Towards a structural epistemology of a discipline

Colin Timothy Symes

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TOWARDS A STRUCTURAL EPISTEMOLOGY
OF A DISCIPLINE

A thesis submitted in fulfilment of the requirements for the award of the degree of

DOCTOR OF PHILOSOPHY

from

THE UNIVERSITY OF WOLLONGONG

by

COLIN TIMOTHY SYMES, B.Ed. (Hons.)

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(1978)
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table of Figures</td>
<td>(iv)</td>
</tr>
<tr>
<td>Acknowledgements</td>
<td>(v)</td>
</tr>
<tr>
<td>Abstract</td>
<td>(vi)</td>
</tr>
<tr>
<td><strong>CHAPTER ONE - PURPOSES AND ORGANISATION OF THE STUDY</strong></td>
<td></td>
</tr>
<tr>
<td>1.1 Introduction</td>
<td>2</td>
</tr>
<tr>
<td>1.2 Purposes and organisation of the study</td>
<td>8</td>
</tr>
<tr>
<td><strong>CHAPTER TWO - EPISTEMOLOGY AND ENCUltURATION</strong></td>
<td></td>
</tr>
<tr>
<td>2.1 Experiential modification of a priorism</td>
<td>16</td>
</tr>
<tr>
<td>2.2 Varieties of experiential transformation</td>
<td>21</td>
</tr>
<tr>
<td>2.3 Language and outlook</td>
<td>29</td>
</tr>
<tr>
<td>2.4 Knowledge and outlook</td>
<td>35</td>
</tr>
<tr>
<td>2.5 Science: some changes in outlook</td>
<td>42</td>
</tr>
<tr>
<td>2.6 Other varieties of knowledge and seeing</td>
<td>47</td>
</tr>
<tr>
<td>2.7 Epistemic vision: some questions of origin and use</td>
<td>54</td>
</tr>
<tr>
<td>2.8 Education, or travelling with a &quot;different view&quot;</td>
<td>59</td>
</tr>
<tr>
<td>2.9 The state of the epistemological art</td>
<td>65</td>
</tr>
<tr>
<td>2.10 General system theory, and a look forward</td>
<td>75</td>
</tr>
<tr>
<td><strong>CHAPTER THREE - FROM NEGENTROPY TO KNOWLEDGE</strong></td>
<td></td>
</tr>
<tr>
<td>3.1 Introduction</td>
<td>78</td>
</tr>
<tr>
<td>3.2 Perception and homeostasis</td>
<td>79</td>
</tr>
<tr>
<td>3.3 From negentropy to knowledge</td>
<td>91</td>
</tr>
<tr>
<td>3.4 Knowledge: its integrations and its expectations</td>
<td>104</td>
</tr>
<tr>
<td>3.5 From experience to knowledge and back again</td>
<td>115</td>
</tr>
</tbody>
</table>
CHAPTER FOUR - COGNISER, COGNISED AND COGNITION

4.1 Knowledge: a triangular relationship ... 123
4.2 The cognised ... ... ... ... ... ... ... 125
4.3 The cogniser ... ... ... ... ... ... ... 128
4.4 The cognition ... ... ... ... ... ... ... 130
4.5 Cognition: art or science? ... ... ... ... 133
4.6 Cognition and the spectrum of knowledge ... 136
4.7 The spectrum and the evolution of knowledge ... 148
4.8 Cognition and cognised ... ... ... ... ... ... 154
4.9 The knowledge triad ... ... ... ... ... ... 158
4.10 Knowledge and the knowledge triad ... ... ... 162
4.11 Consonance and dissonance in the triad ... ... 166
4.12 Varieties of modulation: some examples ... ... 175
4.13 Non-empirical modulation ... ... ... ... ... 182
4.14 Some conclusions which anticipate Chapter Five ... ... ... ... ... ... ... 189

CHAPTER FIVE - THE DISCIPLINARY CONTINUUM AND ADMITTANCE INTO DISCIPLINARY COMMUNITIES

5.1 Introduction ... ... ... ... ... ... ... ... ... 192
5.2 The styles of epistemological sensitivity ... ... ... 195
5.3 The disciplines and the nature of orderly epistemological conduct ... ... ... ... ... 199
5.4 The transformational grammar of knowledge ... ... ... 202
5.5 Knowledge communities and the bureaucratization of knowledge ... ... ... ... ... 217
5.6 The disciplinary continuum: personnel ascent ... ... ... ... ... ... ... ... ... ... 226
5.7 System theory and disciplinary communities I ... ... 242
5.8 System theory and disciplinary communities II ... ... ... 248
5.9 Conclusions ... ... ... ... ... ... ... ... ... ... 252
# CHAPTER SIX - THE PRODUCTION AND DISTRIBUTION OF KNOWLEDGE

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1</td>
<td>Towards a typology of a knowledge community</td>
<td>255</td>
</tr>
<tr>
<td>6.2</td>
<td>Triad into tetrad</td>
<td>260</td>
</tr>
<tr>
<td>6.3</td>
<td>Student cogniser ($sC_r$)</td>
<td>265</td>
</tr>
<tr>
<td>6.4</td>
<td>Teacher cogniser ($tC_r$)</td>
<td>273</td>
</tr>
<tr>
<td>6.5</td>
<td>Research cogniser ($rC_r$)</td>
<td>287</td>
</tr>
<tr>
<td>6.6</td>
<td>Of high repute and the research cogniser</td>
<td>305</td>
</tr>
<tr>
<td>6.7</td>
<td>Evaluator cogniser ($eC_r$)</td>
<td>311</td>
</tr>
<tr>
<td>6.8</td>
<td>Disseminator cogniser ($dC_r$)</td>
<td>320</td>
</tr>
<tr>
<td>6.9</td>
<td>Primary dissemination, or completing the research act</td>
<td>325</td>
</tr>
<tr>
<td>6.10</td>
<td>Secondary dissemination and content descent</td>
<td>331</td>
</tr>
<tr>
<td>6.11</td>
<td>Administrator cogniser</td>
<td>338</td>
</tr>
<tr>
<td>6.12</td>
<td>Polymorphous cogniser</td>
<td>340</td>
</tr>
<tr>
<td>6.13</td>
<td>Some miscellaneous cognisers and conclusions</td>
<td>342</td>
</tr>
</tbody>
</table>

# CHAPTER SEVEN - SUMMARY OF FINDINGS AND RECOMMENDATIONS FOR FURTHER RESEARCH

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1</td>
<td>Introduction</td>
<td>346</td>
</tr>
<tr>
<td>7.2</td>
<td>The 'journey' to epistemological sensitivity</td>
<td>347</td>
</tr>
<tr>
<td>7.3</td>
<td>Education and the passage to knowledge</td>
<td>357</td>
</tr>
<tr>
<td>7.4</td>
<td>The passage to knowledge: some possible areas of further research</td>
<td>361</td>
</tr>
<tr>
<td>7.5</td>
<td>And in conclusion</td>
<td>367</td>
</tr>
</tbody>
</table>

# APPENDICES

<table>
<thead>
<tr>
<th>Appendix</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Semiology and epistemology</td>
<td>370</td>
</tr>
<tr>
<td>II</td>
<td>Glossary of terms</td>
<td>371</td>
</tr>
</tbody>
</table>

