysis that definitely seems to get something right. For example it helps to make sense of the immense importance of sound, in itself, in literature, which brings it close to music, but also of the immense importance of resemblance which brings it closer to myth. C S Lewis has elegantly described what a myth is. It is something which retains its force of meaning even if you only tell it in a minimal form i.e. with literary values minimized:

> There is, then, a particular kind of story which has a value in itself – a value independent of its embodyment in any particular work. The story of Orpheus strikes and strikes deep, of itself; the fact that Virgil and others have told it in good poetry is irrelevant.

Considering the ambiguity surface further, with reference to Levi-Strauss seems likely to bear fruit.

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VIII. PUBLICATIONS RELATING TO THIS THESIS

From: Edinburgh Architecture Research, vol 12, 1985

A BASIS FOR LIBRARY DESIGN

MURDO MACDONALD

LCAD in painting from Hammersmith College of Art 1977. M.A. in Psychology, University of Edinburgh, 1981. At present engaged in Ph.D. research into the relationships between art and science.

PROLOGUE

A fuller discussion of these ideas will appear in the October edition of Edinburgh Review, but it is entirely appropriate that they should also be submitted for discussion here. The more so since it was precisely my recognition of the need for linkages between activities such as, on the one hand, architecture and design, and on the other, philosophy and literature which led me to carry out this work.

PLANNING A LIBRARY

Suppose you were faced with the task of designing a general library, so that the inter-relationships of the areas of thought covered by that library were reflected in the structure of the building itself. The design would only be satisfactory if it enabled people to progress from one subject area directly to any other closely related subject area. It would not be satisfactory if people could not go directly from, for example, social science to, on the one hand, history, and to biology on the other. Similarly it would not be satisfactory if people could not go easily from music to painting or to literature.

The question is this: what shape would such a library be? The answer is: the same shape as a coherent model of ways of thinking. I will propose in this paper a three dimensional model of ways of thinking, and on the basis of this such a library could in fact be built. I hope it will be.

Schopenhauer helps to put such a library in perspective:

> As the biggest library if it is in disorder is not as useful as a small but well-arranged one, so you may accumulate a vast amount of knowledge but it will be of far less value to you than a much smaller amount if you have not thought it over for yourself; because only through ordering what you know by comparing every truth with every other truth can you take complete possession of your knowledge ...

The proposed model or library is a way of comparing every truth with every other truth.

In examining the diagrams and descriptions below keep this coherently related library in mind. Imagine a journey round such a library. Bear in mind that the library will have a highly efficient stair, escalator and lift system connecting nearby areas to each other. Thus in your journey ignore gravity, which would otherwise bias the structure of the library by making it more easy to travel horizontally than vertically.

THE DEVELOPMENT OF THE MODEL

My initial insight was that a three dimensional model had an explanatory power in some way appropriate to the problem of relating the arts and sciences. What are these 'dimensions'?

I approached this problem by giving working labels to the surfaces of ~~the~~ a cube. I eventually became more aware of the precise organization of the model. I was then able to give more precise labels to the surfaces. But in a real sense these labels are provisional. They are 'to meet necessity'. The model does not originate in them.

They represent a coherent group of approaches to meaning. One can call them elements of thinking. They are characterized by the following concepts: analysis, ambiguity, development, space, resemblance and form.

Analysis is closely involved in what we call the sciences. Each work depends on being interpreted in only one way. Typical analytical activities are biology, social science, mathematics and physical science. Ambiguity is very much involved in art. Each work has many possible appropriate interpretations. Typical activities concerned with ambiguity are music, plastic arts, mythology and literature. Development is to do with what one might call a timespace, or following Waddington, a chreod, rather than a spacetime. The irreversible order of events is of paramount importance. Novels, studies of development, chess and biographies do not make sense backwards. Activities typifying this element of thought are social science, history, literature and games. Space is to do with potential reversibility and the implications of such multidirectionality. Even time is thought of in this radically spatial way in physics, for example the 'backward time' of Feynman diagrams. Typical activities are physical science, design, plastic arts and depiction. Resemblance is to do with not so much what shape something is, but what it is like, that is to say with a relation external to the thing. Activities which depend heavily on this concept are history, biology, depiction and mythology. In contrast, form is solely to do with internal relations. The relations within such a formal work count for more than what it is like. This element of thinking is typified by the activities of design, music, games and mathematics.

These concepts can be seen as three sets of complementarities or polarities. These are the dimensions of the model. These polarities might be called categories of meaning. These three categories are:

(1) Definitional: one or many interpretations (analysis vs ambiguity)

(2) Directional: irreversible or reversible (development vs space)

(3) Relational: internal or external (form vs resemblance)

The convention adopted here is that the development/space polarity is represented vertically, the analysis/ambiguity polarity is represented from left to right, and the resemblance/form polarity is represented from front to back.