# BIBLIOGRAPHY

377
<table>
<thead>
<tr>
<th>Figure</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>The Hidden Man</td>
<td>111</td>
</tr>
<tr>
<td>3.2</td>
<td>The American Indian/Eskimo</td>
<td>119</td>
</tr>
<tr>
<td>3.3</td>
<td>Duck/Rabbit</td>
<td>119</td>
</tr>
<tr>
<td>4.1</td>
<td>The Spectrum of Knowledge</td>
<td>147</td>
</tr>
<tr>
<td>4.2</td>
<td>Illustration of the 'chinese box effect in science</td>
<td>153</td>
</tr>
<tr>
<td>4.3</td>
<td>The Knowledge Triad</td>
<td>160</td>
</tr>
<tr>
<td>5.1</td>
<td>The Disciplinary Continuum</td>
<td>241</td>
</tr>
<tr>
<td>6.1</td>
<td>The Knowledge Tetrad</td>
<td>263</td>
</tr>
<tr>
<td>6.2</td>
<td>Teacher Cogniser</td>
<td>274</td>
</tr>
<tr>
<td>6.3</td>
<td>Evaluator Cogniser</td>
<td>313</td>
</tr>
<tr>
<td>6.4</td>
<td>Teacher Cogniser and Disseminator Cogniser</td>
<td>323</td>
</tr>
<tr>
<td>6.5</td>
<td>The Dovetailed Gyre</td>
<td>333</td>
</tr>
</tbody>
</table>
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I also wish to thank my two typists, Val Roberts and Enid Sherwin, whose respective IBM's made a sometimes undecipherable manuscript electrifying! I am particularly grateful to Enid, who typed the bulk of this study, and whose attention to small, but often important, details was exemplary.
Knowledge is both a phenomenon of the mind and of society. Most analyses of knowledge have tended to emphasize either the mental or societal attributes of knowledge, and have rarely sought out cross linkages between them. It is often argued that the disposition 'to know' is a conditional or warranted assertion, and the conditions upon which such assertions are based are a matter of consensual agreement amongst the members of a knowledge community. To acquire knowledge, then, is to be introduced into an arena where assertions about the world have been publicly authenticated. That introduction occurs in the context of education, and from it stems the slow displacement of a private disposition to the world by one that is public and consensual amongst members of a particular discipline. It is possible, in fact, to construct a model of that displacement and show how it is that exposure to knowledge results in the gradual accretion of an epistemological sensitivity towards the world. But knowledge is corrigible and subject to change, so that epistemological sensitivity is itself subject to modification. This raises the issue, then, of how it is and by whom epistemological modification is executed. In fact, it is possible to show that knowledge changes are in the main a matter of refining the nexus between knowledge and reality. That refinement is largely executed by certain sorts of members in knowledge communities. For within knowledge communities - which, it is argued, exist to promote refinements to knowledge - a number of roles can be prescribed, one of which, that of the researcher, advances the territory of publicly certifiable knowledge. But his role is not the only one essential to the functioning of knowledge communities. Teachers are also necessary
to them. If disciplines are, in fact, to survive they must enlist new personnel to be researchers and teachers, with the requisite mental outlook and dispositions to the world, to continue the advancement of certified knowledge.
The thesis contains no material which has been accepted for the award of any other degree or diploma in any University, and, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except when due reference is made in the text of the thesis.

Colin Symes.
CHAPTER ONE

PURPOSES AND ORGANIZATION OF THE STUDY

"In my beginning is my end"

(T.S. Eliot, "East Coker" Four Quartets)
1.1 INTRODUCTION

The focus of this study revolves around delineating the traits and features of a discipline. Inevitably, such an investigation regresses to questions about the nature of knowledge and the character of that substantive content which the discipline serves to embrace. For 'discipline' is only a rather convenient, but nonetheless, appropriate cognomen that has been attached to differentiated and autonomous 'species' of knowledge. Etymologically more adequate than other cognates that are used to designate the basic units or compartments of knowledge, the word 'discipline' evokes the notion of order and submission to rules (Hirst and Peters, 1970, p.125). Its adequacy stems from the fact that knowledge is indeed a form of rule governed behaviour that observes the canons and strictures inherent in a discipline. But there is more to a discipline than a collection of statutes and ordinances, designed to keep knowledge 'in order'. The notion that a discipline restrains untoward cognitive behaviour is dominant, but associated with it is an important epistemological function: that a discipline supplies methods for segmenting and analysing experience. To the extent that a discipline provides a set of rules for ordering and understanding aspects of reality, it has the character of a 'martinet'. But it is possible to over dramatise the metaphorical connotations that flow on from regarding a discipline as a martinet, and forget that, as a form of knowledge, its rules, unlike those which keep children and soldiers in order, supply a set of imperatives whose application results in the
acquisition of knowledge. To disobey these disciplinary imperatives is punishable only to the extent that their flouting does not result in an extension of the territory of certified knowledge. Traditionally, submission to discipline is thought to build character; in the epistemological sense, submission to its imperatives builds knowledge.

The pursuit of knowledge, within the canons of a discipline, then, is an eminently 'moral' activity. It involves the submission to rules and the endorsement of the standards and norms which regulate a discipline. Such constraint is necessary to prevent personal ascriptions about the nature of reality, which do not follow the publicly accredited routes to knowledge (Ayer, 1972, p.33), being elevated to the status of legitimate knowledge. The norms, the rules, that are indigenous to a discipline, execute a form of 'quality control' which prevents the standard of knowledge usually associated with a discipline being degraded. They adjudicate over what is and what is not knowledge. They act as form of behavioral control over epistemological activity.

Knowledge, above all, is a communal affair. It has a civic dimension, and it occurs within an intellectual community whose members have agreed to constrain their pursuit of knowledge within the canons and norms of some disciplinary framework. The existence of such a consensual contract enables the fallacies, that might be induced by solipsism, to be cured and prevented. It does not necessarily mean that the personal component donated by the disciplinarian is wholly purged from the pursuit of knowledge. Within the parameters of the discipline's normative framework, he is permitted a certain amount of licence to impress his own individual standpoint upon knowledge. Indeed, it will be argued, that it is the tension
between the public constraints of the discipline and the private
desire to violate them that is the ultimate breeding ground of know-
ledge. Constraint, far from inhibiting the advancement of knowledge,
actually enhances it.

A disciplinary community, then, like any other community, requires
that its members observe certain standards of conduct and behaviour.
These requirements constitute what could be called the 'moral code'
of the discipline. This code legislates to curb defiance and maintain
epistemological standards. Without it, the discipline would in-
evitably degenerate into anarchy and be prey to the pressures and
vagaries of solipsism.* In order to discourage this, it is important
that the admission of members into a disciplinary community be care-
fully controlled. Would-be members must obviously volunteer a sub-
mission to and a commitment towards the moral code of the discipline,
if that code is to be upheld. They must be seen to support its norms
and abide by its rules; and to exhibit a loyalty to all the con-
straints the disciplinary system imposes.

The sponsorship of admittance into a disciplinary community is
largely conducted by education. It has evolved as the major insti-
tution in society to concern itself with that process of socializ-
ation or, as it has sometimes been called, "initiation" into the
public forms of knowledge (Peters, 1970, pp.50-51). This process of

* This might or might not be ultimately beneficial to the development
of knowledge. The scope of this study is limited to the discussion
of what is, not what ought to be. It is, however, worth counten-
ancing the possibility that Feyerabend (1976) has propounded, that
the acceleration of knowledge acquisition is retarded by the pres-
ence of disciplinary constraints. Better a situation, Feyerabend
argues, of epistemological anarchy than one where disciplinary con-
trol prohibits the fructification of new ideas, new thoughts, new
knowledge: even if those ideas and thoughts mean that that knowledge
ultimately turns out to be implausible.
initiation or disciplinary apprenticeship can be regarded as enduring the whole length of education. Education might achieve many other things, but a primary purpose, as far as this study is concerned, is with conducting the procedures of admission into various disciplinary communities. These procedures, which involve supplying the student with the norms and standards, rules and ordinances associated with the discipline, take many forms and styles. Divers though they may be, their cumulative impact is much the same; the development of a commitment to a disciplinary system.

Through initiation, the student comes to learn the 'lingua franca' of the disciplinary community, its grammar and its vocabulary. He eventually comes to understand its values and its concepts in the way his fellow 'communards' do. He gradually learns to play and accept the rules of the 'knowledge game' that the discipline serves to encapsulate. He comes to conform to the standards of the discipline, through acquiescing to the constraints they impose upon his reasoning. By completing a course of disciplinary apprenticeship, the student acquires, as it were, a licence to practise the pursuit of knowledge within the structure of the discipline's normative framework. He secures a kind of 'moral' autonomy within the intellectual community that the discipline represents.

One of the cognitive side-effects of this initiation or apprenticeship, it has been argued (Kuhn, 1973), is that the members of a disciplinary community possess an outlook on the world which is distinctive and exclusive to themselves. They are bound together by a common conceptual framework that orientates their analyses of the
world in certain preferred directions. The community not only shares the same conceptual 'lingua franca' and a common set of disciplinary values, it also shares the same basic epistemological sensitivity to reality.

This sensitivity, which, it will be argued, arises during the years of disciplinary apprenticeship, accumulates from a continuous exposure not only to the knowledge of a discipline, but also to its methodological and metaphysical prejudices. The impact of this sensitivity is to exaggerate and emphasize aspects of reality that would normally be below the threshold of normal perception and observation. The physicist's vision of the world is thus radically different from that of the layman. The latter can only appreciate the depth of vision the physicist sees by being trained as a physicist (Hanson, 1969a, p.16).

This phenomenon of heightened sensitivity is not peculiar to those trained within the framework of a discipline, rather it is an extension of man's normal perceptual behaviour. All that is perceived, "seeing as", as Wittgenstein (1972, p.193e) pointed out, is charged with interpretation, otherwise it would not be registered. The analysis of the world by the senses, in conjunction with the mind, is accompanied by interpretation. Meaningful perception is born of learning about the conduct of the world, of having knowledge about it. It is broadly the thesis of this study that the training a discipline supplies simply extends this process and leads to the development of a set of "seeing as" interpretations not normally acquired in a casual acquaintance with reality. Such training exploits the fact that man's perceptual outlook is susceptible to transformation and change.
The mental impact of disciplinary training, then, results in the amplification of an individual's ordinary sensitivity to the world. The discipline acts as a power amplifier. It extends the individual's cognitive powers and renders them sensitive to those features of reality which are of particular concern to the discipline. Disciplinary training helps draw the attention of the individual to aspects of reality he would not normally be conscious of. The disciplined mind, then, is one that is regulated according to the norms and ordinances of knowledge; and it is one that sees the world in terms which are compatible with the implications it inherits from being trained within the epistemological framework of a discipline.