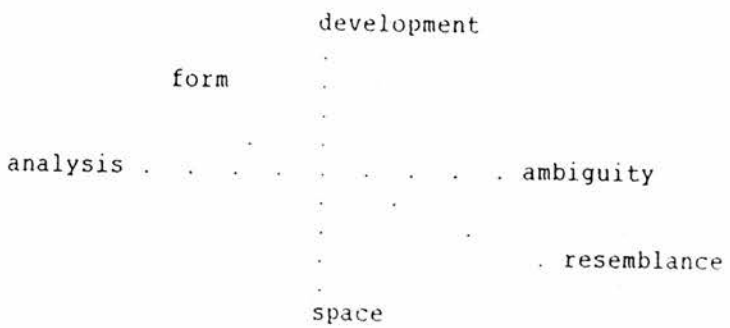

Figure 1

This structure makes sense of a substantial body of human ways of thinking. These are most accurately described by the concepts which characterise them (eg "thinking about development and ambiguity") however each way of thinking is also typified by an identifiable approach to knowledge, an identifiable product. Thus thinking about development and ambiguity is typified by the production of literature. Similarly, thinking about form and analysis is typified by the production of mathematics.

THE MODEL

The complete model is shown in Figure 2:

To clarify the relationships between activities further, the diagrams in Figure 3 show each surface of the model separately. The diagrams show the following surfaces: top right: ANALYSIS; top left: AMBIGUITY; mid right: RESEMBLANCE; mid left: FORM; bottom right: SPACE; bottom left: DEVELOPMENT.

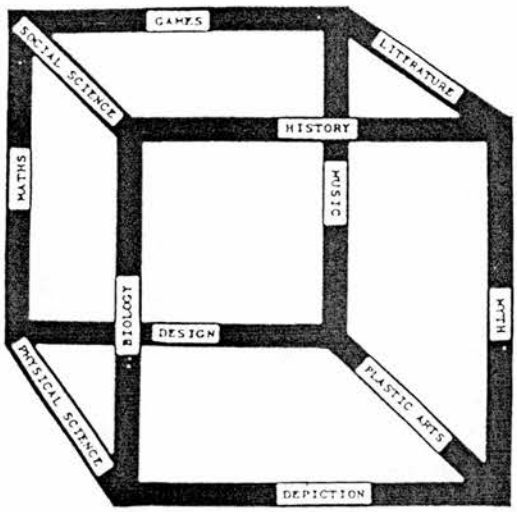

Figure 2

MAKING SENSE OF CONTROVERSIES

Note that the model can contribute to making sense of controversies about the nature of certain activities. For example history relates as strongly to literature as it does to social science. It thus makes sense that there are controversies between historians of literary and sociological orientations. History also relates as strongly to biology as it does to myth. In these terms one can make sense of the controversy between Darwinian claims about the early history of the world and those of creationists.

Similarly it makes sense that social science should be concerned both with problems of formal logic and games, as in cognitive science, but also be concerned with issues impinging directly on history, as in sociology, and on biology as for example in ethology or neuropsychology. The other activities on the model can be considered in a similar way, for example design relates as strongly to physical science and mathematics as it does to music and plastic arts.