* * * * * *

The description of a discipline just outlined indicates the close proximity that the development of an epistemological sensitivity and education have to one another. It suggests that the cumulative impact of a formal education results in the slow transformation of the individual's mentality and outlook on the world. The disciplined mind, it is suggested, possesses a characteristic vision of the world. Almost analogous to the 'tropism' that some animals and flowers exhibit, such a mind is abnormally sensitive and responsive to certain stimuli that inhabit the scenario of its surrounds. This epistemological tropism, however, is not innate as it is in animals and flowers, it is learnt and acquired through long years of training and education in a discipline. This study will be concerned with understanding and describing the educational circumstances and the cognitive results thereof, which generate this form of mental tropism. It will examine the way the mind, as it succumbs to the influence of knowledge, comes to an experience of the world with a set of
disciplinary predispositions or "seeing as" outlooks. This study, in short, will look at the way knowledge influences the behaviour of the mind. It will explore the relationship between the knower and the known; and try to show how it is that the character of the latter comes to influence the outlook of the former.

1.2 PURPOSES AND ORGANIZATION OF THE STUDY

The theme of this study, it has been suggested, deals with the psychic impact of knowledge. That theme, in fact, will be explored from two rather different, though not independent, perspectives. The first will examine the theme from the way the knowledge an individual acquires transforms his vision of the world. It will, as it were, try to encompass what are essentially the cognitive facets of the theme. The second perspective will examine the theme in terms of the educational context in which mental transformation usually occurs. It will examine the sort of processes of training which cumulatively bring about a progressive metamorphosis of an individual's outlook. This, since it largely occurs through the individual interacting with other people, particularly teachers, will represent the theme's social perspective. But whilst it is possible to separate both these themes, what in fact the study wishes to do overall is develop a model of knowledge, and the epistemological enterprises it embraces, that will encapsulate both the cognitive and social themes.

The quest for this model will commence in Chapter Two, where it will be initially indicated that knowledge is only one of a whole 'family' of phenomena that have the potential to influence the way
the world is regarded. It will be argued, however, that knowledge, of all the members of this 'family', has the greatest capacity for influence. A number of instances of this influence, in a variety of knowledge areas, are then cited, which endeavour to show that epistemological sensitivity, far from being a hypothesis, is a fact. The remainder of Chapter Two is concerned with ascertaining a disciplinary approach that might help to explain this apparent power of knowledge to influence outlook in very profound and dramatic ways.

It emerges from the 'literature survey', that, whilst knowledge represents one of the most intensively cultivated fields of philosophy, most approaches to it are 'reductionist' in tenor, and do not really encompass in any substantive way the phenomenon of epistemological sensitivity. Contrary to the approach that will be adopted in this study, most epistemological analyses of the knowledge process tend to concentrate on understanding its fundamental elements. Rather than looking to preserve its 'holistic' attributes, most examinations of knowledge are prone to reducing it to its discrete and component parts. They either examine knowledge as a phenomenon that reflects reality in some unexplained way; or treat it as an essentially mental phenomenon whose psychic and mental character needs to be more fully understood. But although there can be merit in looking at the mental 'substrata' from which knowledge is fabricated and nothing else, such an approach offers explanations, it is argued, at the expense of a total understanding of knowledge. They would tend to divorce, for instance, those cognitive and social dimensions of the knowledge process, which, it has been declared, this study is principally interested in. Therefore such approaches to knowledge will tend to be looked upon with disfavour for the purposes of this study.
But not all examinations of knowledge are necessarily so reductionist in character. The approach adopted notably by Polanyi (1962, 1969) and the "beyond reductionism" school (Koestler and Smythies, 1972) has often served to bridge the gap between philosophy and the human sciences. In the light of this approach it is concluded in Chapter Two, that it is to the holistic rather than the reductionist style of epistemology that this study should show most allegiance.

With the decision made in Chapter Two, to regard knowledge as a comprehensive rather than a disjunctive entity, Chapter Three makes some attempt to apply the implications of this decision to understanding the psychological origins of knowledge. It initially tries to show how it is that knowledge arises out of the mind having a rapport with reality. It argues that consciousness and experience represent the incipient conditions for the creation of knowledge. The theme of Chapter Three, then, centres on the notion that knowledge represents a kind of cerebral extension of sensory awareness. Knowledge is not, as Locke (1971, Book II, Section 23) pointed out, "coeval with sensation", but it does have its origins in sensory awareness. About that, as Kant (1969) said, there can be no doubt. The chapter also indicates that knowledge initially arose as an efficient way of coping with contingencies man encounters in coming to terms with reality. It ameliorates man's problem solving capacity. Knowledge, then, is a product of the colloquy between the individual and his environment. This colloquy, it is suggested in Chapter Three, begins with sensory awareness and ends with knowledge.

In further developing this notion of colloquy, Chapter Four endeavours to construct a model of how it is the mind has contact with
reality (Winch, 1958, p.21); and what sort of epistemological results accumulate from that contact. It suggests that there is a strong 'isomorphism' between language and knowledge, and that the models of meaning formulated by a number of linguistic theorists offer parallels between the structural condition of language and knowledge. That is to say, the relationship that exists between a word, its meaning and the object to which it refers (its referent), and to which traditional models of meaning draw attention, resembles the relationship between the three basic radicals of the epistemological enterprise: knowledge, reality and mind. Chapter Four argues that a model of verbal meaning can act as an analogue for epistemological meaning. On that basis, a model of knowledge is constructed which serves to describe the nature of the relationship between knowledge, mind and reality. The model is sufficiently flexible to incorporate the theme of this study, the psychic impact of knowledge on the perception of reality.

Much of Chapter Four, then, is concerned with the way knowledge comes to reflect and modify the mind's interpretation and reading of reality. One of the conclusions of looking at knowledge through the perspective of the model, is that it indicates that various minds regard knowledge and its relationship to reality rather differently. Some minds possess a critical attitude to extant knowledge and are eager to diagnose doubts in the power of some knowledge to reflect reality. Out of such doubts, it is argued in Chapter Four, eventually come refinements to knowledge, which improve its compatibility with the behaviour of reality. Knowledge advances through "error eradication" (Popper, 1973a, p.119).

Other minds, not trained to diagnose doubts, are much more neutral in their attitude to knowledge. They are often willing to adhere to
the authenticity of knowledge and to support the epistemological status quo. The latter half of Chapter Four, then, indicates that within a disciplinary community there might be different styles of cognitive outlook and epistemological sensitivity. This provides a basis for analysing the social dimension of knowledge. This dimension, which constitutes the second major perspective of this study, is dealt with in Chapters Five and Six.

The analysis of the social dimension of knowledge - in particular that associated with disciplines - begins in Chapter Five. It is asserted that there are useful analogies to be made between disciplinary and so-called 'open' systems. Like an open system, it is argued, the disciplinary system requires an input of personnel and an output of knowledge, if it is to maintain itself in equilibrium and not degenerate into chaos and 'entropy'. Since those personnel, if they are to produce new knowledge, must be prepared to submit themselves to the constraints of the discipline, there must be some institutions dedicated to equipping the personnel with the values and ordinances that are indigenous to the discipline. Those institutions, which in our culture are associated with education, conduct the initiation into the disciplinary systems, and thereby ensure that they are supplied with the requisite, qualified personnel.

Chapter Five suggests, then, that education attends to the needs of disciplinary initiation. It conducts the various 'rites' which surround that initiation. The whole structure and dynamic of education, which Chapter Five attempts to map out in what is called the 'disciplinary continuum', reflects the need to create individuals who can satisfy the epistemological needs of the disciplinary community. As such, the structure of education appears to be
functionally arrayed, so as to bring about in students a 'mental tropism' that is in accordance with the discipline's publicly accredited outlook. Education, in essence, serves to bring about a degree of conformism within the conceptual frameworks of the various disciplines.