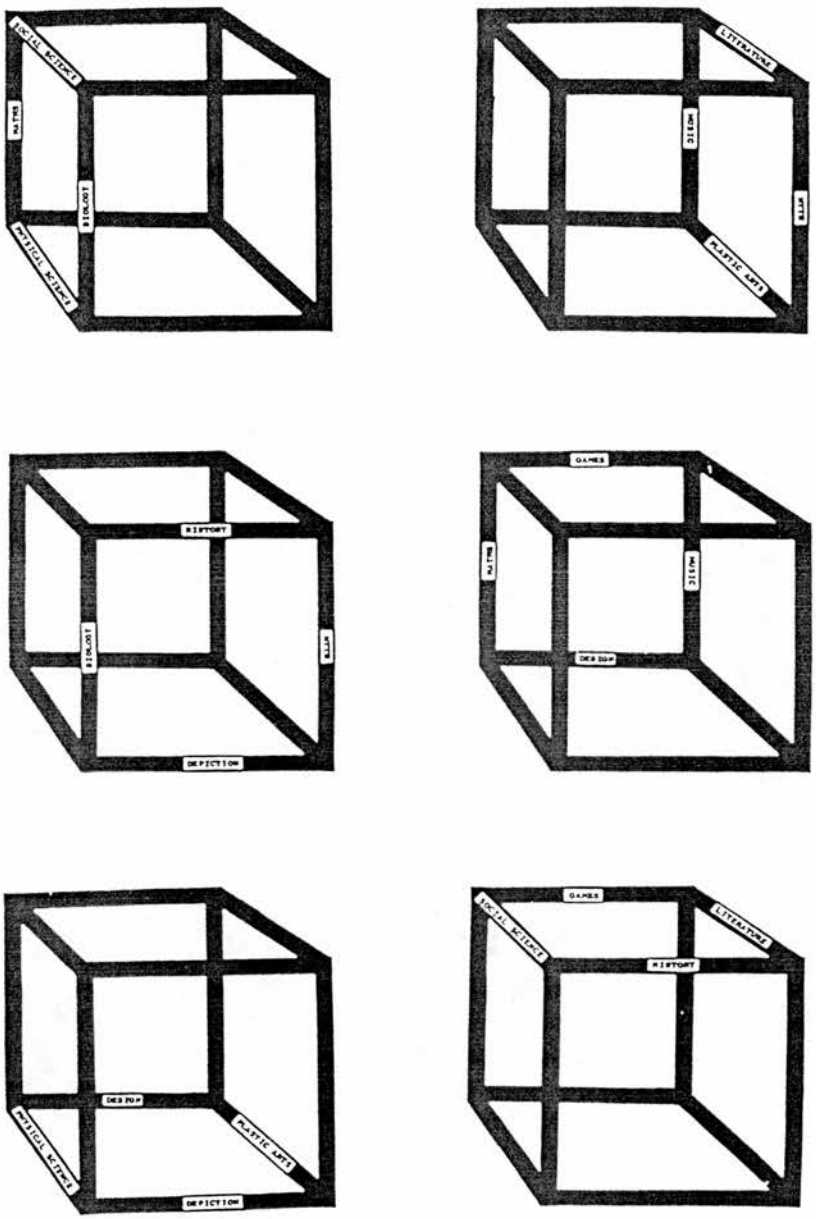
SOCIAL SCIENCES
MATHS
BIOLOGY
POLITICAL SCIENCES
LITERATURE
MUSIC
ART
PLASTIC ARTS
HISTORY
BIOLOGY
ART
DEPICTION
GAMES
MATHS
MUSIC
DESIGN
SOCIAL SCIENCES
LITERATURE
HISTORY
DESIGN
POLITICAL SCIENCES
PLASTIC ARTS
DEPICTION

Figure 3

REPRESENTATIVE THINKERS

It is helpful to include here another diagram of the model on which have been placed names of representative thinkers:

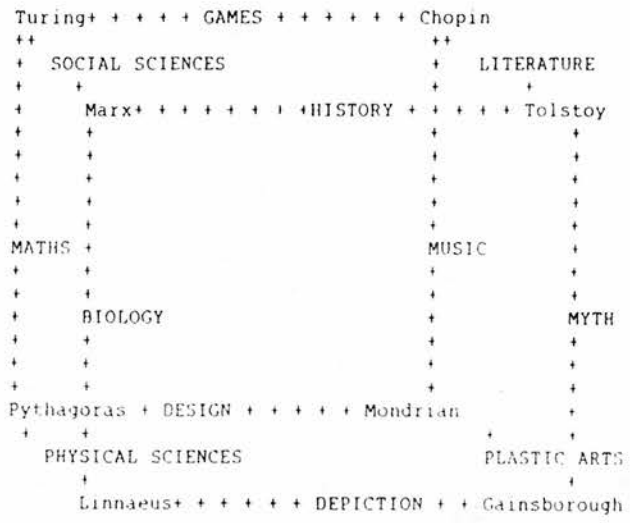

Figure 4

For the sake of clarity these names are only placed on the corners of the model. This is a distortion. Taking for example the 'Marx' corner: ideally Marx should appear between history and social science, Darwin should appear between history and biology, and a geneticist such as Waddington should appear between social science and biology.

I would not want to take this naming of the cube too far because it encourages yet further distortions. Most thinkers avoid neat positioning. For example the corner named 'Mondrian' only represents Mondrian at his most well known neoplastic stage of development. In his earlier work he was much more concerned with resemblance, closer to the point named 'Gainsborough' above. Nevertheless as an exercise in gaining familiarity with the model such naming is worthwhile.

THE MODEL AS AN ANALYTICAL TOOL

In the light of the above comment about Mondrian, it is clear that one can see the model as a tool for the analysis of the development and scope of ways of thinking in a particular individual. For example, Leonardo was engineer, plastic artist and anatomist, and these activities can be seen as substantially covering the 'space' (lower) surface of the model. On the other hand Michaelangelo was best known as poet and plastic artist: with reference to these achievements the 'ambiguity' (right-hand) surface seems more appropriate.

SUMMARY OF AREAS TYPIFYING WAYS OF THINKING

Biology is centred on ideas about single definition (analysis) and external relations (resemblance).

Physical science is centred on ideas about single definition (analysis) and multiple direction (space).

Mathematics is centred on ideas about single definition (analysis) and internal relations (form).

Social science is centred on ideas about single definition (analysis) and single direction (development).

History is centred on ideas about single direction (development) and external relations (resemblance).

Mythology is centred on ideas about multiple definition (ambiguity) and external relations (resemblance).

Depiction is centred on ideas about external relations (resemblance) and multiple direction (space).

Plastic art is centred on ideas about multiple definition (ambiguity) and multiple direction (space).

Design is centred on ideas about internal relations (form) and multiple direction (space).

Music is centred on ideas about mutliple definition (ambiguity) and internal relations (form).

Literature is centred on ideas about multiple definition (ambiguity) and single direction (development)

Games are centred on ideas about single direction (development) and internal relations (form)

THE THINKER NOT THE THING

It is worth stressing the primary importance of the interpreter. Beloff(1984) has noted that, among other things, the same photograph can have both scientific and artistic aspects. This is an important point to consider with reference to the model. What you get out of an artifact depends on the way you think about it. A portrait by David Hockney can be thought of as a work of art. It can also be thought of as a way of identifying the sitter. It is not that the portrait is both an artwork and a means of identification; rather what the portrait is depends on how you use it, on how you think about it. However certain artifacts are tailored to certain ways of thinking, that is to say they are produced by a certain way of thinking and are best understood by that way of thinking. A simple linear composition by Mondrian is best considered in an ambiguous, formal, spatial way. But clearly it could be thought of as a stylized resemblance of scaffolding. The things which are not tailored to any way of thinking are those of the natural world. As Blake said: "Nature has no Outline, but Imagination has". This is, perhaps, a key to understanding the model. It is a model of what we can imagine.

LIBRARY, SCHOOL AND UNIVERSITY

In a library constructed on these principles one would find each area coherently connected to its neighbours. For example one can go from music to literature to history to psychology to biology to physics to maths to design. Each area leads into its neighbours. Since most activities have accompanying texts, the library is the most obvious architectural use of the model, however one could extend this idea into that of a general resource centre. Here one could play games as well as read about them, write, design, make use of laboratories or have a base for studies, listen to and perform music, paint, make or go to films. This extension is useful because it begins to make clear the possibilities inherent in the model with respect to the development of a properly integrated theory of education. One can regard this resource centre as a model for a school or university.

MEDITATION AND PATRICK GEDDES

There is, however, one element missing from the library. This is an area devoted to

understanding the context for thought, rather than its products. In the centre of the library one could devote an area to the contemplation of context. The appropriate activity here would be meditation. It is interesting to note that Patrick Geddes had just such an area in his Edinburgh teaching institution, the Outlook Tower. Boardman(1978) remarks that Geddes thought that it should be an Inlook Tower as well, and that this 'meditation cell' was the beginning of this.

CONCLUSION

I hope that architectural thinkers will find something stimulating in these ideas, with respect to both the possibilities for library design, and to the nature of the links between their own and other ways of thinking.

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From: Edinburgh Review, no. 71, Nov 1985

A Model of the Relationships between Art and Science

Murdo Macdonald

INTRODUCTION: BACKGROUND TO THE MODEL

Some years ago I studied painting at art school. During this time I became increasingly interested in the nature of art. Painting seemed to be a way of understanding one's position as a human being in and of the universe, or just simply understanding the universe. In this respect it seemed to be very like science.

I was attracted to Arthur Koestler's discussion of the aesthetic aspects of science in *The Sleepwalkers* (1959) and for similar reasons I was interested in the fictional game which according to Hermann Hesse involved all types of intellectual activity. In its most advanced form each move is a cue for contemplation of the relationships between different intellectual activities. While tracing Hesse as an antecedent to my own thought I re-read his description of the history of this game, which gives context to general approaches to ways of thinking:

> How far back the historian wishes to place the origins and antecedents of the Glass Bead Game is, ultimately, a matter of his personal choice. For like every great idea it has no real beginning; rather it has always been, at least the idea of it. We find it foreshadowed, as a dim anticipation and hope, in a good many earlier ages. There are hints of it in Pythagoras, for example, and then among Hellenistic Gnostic circles in the late period of classical civilization. We find it equally among the ancient Chinese, then again at the several pinnacles of Arabic-Moorish culture; and the path of its prehistory leads on through Scholasticism and Humanism to the academies of mathematicians of the seventeenth and eighteenth centuries and on to the Romantic philosophies and the runes of Novalis's hallucinatory visions. This same eternal idea, which for us has been embodied in the Glass Bead Game, has underlain every movement of Mind towards the ideal goal of a universitas litterarum, every Platonic academy, every league of an intellectual élite, every rapprochement between the exact and the more liberal disciplines, every effort towards reconciliation between science and

> art or science and religion. Men like Abelard, Leibniz, and Hegel unquestionably were familiar with the dream of capturing the universe of the intellect in concentric systems, and pairing the living beauty of thought and art with the magical expressiveness of the exact sciences.
>
> (*Das Glasperlenspiel*, 1943; trans. R. & C. Winston as *The Glass Bead Game*)

Hesse is writing in the person of a cloistered academic at this point, and indeed the whole book is very much the view from the ivory tower. But the very popularity of the book is an indication of the everyday importance of the ideas.