By attempting to assemble a 'role typology' of the participant members in a disciplinary community, Chapter Six extends the analysis, commenced in Chapter Five, of the discipline as a social system. The typology represents an attempt to classify those members the community demands, if it is to function properly as an open system. As has already been indicated, not all members of a disciplinary community are necessarily concerned with stripping the veil of mystery from reality (Duhem, 1954, p.7); for, as Chapter Five indicated, the community, in order to survive as a functioning, corporate unit, needs other sorts' of personnel apart from those solely engaged in extending the limits of knowledge. The disciplinary community needs, for example, personnel to conduct the initiation of students; and still others to see that new knowledge is disseminated to the whole community. Each responsibility, each type of role, requires a rather specific outlook on knowledge and reality. Those gathering knowledge, for example, need to possess a more critical outlook on extant knowledge, than those concerned with disseminating it. The latter half of Chapter Six, then, is concerned with identifying and describing the roles in a disciplinary community, and showing how these roles can be symbolically represented on the model of knowledge developed in Chapter Four. This chapter, then, represents an attempt to bring about a synthesis of the cognitive and social dimensions of knowledge developed in the earlier chapters of the study.
The seventh and last chapter offers a summary of conclusions. It tries to indicate what sort of contribution to the understanding of knowledge the study attempts to make. It also tries to assess what sort of use this understanding of knowledge is potentially able to offer. It looks, then, at the implications, particularly for education, that the study yields. The chapter also notes that the models of knowledge developed in the study are attempts to abstract from the total spectrum of knowledge some general features and traits of knowledge that can be systematized within the framework of a model. The study has not concentrated on describing the features and characteristics of particular forms of knowledge. Instead, Chapter Seven suggests this might be an area of research that could be pursued to supplement and corroborate the models of knowledge posited in the study.
CHAPTER TWO

EPISTEMOLOGY AND ENCULTURATION

"The eye's plain version is a thing apart, 
The vulgate of experience"

(Wallace Stevens,  
An ordinary evening in New Haven)
2.1 EXPERIENTIAL MODIFICATION OF A PRIORISM

Traditional debate about the foundations of knowledge has tended to focus on whether knowledge is ultimately generated from experience alone, or from some timeless mental entities that are archetypal to all thought and cognitive activity. The debate reduces itself to whether knowledge is governed by a priori or a posteriori principles, or arises from a concessionary interplay between the two. Virtually the whole history of epistemology - from Plato through to Frege - is devoted to settling this debate, and there is no sign yet that the debate is exhausted. It seems that just as the empiricists were about to triumph, in the guise of Behaviourism, thus settling the debate, the issue, once again, has been resurrected by those who would have epistemology turn to Seventeenth Century rationalism rather than empiricism as a mentor in the matter of cognitive activity. The foundations of knowledge are, it seems, as uncertain as ever!

It has been the problem of explaining "language acquisition" which has reawakened interest in the credibility of psychological a priorism. The explanation as to why all humans, irrespective of their intellectual ability, should be competent language users, or why that competence should be apparently so "species specific", it has been argued (Chomsky, 1967, 1972), cannot readily be accounted for in a posteriori terms: hence the vigorous defection from the tenets of Behaviourism. For the tabula rasa thesis of the latter - with its insistence that all cognitive behaviour has its incipience in environmental stimuli of some kind - cannot, so the new a priorism argues, accommodate the phenomenon of "language acquisition". An inductive awakening of language ability, one that is motivated into
existence by sensation and that alone, Chomsky feels represents a wholly inadequate explanation. The phenomenon of language is founded upon something other than the skeleton of a stimulus/response mechanism. The advantage of the "innateness hypothesis" - which Chomsky proposes as a more plausible alternative to straightforward Behaviourism - is that not only does it explain the human specificity of language, but also why it is that, beneath their superficial diversity, all languages display a homogeneous structure. All languages have their provenance in the same "deep grammar"; they share a "vast central core of common rules" (Chomsky, 1972, p.79). And it is that central core and grammar, which, being somewhere embedded in the cortex of human beings, is finally responsible for generating linguistic behaviour.

In effect, Chomsky's neo-Kantianism, or as he prefers to see it, neo-Cartesianism, 'has once again opened the Pandora's Box of whether man learns by experience alone, or whether the mind is furbished, to begin with, with some basic spatio-temporal concepts, grammars, "eternal essences", which help it to initially extrapolate meaning from experience. In short, are the origins of language and ideation in general ultimately mental or experiential? Interestingly, Chomsky's own defence for the existence of "innate" grammars rests on the evidence of language, rather than any observed features in the neuro-physiology of the brain. He argues retroductively that the task of language learning demands "innate assistance". Otherwise, according to Putnam (1967, p.94), given the complexities of language, it would be miraculous if one tenth of the human race were ever able to master it. But as to whether there are any generative grammars embedded somewhere in the cortex, at the moment, that remains undemonstrated.
Their existence, then, is a product of reason rather than observation. Not that Chomsky's "innateness hypothesis" looks wholly implaus-ible. When lower order cognitive capacities than language are con-sidered, there is a certain amount of empirical evidence to suggest a degree of innateness. Research, for instance, into the perceptual receptivity of "visually inexperienced" animals, like kittens (Hubel and Wiesel, 1970) and frogs (Laszlo, 1969), has indicated that from birth the cortices of these animals are responsive to elementary configurations of line, angle and motion. They have a congenital sensitivity to the world that appears to be operant before visual exposure to the world actually occurs. That sensitivity, then, is pre-experiential; it is innate. This would appear to indicate that the cortex has "wired into" it a series of "neural nets" that are able to resolve into archetypal geometrical forms the plethora of perceptual data that a neonate organism encounters. Empirical research, then, does indicate the existence of a basic perceptual 'language' embedded into the cortex which, once engaged, allows the organism to generate more complex analyses of its experience.* Once an organism begins 'talking' with its environment, it is able to develop a more discriminating perceptual 'vocabulary'. From the few basic eidetic 'words' that have been physiologically encoded, the organism is able to assemble those 'portmanteau words' of mature perception that

* It is of note that Chomsky (1972, p.94) draws support for his own innateness hypothesis from such research. He argues that such innateness could well extend beyond the arena of perception and explain higher order cognitive capacities like language.
enable it to engage in an infinitely richer and more subtle 'dialogue' with its surrounds. Experience thus leads to a general enrichment and diversification of the organism's innate visual vocabulary (Gregory, 1971, p.24).

Perception, however, is not the only form of behaviour in which some semblance of a "deep grammar" can be described. It has been observed, for instance, that babies are able to modify their innate sucking and mouthing rhythms to feed more efficaciously at the breast — thus exhibiting a primitive and pre-linguistic problem solving capacity. Moreover, this compulsive sucking action, that is so characteristic of the neonate's behaviour, can be adapted to do other things than receive lactation. For, embedded within the "grammar" and "syntax" of sucking, is a whole repertoire of mouthing actions, like blowing glass, using a pipette, smoking a cigarette, which can be generated from it (Bruner, 1972). New sensori-motor 'sentences' or co-ordination can, as it were, be constructed from the basic syntax of sucking. And in an analogous way, Piaget (1971a, pp. 42-43) has noted how it is possible to see "logical mathematical structures" as sophisticated extensions of a tendency to generalize that which, from a very early age, is evident in the child's sensori-motor manipulations of his surrounds. In this way, mathematics could almost be regarded as one of the crowning achievements of motility!

Seen from these perspectives, the matter of mental a priorism, providing its ambit is restricted to relatively primitive cognitive capacities, does have a degree of empirical credibility to it. The story of mental development, however, is not wholly a prioristic, just as it is neither entirely behaviouristic. It looks increasingly
plausible that development is most satisfactorily explained by regarding it as a kind of experiential modification of innate patterns of behaviour. It is a matter of ontogenesis fusing with phylogenesis to produce an offspring of cognitive behaviour that emerges as much from what is cortically embedded as from what owes its origin to the environment. Thus there is some ontogenetic encoding and an amount of environmental influence, and it is the interaction between the two that gives rise to cognitive behaviour in all its diverse forms (Waddington, 1973, pp.39-40).

What remains more contentious is the type and range of encodings that are ontogenetically "wired-in". Do these extend beyond the perception of elementary geometrical structures, and include spatio-temporal concepts like causality, or "universal grammars" that provide a preliminary syntactical foundation for the acquisition of language and logical thinking? Chomsky undoubtedly thinks so (vide supra), but his critics are less inclined to accept what is in the main a post hoc ergo propter hoc rather than empirical argument. Putnam (1967, p.98), for instance, has argued that language acquisition can be quite convincingly explained without the need to resort to "deep grammars".

It might or might not be, then, that the ultimate foundations of knowledge are imprisoned somewhere within the anatomy of the cortex. If so, maybe physiopsychology will one day isolate the cortical regions that are responsible. In the meanwhile, hypotheses about the matter will have to prevail instead. But if there are "deep grammars" underlying perception, language, knowledge and so forth, it is clear that when experience activates them, as Chomsky (1967, p.88) rightly notes, a whole medley of schematizations are produced which
differentiate and analyse the world in various and often very antithetical ways. Thought and perception might have a parent in some a priori structures that are innate, but when subjected to experience a whole progeny of a posteriori structures are produced; and these represent expressions of how the world is finally understood and perceived. It is the origins, then, of these surface grammars, engendered by experience, which are articulations of the "deep grammars", that is a concern of this study. But the nature of experience is itself manifold, and the number of surface grammars inherent in it equally manifold, so that before the process of articulation can be fully described, it might be first desirable to typify the varieties of experience and the sorts of transformations they are capable of engendering.

2.2 VARIETIES OF EXPERIENTIAL TRANSFORMATION

Experience is man's portal to the outside world. It is the door through which his consciousness flows in the struggle for sense and understanding. The world which experience encounters, however, is a thoroughly rich tapestry of diversity, a medley of infinite variety and unparalleled uniqueness, wherein it becomes impossible for a man to attend to everything that potentially has the power to impinge upon his consciousness. He must somehow adjust to this panorama of absolute and unending diversity, if sense and meaning is eventually to be yielded from it; he must somehow separate from the arena of his vision those elements of perception that are superfluous to the fuller understanding of his surrounds. It is a paradox, but it seems (see 3.2) that fullness of vision is only made possible by limiting it!
But what causes this condensation of vision to take place? What ultimately catalyses the transformation of the "deep grammars" of perception into thoroughly individualistic 'languages', having a perceptual timbre all their own? Where do these 'languages' spring from? And in what tangible ways do they affect our visual accomplishment in the world? But first it needs to be demonstrated that the transformation occurs, and that a man's outlook is indeed affected by the things which are most prominent in the vista of his experience. And since the most prominent landmarks in a man's experience are the culture and topography he inhabits, it seems reasonable to infer that these two things would leave the heaviest 'footprints' on his outlook. But is this so? Does his culture and topography render a man conscious of vistas of reality of which he might otherwise be unaware? Or do they lead to fallacious distortions that, had a man been nurtured in another culture and environment, would have been seen as obviously false?

In fact it has been shown that there is indeed some demonstrable correlation between perceptual sensitivity and the dominant character of a topography. Children, for instance, who are brought up in a largely "carpentered" environment - one that is dominated by straight lines, rectangles and horizons - do appear more prone to misperceive certain visual illusions than those children whose environments provide no opportunity to view horizons or vast distances, and vice versa (Segall, Campbell and Hersovik, 1966). Of course a tendency to be deceived in a test situation need not in itself reflect what might be the actual perceptual character of an individual in his 'natural habitat'; physiological factors could account for such deceptions (Cole and Scribner, 1974, pp.78-79). But although subsequent
field research has tended to weaken rather than strengthen Segall's hypothesis, there is still a body of evidence - mainly of an anecdotal kind (Cole and Scribner, 1974) - that does suggest that the dominant character of a habitat might serve to foster certain styles of perceiving and inhibit others. The child brought up in a visually claustrophobic environment, a forest for instance, often finds it difficult to adjust his mode of seeing to uninterrupted distances, and will often misconstrue the nature of things observed in an expansive environment.* It is possible, then, for someone to be visually literate in one environment and illiterate in another. This has shown to be particularly pronounced in the interpretation of perspective. A comparative study of Zambian and Scottish children revealed convincingly that the former experienced difficulties disentangling the right visual significances from the three dimensional mode of representation in perspective (Lloyd, 1972, p.107). It seems perspective is not immediately accessible without a previous background and familiarity with it as a representative device. This background is more likely to be possessed by Scottish children, because they have been brought up in a habitat where perspective is constantly used to portray the recession of distance. The matter of perspective, however, whilst it finally affects visual outlook, springs from a rather different experiential source than topography. Properly speaking, its influence should be attributed to culture, not landscape.

* A good example of this is provided by an anecdote of Cole and Scribner's (1974, p.97). They once took a child, who had been raised in the African jungle, to a port, where they all stayed in a tall hotel from which, far out to sea, could be seen a large oil tanker. "The child, who had never seen such a view before, and was not familiar with tankers, commented on the bravery of men, who would go out to sea in such small boats".
Research showing the probable ethnocentricity of perspective, then, highlights the ramifications that cultural experiences are likely to have on an individual's outlook on the world. Arguably topographical influences are really quite trivial by comparison, and really only prevail in exceedingly 'eccentric' environments like deserts and forests. In more balanced environments their effect is likely to be so minimal, they can all but be discounted. This means, then, that the bulk of transformative influences, affecting the individual, originate from his cultural experiences; and that if there are major differences between the 'outlooks' of individuals these differences are attributable to culture, rather than the character of the topographical regions where those individuals live. Discrepant cultural milieux therefore should initiate correlatively discrepant outlooks on the world; they might tend to blind the onlooker to things which are transparently clear to an onlooker brought up on a 'diet' of different cultural experiences. In fact, the differing reactions, already discussed, do suggest that this close bond between outlook and culture is more than just an imperative, it is a fact.

That cultures tend to breed outlooks, which are sometimes very dissonant with one another, is amply born out by studies of cultures of an extremely contrasting character. Anthropology is legion with examples of the profound differences, for instance, which prevail between the Western and scientific outlook on reality, and that of the African. It seems it is not just reactions to things like perspective that are grossly affected by variant cultural background, but reactions to the world in general. And although it has been argued (Horton, 1974) that the differences have been sometimes overdramatised,
and that there are more evident parallels between Western science and African thought than perhaps anthropologists have been prepared to acknowledge, it does seem that African thought can serve to trammel outlook to a state of inflexibility where it becomes impossible to accommodate even the most elementary principles of Western logic. The Azandes and their incorrigible faith in the ineluctable power of their oracle is regularly cited as evidence for this. Thus the regular and dramatic failing of the oracle was always ingeniously accommodated in some explanation that lay beyond criticising the oracle itself. That was always considered beyond suspicion. The recalcitrant example, which the oracle appeared not to explain and which should have led the Azandes to lose faith in the ineluctability of their oracle, was in fact totally outside the scope of their concern. There was nothing intrinsically wrong with the oracle, rather it was the manner in which the oracle was prepared that was in error. It was as though the Azandes could "reason excellently in the idiom of their beliefs" (Evans-Pritchard, 1937, p.338), but not outside them. Their culture had closed them off from the possibility of comprehending the ways of Western logic.

That contact with Western logic might yield perspectives on the world, contained in rather different frameworks of rationality, is also born out by cross-cultural studies of cognitive development. Greenfield and Bruner (1969) have demonstrated how Western schooling (and the knowledge dispensed therein) tends to accelerate the growth of operational thought by encouraging the ready discrimination between different points of view. On the other hand, children brought up in environments where rather different modes of schematization prevail, do not have that benefit, and often find it difficult to differentiate
between the self and the external world. Operational thought, therefore, tends to be retarded for the lack of appropriate cognitive stimulation.

Belief idioms, then, have the power to permeate and mould even the immature vision of the world; they can train it in directions of thinking that are often difficult to relinquish or modify. It is almost as if culture were a powerful magnet, drawing the threads of our thought in directions from which it is almost impossible to turn. The fate of the individual's outlook on the world is often beyond his control; for it lies incarcerated in the culture to which he belongs, and to which, from birth, he is constantly exposed, learning the ways of the world, as the ways of his culture. And this causes major problems of cognitive disorientation when the individual encounters the thoughts and values and outlooks of a culture other than his own. Arguably this is only an ethnographical problem, which is met only when rival cultures try to set up 'conversation' with one another. It is also a problem the intellectual 'missionary' worker might confront, when he tries to convert African tribes like the Azande to the ways of Western science. But it is not a problem that is exclusively inter-cultural. It is just that when a single culture is being considered the magnitude of intra-cultural discrepancy between belief idioms is likely to be more diminished than it is between very contrasting cultures. However, it is not entirely absent. Moreover with the ascendancy of more pluralistic societies, particularly in the West, the scale of this intra-cultural discrepancy is likely to be on the increase rather than the decline. To infer, for instance,
that the canons of Western rationality and science are uniformly and egalitarianly distributed, without intellectual variation, throughout the Western world, is to infer an illusion not a reality. The make-up of each nation's "cultured habitus" (Bourdieu, 1971, p.194), in which the average Western man's rationality ultimately has its incipience, harbours too many idiosyncracies and nationally engendered proclivities to create a wholly homogeneous cultural identity throughout the West. Of course rationality does not even dwell in all of them, and even where it does, it has been posited (Duhem, 1954, pp.69-81) that what is essentially the English, the German, the French way of regarding the world introduces its own subtle nuances into artistic and scientific activity. There are national styles of thought, just like there are of dress! In this regard, Duhem (1954, p.64) claimed, for instance, that English and French novelists could be divided about their respective attentions to detail. Amongst the English that attention was always inordinate, with excessive concern being given to the minutiae of a novelistic scenario. They tended to follow the principle of Baconian induction, by constructing a verbal edifice of reality from its individual components. In contrast to this, the French novelist tended to quest after condensation. He was interested in producing 'sketches', not detailed drawings of reality; he wanted to sum up a scenario in a few lines, not a few pages.*

* It is important to place these observations in the right chronological context. Duhem's generalizations (his book, La theorie. Son objet et sa structure, was first published in 1906) referred exclusively to Nineteenth Century novelists; and as generalizations they would appear to have less aptness today. They certainly would not accommodate, for example, the French school of writing known as Nouveau roman, for its writers have made a virtual cult out of inordinate attention to detail.
Duhem (1954, pp.69-72) extended this style of analysis to the practises of English and French scientists. He noted, for instance, that whereas the former were pre-eminently "model builders" and tended to see the material world in very mechanistic terms, the latter were very much more abstractionist in their tendency and were inclined to turn nature into algebra rather than machines. It was as though the Gallic mode of science was essentially Cartesian, the Anglo, Baconian.