It was with this background and these interests that I started to study psychology. I was not intentionally studying the relationships between ways of thinking such as art and science however the possibility of such relationships was always at the back of my mind. Occasionally it was manifested as a couple of dimensions with different arts and sciences scribbled into the quadrants, or as an extension or modification of the 'circle of the sciences' which Piaget refers to in *Psychology and Epistemology*.

Another thinker I found helpful at an early stage was C. H. Waddington. His interest in the relationship between art and science emerges first in *The Scientific Attitude* (1941), and receives proper consideration in *Behind Appearance* (1969). The latter is subtitled 'a study of the relations between natural science and painting in this century'. In it he considers both natural science and non-figurative painting to be complementary investigations of what lies 'behind appearance'. He regards these two areas as linked by identifiable features and claims that there is a 'dialogue between painting and science about the nature of the external world'. He concludes:

> We have been led, by a consideration of one apparent discontinuity in human experience, that between painting and natural science, to recognize that there is a continuity between them after all, and that this continuity extends out into wider fields . . . the conclusion we have come to is that man is an Argus with innumerable eyes, all yielding their overlapping insights to his one being, that struggles to accept them in all their variety and richness.

I wanted to see this variety and richness within one coherent framework.

THE MODEL OF WAYS OF THINKING

Things began to fall into place when I started trying to map the disciplines I was interested in onto a three-dimensional surface, namely a cube. This shape is a good tool for thought: it helps to keep thinking straight because it has edges and corners (but a sphere can be used as an alternative).

There are substantial difficulties in communicating an unfamiliar model, but suppose you were faced with the task of designing a general library, so that the inter-relationships of the areas of thought covered by that library were reflected in the structure of the building itself. The design would only be satisfactory if it enabled people to progress from one subject area directly to any other closely related subject area. It would not be satisfactory if people could not go directly from, for example, social science to, on the one hand, history, and to biology on

the other. Similarly it would not be satisfactory if people could not go easily from music to painting or to literature.

The question is this: what shape would such a library be? the answer is: the same shape as a coherent model of ways of thinking. It is interesting to reflect that since the model to be proposed is three-dimensional, such a library could in fact be built. I hope it will be.

Schopenhauer helps to put such a library in perspective:

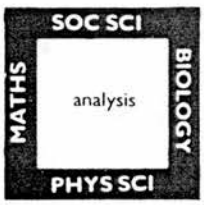
> As the biggest library if it is in disorder is not as useful as a small but well-arranged one, so you may accumulate a vast amount of knowledge but it will be of far less value to you than a much smaller amount if you have not thought it over for yourself; because only through ordering what you know by comparing every truth with every other truth can you take complete possession of your knowledge. . . .

The proposed model or library is a way of comparing every truth with every other truth.

In examining the diagrams and descriptions below keep this 'coherently related library' analogy in mind. Imagining a journey round such a library may be of particular help. The library will have a highly efficient stair, escalator and lift system connecting nearby areas to each other. Thus in your journey ignore gravity, which would otherwise bias the structure of the library by making it more easy to travel horizontally than vertically.

THE DEVELOPMENT OF THE MODEL

I've said that the initial insight was that a three-dimensional model had an explanatory power in some way appropriate to the problem of relating the arts and sciences. What are these 'dimensions'?



I approached this problem by giving working labels to the surfaces of the cube. I eventually became more aware of the precise organisation of the model. I was then able to give more precise labels to the surfaces. But in a real sense these labels were provisional. They are 'to meet necessity'. My thought about the model does not originate in them.

They represent a coherent group of approaches to meaning. One can call them elements of thinking. They are characterised by the following concepts: **analysis, ambiguity, development, space, resemblance and form**.