But it is possible to characterize the general intellectual complexion of a nation's people in terms other than the novels they write and the science they are inclined to do. Indeed, it is one of the favourite preoccupations of comparative educationalists to seek out those cultural qualities that are caused by different emphases in different systems of education. They try to discover what it is that education contributes to the spirit of a people. For whilst each nation tends to share common social and educational goals, each tends to place a rather idiosyncratic set of stresses upon them. One nation, for instance, might emphasize "character formation", another "individual development", and presumably the recipients of education sponsored under these emphases will come to acquire these traits. The signature of a nation's personality is written into its schools. Bereday (1964, pp.26-27) has tried to decipher some of these signatures. He argues that English education tends to register the desire in its society for law and order, whereas the American registers a tolerance and permissiveness evident in American society as a whole. It is out of this permissiveness that emerges the individualism characterising the average American. But it is possible to oversubscribe to the power of education. Education is not solely responsible for moulding
the character of a nation's affectivity. There are more things than just 'school' which are responsible for promoting American individualism. One could equally point to the church, the economy, the political system, the family, as all equal to education in the promotion of individualism as the desirable American disposition.

In the main, however, Bereday's observations tend to reinforce the hypothesis slowly being shaped here: that an individual's experiential milieu or habitus nurtures into existence, often covertly, an outlook that is to some extent consensual amongst all the members of a particular culture. But what have not so far been identified are the sorts of strands in the habitus which are most instrumental in altering outlook. Whilst, then, some of the after effects of cultural experience have been typified, their specific origins have not.

2.3 LANGUAGE AND 'OUTLOOK

It has been noted (see 2.1) that it is experience which allows men to enter into a dispositional discourse with reality; but it is language that allows that discourse to be recounted and communicated, and knowledge, that allows it to be understood and explained. Language and knowledge then, permit an egress out of the confinement of private consciousness and an ingress into a world of shared experience and common understanding. They allow our private discourses with the world to be exchanged with others. Language and knowledge, then, are very much the currency of a culture. They enable ideas about reality to be traded, bargained with and sold, thereby allowing all the members of a culture to profit from the experience and sometimes
private understandings of others. But what needs to be understood here is the effect of this 'currency' upon the individual's consciousness of the world. Can there be, for instance, a thoroughly virgin disposition to the world that remains unaffected by language and knowledge? Do both language and knowledge permeate the roots of consciousness to the degree that a thoroughly uncoloured vision of the world is impossible? Does the medium demanded by the need for consensuality make nonsense of the idea of a culturally neutral transposition of the world? The only way of course to answer these questions is to trace the lineage of any distorted patterns of thought about reality back to language and knowledge. It is that tracing which will remain the objective of the next three sections.

If all languages at their core share a common "deep grammar" as Chomsky (see 2.1) insists that they do, then the proposal that particular languages 'are sufficiently distinctive to evoke equivalently distinctive patterns of thought might have less veracity to it than has been implied. However, as Chomsky (1972, p.71) admits, the body of homogeneous principles at the core of all languages, does not prohibit considerable variation at a surface level between languages. For from the same deep grammar an infinite number of linguistic variations can be generated, and it is this that accounts for the wide diversity of language types that are housed in the 'Tower of Babel'. Thus, if the deep grammar hypothesis has some measure of veracity to it, it will be the surface rather than the deep aspects of a language that generate idiosyncratic views about reality. After all, it is the deep grammar that mankind as a whole shares, and the surface grammar which makes for differences between Swahili and English. But then there is the problem of identifying which of the surface aspects of a
given language generate significant modifications of outlook. The best way to approach this problem is to examine some languages.

It has been observed (Jespersen, 1922, p.429; Revesz, 1956, p.61) that so-called "primitive languages" exhibit a high level of discrimination and hardly any generalization at all. They can analyse the discrete elements of reality to an exceedingly high degree of specificity, and would no doubt make excellent tools for taxonomy,* yet are singularly lacking in words to cover concepts or ideas. On the other hand, it has been argued that what primitive languages lack in the area of concept formation, they make up for in their capacity, not only to achieve fine measures of discrimination, but to express emotions and affective dispositions (Bowra, 1962, p.259). Poetry comes more naturally to them than science.

Now if language and outlook are in some way connected, then primitive languages might perhaps be 'parent' - given their propensity for highly particularistic vocabularies - to an outlook on the world that is inordinately sensitive to the minutiae of the world. It might also be expected too - given the limited array of conceptual vocabulary in such languages - that this might restrict their users' capacities for "formal-operational" thought. So are these ramifications evident, and are there any other modifications of outlook that can be attributed to the qualities of language?

* Not that this is a forte necessarily restricted to the 'family' of primitive languages. It has been claimed equally of Arabic, a language notable for a considerable lexicon of words to describe animal and plant species (Martin, 1975, p.119). Moreover, it has the added advantage that the perimeter of its usage is considerably greater than most primitive languages, which, whilst they might carry out a very thorough taxonomy in the regions in which they are used, do not have much currency beyond them.
In fact the classificatory acumen of some 'primitive' peoples has been attested to. The stories of them outwitting in taxonomical 'agility' Western trained biologists are legion in the anthropological literature. But whether this acumen springs from language is another matter. For it does not seem that classificatory ability and language are necessarily close neighbours (de Lacey, 1974, p.63). On the other hand, there is strong evidence to support the fact that the discriminations which are available in a language do condition our perception of the world. This is particularly true, it seems, in the area of colour. There is suggestive evidence indicating that the same colours were actually 'seen' differently by speakers of Zuni and English, due to different denotations used for the colours in those languages (Martin, 1975, p.119).

But it is not merely in matters of 'discrimination' that language is said to contaminate outlook. The very grammar of language, and the way it comes to symbolise the to and fro of experience, can insinuate in its users a veritable weltanschauung. That it has this power is the substance of the so-called 'Sapir-Whorf' hypothesis which takes as its premise the belief that human beings, in their attempts to understand reality, are very much at the mercy of the language they use (Whorf, 1972, p.134). As evidence for this, Whorf contrasted the nature of Standard Average European (SAE) with the language used by the Hopi Indians. He noted how very time-laden 'European' is as a language, in the main constructed around a matrix of time and space. In that matrix there are many tenses available for denoting and specifying events happening at a different time and in a different place. As a language, European, it was Whorf's contention, was pre-eminently Newtonian in outlook. Yet in Hopi all is one! The tissue
of time is entirely absent from its grammatical fabric. Instead, space is substituted for duration, and everything is related to everything else in terms of the distance which separates them. Any distance, for instance, which separates objects subverts the possibility of simultaneity; for the further away an object is, the further back in 'time' that events must happen to it (Whorf, 1972, pp.62-63). It is as though the grammar of Hopi has a relativistic framework inhabiting it, in which a 'spacescale' takes the place of a timescale.

Many of the said ramifications of the Sapir-Whorf hypothesis have in fact been discredited. Yet despite heavy critical onslaught on that hypothesis, most linguists would appear to concede, that, if it does not exactly generate a world view, language must impart something to the way we interpret reality (Martin, 1975, p.125). Given that so much of the discourse about reality is conducted in language, it would be highly improbable if language did not imprint something of its more dominant character upon the way reality is interpreted and understood. After all, what is it about SAE that makes the 'future' appear to be in 'front of us' when in another language, Quechua, it is always 'behind' one? Yet the logic of Quechua is sound enough: what is past can be seen, it is in front of us; but not the future, that is always out of view, behind one. Here, then, is an example of a complete reversal of outlook about the nature of past and future. And if such things are possible between Quechua and SAE, is it not also possible that, within the 'family' of languages that comprises SAE, comparable conceptual distinctions might also be brought on by the individual differences between the languages. It might also be that such differences are partially responsible for the 'national styles of thought' that Duhem (see 2.2) and others have claimed exist.
What this might mean in concrete terms is the possibility that Kenner (1973, p.97) has alluded to: that German provides as natural a 'habitat' for Hegel, as English does for Locke, and French does for Descartes; for, as Kenner argues, their respective philosophies would appear to reverberate with the qualities of their respective 'mother tongues'.

It could be, then, that language does impede an entirely uncontaminated vision of the world. However it is not the only element within a culture to have a mutative impact on outlook. If it was, the limits to thought would be imposed by the limits to language. The path of understanding in a culture would be circumscribed by the weltanschauung inhabiting its language. There would be no escape from the metaphysics imputed therein. And this would mean that there could be no reciprocity of thought between languages supporting rival and contradictory systems of metaphysics. Yet this is not true: the user of SAE can understand how it is possible for Hopi to measure out chronology on a 'space' rather than timescale. Moreover, understanding that empirical legitimacy does not flow from SAE. For arguably it is only Einstein that allowed Whorf 'to see' the permissibility of the relativistic syntax of Hopi. However, Einstein's theories were not of SAE; they came from physics, and physics belongs to the cultural domain called knowledge. So that if there were any metaphysical projections that stemmed from SAE, which restricted Western man's outlook, knowledge served to liberate them. A man's vision of the world, then, is not necessarily monopolised by language. If it was, SAE, given its Whorfian features, could have only produced a Newton, not an Einstein. Therefore, to see the complete picture of a man's vision of the world, not only must those transformations which have their provenance in language be considered, but also those which would
2.4 KNOWLEDGE AND OUTLOOK

It will be argued in this section that man's eloquence in the world is as much enhanced by knowledge, as it is by language; and that knowledge injects into the compass of his ordinary outlook a range of awarenesses outside the range of language. This section, then, will examine the expansionist effect of knowledge on outlook.

Goethe once said men only see what they know. Such a statement is sententious enough to encompass the notion being developed here: that knowledge augments outlook. But the risk of sententiousness is a paradox: that in the desire to be concise it is possible to end up saying more than should be said. This is certainly true of Goethe's statement. For when taken to its logical conclusion it tends to impute that men without knowledge are men without sight; and that the epistemologically impoverished are somehow visually deprived. Yet as Dretske (1969, p.17), in another context, argues, "total ignorance is not a sufficient condition for total blindness". The absence of knowledge does not mean the absence of visual sentience. However, it needs to be asked what sort of sentience is totally devoid of 'knowledge'? What is a primal outlook like, from which accents of experience, belief, knowledge, language have been purged? Is it possible to empathise with a person having a virgin outlook on the world?

Dretske (1969, p.75) has proved philosophically that primal vision is not really any different from any other vision. It merely
differs in the kinds of interpolations that are placed upon it. Thus at the retina a tomato is seen as a "patch of red", irrespective of whether it is seen as a 'tomato' or not! The world does not suddenly undergo a change of countenance because of knowledge; it is not a chimera that dutifully changes its forms according to the dictates of episteme. But, on the other hand, primal vision does differ qualitatively from informed vision, otherwise babies and those who recover their sights after a protracted period of blindness, would immediately see the world as differentiated into the shapes, forms and entities that constitute ordinary vision. Yet this is not so. It would seem that the world of initial vision is abstract rather than naturalistic, and that what is 'seen' is a rhapsody of colour and form which makes little or no sense; it is a sentience without a significance (Gregory, 1974, pp.20-25; Hanson, 1969a, pp.131-132). With the onset of visual comprehension, what is mere sentience slowly gives way to a perception in which unity and discrimination prevail. What was seen to be formerly rhapsodic is seen to be possessed of independent entities, whose properties can be regularised and patterned. Dretske, then, is right to assert that when the apperceptive aura surrounding the seeing of a tomato as a 'tomato' is stripped away the "sensory core" of a red patch remains. This would be a Kasper Hauser's* vision of it. However, what Dretske does not point out is that the residual redness will be suffused in the whole welter of colour and general formlessness that is initial vision, and will remain thus suffused

* Kasper Hauser was a German version of the 'wolf-child', who, having managed to survive in the wild, apparently since birth, was discovered and brought back into orthodox society, where some attempt was made to educate him.
until it is recognised as belonging to the class of red patches that are tokens of 'tomato-ship'. It is at that stage that the act of 'seeing' graduates to what Wittgenstein (1972, II, xi) called "seeing as", or the condition of informed vision. Thus what Goethe should have said is that men only see as something what they know. It is that which marks the difference between seeing as a mental rather than a purely retinal act.

If the proposition that has been wrought from Wittgenstein has any substance to it, then it ought to be possible to detect measurable differences in perceptual outlook in moving from one field of knowledge to another. After all, it has been asserted that whilst all men would appear to see the same image at the retina, the way that image is 'mentally' seen and interpolated is largely dependent on the current theories and knowledge that are currently to use Gregory's (1971, p.15) apt word, "contaminating" the mind. However it would also have to be acknowledged that beneath the specialised visions that are evoked by particular forms of knowledge there is a common 'vocabulary' of viewing that enables most men to cope with a relatively orthodox repertoire of experiences. It is true too that this vision of the familiar world would also be contaminated with 'theory' and 'knowledge'; but it is also true that that theory and knowledge would not be consciously trained into existence, but simply acquired in the ordinary, run-of-the-mill of experience. Being able to make the substitution tomato for 'red patch' would be like this. It is something that in their discourses with 'reality' most people could do without consciously thinking about it; for all intents and purposes, it could be regarded as a non-mediated ascription. But more than just this, the ability to
see some red patches as tomatoes is a socially generalised ability - at least in societies familiar with tomatoes - which is not restricted or specific to groups of particular epistemic predilection. In this sense, it is unlike that ability possessed by the welder, who, from noting the characteristic shape and colour of a flame, knows whether his torch is being fed with the proper ratio of oxygen and acetylene. Those unfamiliar with the art of welding will of course 'see' the same flame, but only the welder will be able to 'visually' analyse its chemical composition. In the same way, where the trained radiologist sees on an X-ray plate the symptoms of a physiological condition, the untrained eye will only see a meaningless welter of shape and form. And often the good diagnostician does not need X-rays and laboratory tests to recognise the nature of a patient's syndrome. He can 'sight read' a patient, and learn from any proclivities in his pallor, posture and gait, what it is that ails him (Dretske, 1969, p.179; Abercrombie, 1974, p.43; Bruner, Goodnow and Austin, 1962, p.10). Not that the 'eye' is sole claimant to sagacity in matters of perceptual subtlety and nuance. The sense of taste and hearing are equally cultivatable and capable of making minute discriminations and differentiations. Those who blend teas or taste wines, or who have a sense of perfect pitch bear this out; they have perceptual 'taxonomies' which alert them to the subtlest of distinctions. Singers of perfect pitch, for instance, can often 'hear' the difference between a British A-flat and a German one, even though the difference in actual frequency is often only of the order of two or three cycles per second!

It seems, then, that the senses can be fostered so as to develop an exaggerated sense of recognition, or what Polanyi (1962, pp.54-55) has called "connoisseurship". That connoisseurship, in fact any
sufficiently specialised vision that is characterized by heightened awareness, would appear to emerge from pursuing some avocation or other.* Connoisseurship is seemingly differentiated from that more consensual and socially generalised vision of reality - which is not exaggerated in any particular direction or other - and which is characteristic of ordinary and non-vocationally orientated vision. By comparison with connoisseurship, it is likely to be a vision of the world that is infiltrated with coarse rather than subtle distinctions; and that is prey to overlooking the gradations of nuance which can often be identified in the most familiar. But then men can have an eminently satisfactory rapport with reality without having to look too closely at it; they can gloss over the fine detail of the world, and still see what they need to see. The contrast, then, between the avocational and the ordinary view of the world is not so much that the scenario of things is seen any differently, but that different and more sophisticated inferences can be drawn from the world. It is as though reality consists of an infinite number of 'hieroglyphs', whose meaning becomes more and more profound the deeper their observer is capable of looking into them. Moreover, the world is also 'homonymous': the same scenario, the same object, can carry different denotations to different people. The hieroglyphs of reality are polysemous. But which meaning dominates depends, as Woozley (1967, pp.18-19) points out, on the "interests" and avocation of the observer. It is not merely a matter, then, of 'informed vision' - for all that is seen, which is at all significant is informed vision -

* The matter of perfect pitch may be the exception to this. It is often argued that it is one of those congenital 'gifts' that is there because of nature, not nurturing.
but rather of the type and species of knowledge that informs vision. The carpenter's vision of a "card table" (Woozley's example) will then be rather differently focused from that of a draper; and whereas the one might "remark (on) the legs, the jointing of the sides", the other - the draper - will look to "the precise colour, nap, and quality of the baize" (Woozley, 1967, pp.18-19) covering the card table. But neither will look beyond the most outward manifestations of the table; for their attentions will only be magnetised by its surface attributes, not the ones in the substratum of the wood and the baize, and in the material world in general. To be drawn to them requires a vision informed by a different set of epistemic imperatives altogether. Thus it will be the physicist who will tend to 'see' the hieroglyph 'table', not as mere baize and wood, but as an "aggregate of electrons, protons and neutrons". His 'vision' of the table will be like a Pointillist painting, made up of many microscopic parts. On the other hand, the chemist will be drawn to the table's chemical composition, the biologist to the cellular construction of its xylem. And then of course there would be some who might look altogether beyond the physical properties of the table. The art historian might 'see' it thus, in being primarily interested in whether the table belongs to the Baroque or Rococco era of furniture design.