Analysis is closely involved in what we call sciences. Each work depends on being interpreted in only one way. Typical analytical activities are biology, social science, mathematics and physical science. Ambiguity is very much involved in art; each work has many possible appropriate interpretations. Typical activities concerned with ambiguity are music, plastic arts (e.g. sculpture, painting), mythology and literature. Development is to do with what one might call a timespace, or following Waddington, a

chreod, rather than a spacetime. The irreversible order of events is of paramount importance. Novels, studies of development, chess, and biographies do not make sense backwards. Activities typifying this element of thought are social sciences, history, literature and games. Space is to do with potential reversibility and the implications of such multi-directionality. Even time is thought of in this radically spatial way in physics, for example the 'backward time' of Feynman diagrams. Typical activities are plastic art, physical science, design and depiction. Resemblance is to do with not so much what something is, but what it is like, that is to say it is to do with a relation external to the thing. Activities which depend heavily on this concept are history, biology, depiction and mythology. In contrast, Form is to do with internal relations. The relations within such a formal work count for more than what it is like. This element of thinking is typified by the activities of design, music, games and mathematics.

These concepts can be seen as three sets of complementaries or polarities. These are the dimensions of the model. They can be called categories of meaning. These three categories are:

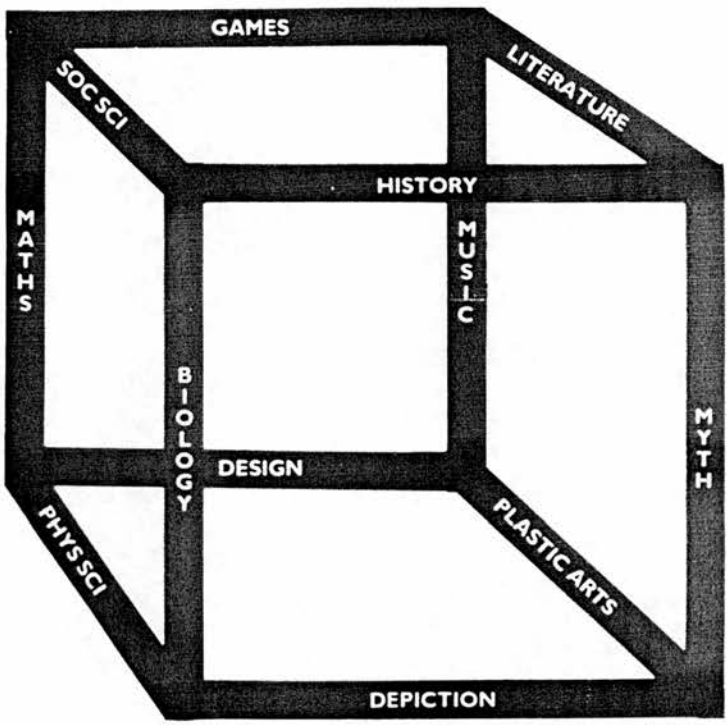
- Definitional { one or many interpretations / **analysis** or **ambiguity**
- Directional { irreversible or reversible / **development** or **space**
- Relational { internal or external / **form** or **resemblance**

This structure makes sense of a substantial body of human ways of thinking. These are most accurately described by the concepts which characterise them (e.g. thinking about development and ambiguity'), however, each way of thinking is also typified by an identifiable approach to knowledge, an identifiable product. Thus thinking about development and ambiguity is typified by the production of literature. Similarly, thinking about form and analysis is typified by the production of mathematics. Thinking about resemblance and space is typified by depiction, for example anything from a scientific anatomy drawing to a portrait by Diane Arbus.

The convention adopted here is that the development/space polarity is represented vertically, the analysis/ambiguity polarity is represented from left to right, and the resemblance/form polarity is represented from front to back.

THE MODEL

The complete model is shown below:



Note that the model can contribute to making sense of controversies about the nature of certain activities. For example, history relates as strongly to literature as it does to social science. It thus makes sense that there are controversies between historians of literary and sociological orientations. In *The Nature of History* (1970),

Arthur Marwick makes this controversy plain while discussing Trevelyan:

> Returning again to the question of whether history is art or science, Trevelyan concluded, rather as Thierry had done before him, and as contemporaries like Stuart Hughes have agreed since, in this fashion: 'Let us call it both or call it neither, for it has an element of both.'

Macaulay versus Marx, so to speak. This controversy is illustrated by Robert Graves in *I Claudius* by an imaginary argument between the Roman historians Livy and Pollio. The former mythologizes history, the latter scientizes it.

History relates as strongly to biology as it does to myth. In these terms one can make sense of the controversy between Darwinian claims about the early history of the world and those of creationists.

The creational view is mythological, with reference to the model, in the same sense as the evolutionist view is biological. They both make sense of questions which bear on history, but they do not attempt to answer the same question. A problem arises when proponents of one view think that it answers questions posed by the other. As, for example, when a creation myth is thought to answer a scientific question, or when a scientific theory is thought to have shown that a myth is stuff and nonsense. These are simply errors of classification. An interesting example is given by D. J. Kelves: 'To Galton's mind, the scientific doctrine of evolution destroyed the religious doctrine of the fall from grace.' ('Annals of Eugenics I', *New Yorker*, 8 October 1984.)

Similarly it makes sense that social science should be concerned both with problems of formal logic and games, as in cognitive science, but also be concerned with issues impinging directly on history, as in sociology, and on biology as for example in ethology or neuropsychology. The other activities on the model can be considered in a similar way. For example, design relates as strongly to physical science as to plastic art, and literature relates as strongly to myth as to music.

REPRESENTATIVE THINKERS

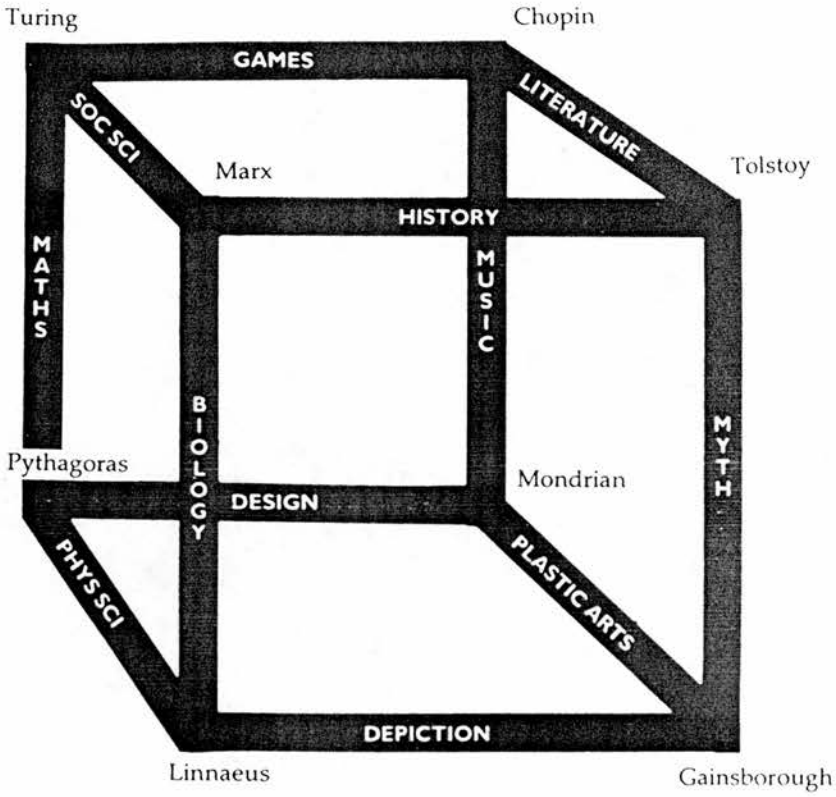
It is helpful to include here another diagram of the model on which have been placed names of representative thinkers, see next page.

I would not want to take this naming of the cube too far because it encourages distortion. Most thinkers avoid neat positioning. For example the corner named 'Mondrian' only represents Mondrian at his most well-known neoplastic stage of development. In his earlier work he was much more concerned with resemblance, closer to the point named 'Gainsborough' here. Nevertheless as an exercise in gaining familiarity with the model such naming is worthwhile.

THE MODEL AS AN ANALYTICAL TOOL

In the light of the above comment about Mondrian, it is clear that one can see the model as a tool for the analysis of the development and scope of ways of thinking in a particular individual. For example, Leonardo was engineer, plastic artist and anatomist, and these activities can be seen as substantially covering the 'space'

(lower) surface of the model. On the other hand Michaelangelo was best known as poet and plastic artist: with reference to these achievements the 'ambiguity' (right-hand) surface is more appropriate. Similarly the 'form' (back) surface, with



its characteristic activities of maths, games, music and design strikes one as a good starting point for any consideration of Wittgenstein. These are clearly preliminary analyses, but they demonstrate the potential use of the model with respect to biographical understanding. Its use with reference to biases inherent within

particular societies (and how they change) is similar. That is to say its use with respect to the analysis of dominant socially defined notions of reality.

SUMMARY OF AREAS TYPIFYING WAYS OF THINKING

Biology is centred on ideas about single definition (analysis) and external relations (resemblance).
Physical science: single definition (analysis) and multiple direction (space).
Mathematics: single definition (analysis) and internal relations (form).
Social science: single definition (analysis) and single direction (development).
History: single direction (development) and external relations (resemblance).
Mythology: multiple definition (ambiguity) and external relations (resemblance).
Depiction: external relations (resemblance) and multiple direction (space).
Plastic art: multiple definition (ambiguity) and multiple direction (space).
Design: internal relations (form) and multiple direction (space).
Music: multiple definition (ambiguity) and internal relations (form).
Literature: multiple definition (ambiguity) and single direction (development).
Games: single direction (development) and internal relations (form).

One might raise objections here. For example: surely there is a great deal of external relation to music, such as that of Mahler? True enough: the point with respect to the model is that music can, with a high degree of meaning, be concerned with internal relations (form) and multiple definition (ambiguity), e.g. Bach's art of fugue, while other activities are less likely to be so concerned. Similarly, biology can, with a high degree of meaning, be concerned with external relations (resemblance) and single definition (analysis), e.g. taxonomy. Other activities are less likely to be so concerned.

Ways of thinking are thus, one might say, epicentres for particular subject areas. They are helpful in sorting out one from another, but *they do not bind the thinker*. The provide an epistemological home.

THE THINKER NOT THE THING

It is worth stressing the primary importance of the interpreter. In her recent book, *Camera Culture*, Halla Beloff has noted that, among other things, the same photograph can have both scientific and artistic aspects. This is an important point to consider with reference to the model. What you get out of an artifact depends on the way you think about it.

A portrait by Rembrandt can be thought of as a work of art. It can also be thought of as a way of identifying the sitter. It is not that the portrait is both an artwork and a means of identification; rather what the portrait is depends on how you use it, on how you think about it. However, certain artifacts are tailored to certain ways of thinking, that is to say they are produced by a certain way of thinking and are best understood by that way of thinking. A simple linear composition by Mondrian is best considered in an ambiguous, formal, spatial

way. But clearly it could be thought of as a stylized resemblance of scaffolding. The things which are not tailored to any way of thinking as those of the natural world. As Blake said: 'Nature has no Outline, but Imagination has'. This is, perhaps, a key to understanding the model. *It is a model of what we can imagine.*

UNIMAGINABLES

But what happens when we can't imagine something, yet still feel that it's there? How can we feel it's there if we can't imagine it? We can do this if we regard it as a context. That is to say something which gives sense to our thought but by virtue of this cannot be made sense of by our thought.

Such ideas seem strange however they reflect the way we use similarly strange words such as God. 'God in whom we live and breathe and have our being', sums the idea up quite well. What is God if not a way of identifying the context for thought? Wittgenstein takes this view when he says in his *Notebooks (1914-1916)* that God is the world. The unimaginable context.

This notion of God is mystical not mythical. These notions are entirely distinct, although a myth may lead to God just as may a work of theoretical physics. A mythological god is a type of thought, not a context for thought. A mythical god can be the figure of fun or tragedy. A mystical God is not a figure. 'I am that I am' is a way of indicating this, as is 'In the beginning was the word, and the word was with God and the word was God'. A context, not a jovial personage.

LIBRARY, SCHOOL AND ENCYCLOPAEDIA

To return to the library analogy: in the light of the model one can now imagine moving round the library and finding each area coherently connected to its neighbours. For example one can go from music to literature to history to psychology to biology to physics to maths to design. Each area leads into its neighbours. Since most activities have accompanying texts, the library is a good analogy for the model, however one could expand the analogy by extending the notion of the library into that of a general resource centre. Here one could play games as well as read about them, write, make use of laboratories or have a base for studies, listen to and perform music, paint, etc. Extending the notion of library is useful because it begins to make clear the possibilities inherent in the model with respect to the development of a properly integrated theory of education. One can regard this resource centre as a model for a school or university.

This organisational system has an interesting bearing on the meaning of 'encyclopaedia'. This word is defined by *Chambers Twentieth Century Dictionary* as 'The circle of human knowledge'. The model can be regarded as a series of circles of knowledge; a programme for a complete encyclopaedia.

There is, however, one element missing from the library. This is an area devoted to the consideration of unimaginables. These could be characterised by the act of the Zen master who hits his pupil. He knows what he is not talking about. Wittgenstein says in the *Tractatus*: 'It is not how things are in the world that is mystical, but that it exists.' A 'how' problem can be interpreted. A 'that'

problem cannot be so treated. It is neither interpretable nor uninterpretable. To approach it on the level of interpretation is not appropriate. In the centre of the library one could devote an area to the contemplation of these things which indicate context. The appropriate activity here would be meditation or prayer.

It is interesting to note that Patrick Geddes had just such an area in his Edinburgh teaching institution, the Outlook Tower. Philip Boardman in *The Worlds of Patrick Geddes* (1978) remarks that he thought that it should be an Inlook Tower as well, and that the 'meditation cell' was the beginning of this.

The significance of the model is reflected in a statement made in 1919 by John Burnet, the educationalist and classical scholar:

> The most important side of any department of knowledge is the side on which it comes into touch with every other department. To insist on this is the true function of humanism.

The model can be of use to those who, with Burnet, see an awareness of connections between activities as essential to an education true to the potential of the mind.