The same object, then, can take on different significances altogether when envisaged from different epistemic and vocational perspectives (Bertalanffy, 1971, p.249). But antecedent to these significances coming into view, there is the acquisition of the appropriate epistemic perspective, and that is by no means a spontaneous acquisition. For if knowledge, as Hanson (1969a, p.149) has characterized
it (and it is a characterization that is thoroughly commensurate with the view of knowledge being developed in this study), supplies the spectacles behind the eyes through which the world is seen, then it takes time and considerable training to look through those spectacles in the way, say, a physicist does. Meanwhile, the layman will remain "blind" to quite a lot of what the physicist sees (Hanson, 1969a, p.104). Of course the physicist and the layman always receive the same visual image at the retina, but the way that each respectively transposes that message into sense often differs radically. For as has been indicated, the physicist's 'hieroglyph' is not necessarily the carpenter's, and vice versa. Thus the carpenter walking into the physicist's laboratory will register its furnishings and effects, and possibly the way they have been put together, but not their significance within the framework of physics. To do that, he "must learn some physics". Until he does so, he will remain a stranger to the world that the physicist sees (Hanson, 1969b, pp.15-17). That world, in effect, will be like a hieroglyph without a Rosetta Stone; it will be, to adopt the jargon of semiosis, all sign and no signification.

The move from "seeing" to "seeing as", then, is accompanied by the acquisition of what will be called 'epistemic behaviour'. For it is knowledge that serves to direct attention of particular phenomena and elevate sensitivity to the world; it is through knowledge that the significance of things comes to be magnified and amplified. So that whilst the scenario of reality remains relatively constant, it is the way an individual's attention to that scenario is directed which is subject to modification. It is the style of Hansonian "spectacles", then, which an individual wears that alters, not the
spectacle they observe. Thus it has been argued that different disciplinary and vocational "spectacles" promote rather different species of 'seeing' that are alerted, in an exaggerated sense, to those features of the world which are of paramount importance to the discipline. In this way, knowledge would appear to have a similar transformative impact on outlook as language and topography. But knowledge is immensely more pluralistic than either of these things; its 'spectacles' come in many different 'frames'; so that more diversity of outlook and varieties of epistemic behaviour would be expected to spring from it than either language or topography. Moreover, knowledge is subject to change and radical amendment. Thus even though the basic 'frames' of knowledge tend to remain the same, some of the 'lenses' contained within them are periodically renewed, and as a consequence give birth to new visions of the world. Entailed, then, in the mutability of knowledge is the possibility that new knowledge generates correlative changes in outlook and epistemic behaviour. If this is so, then it should be possible to show how knowledge colludes with outlook to both constrain and expand our perception of the world.

2.5 SCIENCE: SOME CHANGES IN OUTLOOK

It has been science's task to free the secrets that lie interned in Nature. But Nature has proved, in the past, to be a thoroughly effective gaoler, who no doubt still harbours Her deepest secrets incarcerated in the maximum of security gaols! Even those secrets that scientists have managed to wrest from Her, were only liberated after a long and arduous intellectual struggle, in which some of the best
minds of mankind have taken part. And even then, what scientists managed to 'get out' of Nature's prison often turned out to be nothing more than a 'confidence trickster' who proved very willing to lie and spoof about the true physical condition of reality. Scientists, then, have often been taken in by Nature, and sometimes it has taken generations of them to realise it. If ever a discipline is testimony to the belief that 'things are never quite what they seem', it is science. For it is legion with false conquests of ignorance that have led to a pack of erroneous and aberrant notions about what nature is really like. Often scientists have placed a completely false construction upon what it is they are seeing in nature. This section will report some of those false constructions, and the change of outlook that was needed to correct them.

In looking up to the 'heavens', astronomers seemed to have had a more solid alliance with error than truth. For virtually the whole history of astronomy proves that a science can long exist on gross misconceptions, and also in quite elementary areas of understanding. Take, for instance, the appearance of Saturn: ever since astronomers had first seen this planet through their telescopes they had puzzled over its rather odd 'physiognomy'. Various astronomers * had sketched it in its various phases, and most had pictured it as a kind of planetary 'Big Ears', with large lobes, that periodically changed their form, extruding from the main body of the planet. It was not until these rather idiosyncratic extrusions were construed as a ring encircling the planet, that a correct visual interpretation of Saturn

* Huygens, Helvetius and Galileo were principal amongst these. Interestingly, Galileo did conclude that Saturn was probably enringed, but he did not report this conclusion. This brings out another feature of science, to be dealt with in a later chapter, that of its publicness.
was made. Now astronomers would have difficulty in seeing it in any other way (Gregory, 1971, pp.119-122).

The problem of seeing Saturn correctly, then, was a bit like those puzzles gestalt psychologists are fond of setting, in which a figure of a man is hidden. It generally takes some time to isolate the man from all the irrelevant forms that are serving to dissemble him. However, once seen, it is difficult to see the puzzle as anything other than a man. Most stimuli patterns, then, have the potential to be comprehended in a number of ways; a multitude of visual meanings can be inferred from them. What science tries to do is outlaw that ambiguity; it endeavours to elicit that meaning which most accords with the facts as they are observed; it shows which configuration amongst the many possible is most plausible. Having done that, it serves to transform, as it did with Saturn, our vision of physical reality in some way.

Seeing which 'is due to epistemic behaviour is, as Hanson (1969a, p.131; 1969b, p.19) has pointed out, "theory laden". But sometimes those theories can interfere with an authentic apprehension of reality. Instead of guiding scientists to the truth, they can send them down false trails of speciousness, and cause them to see things that are an hallucination of a theory, not of reality. The attempt to account for the perturbation in the perihelion of Mercury was subject in this way to the malevolent influence of a theory.

So confident were Eighteenth Century astronomers in the efficacy of Newtonian mechanics, that they had come to believe that that mechanics could explain virtually any phenomenon in the universe. That confidence had been somewhat strengthened by the fact that Newtonian mechanics had produced a reliable explanation of the perturbation of Uranus and led to the prediction and eventual discovery
of a new planet, Neptune. Astronomers naturally assumed that what applied to Uranus must equally apply to an analogous case of perturbation, that of Mercury. Thus another planet, Vulcan, was hypothesised into existence, which to perturb Mercury, it was supposed, must orbit somewhere between it and the Sun. And a number of astronomers even reported sighting the existence of this planet, not realising that what accounted for Mercury's perturbation was another theory altogether, one that had not yet been formulated (Hanson, 1962).

This does not really undermine the proposition that seeing is "theory laden"; rather it shows that sometimes seeing becomes laden with wrong theories. With Mercury's perturbation, it was a matter of having too much faith in the infallibility of a theory; it was impossible 'to see' that Newton's system could sometimes be in error. The system had an aura of absoluteness about it that blinded scientists to alternative ways of regarding physical reality. Theory, then, can sometimes serve to blunt, not sharpen our vision of things; it can imprison, not release, our outlook, and blinker us to the possibilities that lie outside the ambit of a theory governing our vision of things. Rather than accelerate understanding, theories can sometimes retard it, as was the case, for instance, with the discovery of the sub-atomic particle known as the "positron". That particle, like the true cause of Mercury's perturbation, was only discovered after 'offloading' a theory that was apparently governing 'seeing' in sub-atomic physics. For just as in the case of Mercury, it was a prevailing theory that led to all sorts of specious conclusions about what was being observed, in particular, the nature of certain anomalous tracks that were seen on Cloud-Chamber photographs. Such tracks, and
they were regularly photographed, were "discounted as 'spurious', or as 'dirt effects'" (Hanson, 1963, pp.135-139). No one until Anderson, in 1932, had seriously considered that the tracks might in fact be the footprints of another sub-atomic particle, the positron. But to register them as positrons required a radical readjustment of atomic theory, which most experimental physicists of the time were unwilling to make. Anderson, however, was able to offload the conventional view of the atom, and see that the positron was a vital element in its construction, and that its existence would clear up the mystery of what had been formerly dismissed as "dirt effects" on the Cloud Chamber photographs.

One of the negative effects of "epistemic seeing" is that it can serve to diminish the significance of the familiar. In opening our eyes to the world which normally goes 'unseen', knowledge can sometimes effect to emasculate our sensitivity to the ordinary and the apparently mundane. Yet the all too familiar can sometimes harbour a hieroglyph of profound epistemological significance. Anderson, for instance, saw positrons in that which physics had taught him were pieces of dirt. But he had to invent his own Rosetta Stone before he could see them thus; he had to overcome the conventional way of regarding the familiar. In much the same way, the Arctic explorer and scientist, Nansen, was also able to draw epistemological significance in the familiar that went well beyond its conventional connotation. For the 'flotsam' - the dirt effects of the land - he picked up off the coast of Greenland turned out to be the key that eventually yielded the existence of an Arctic Ocean (Nansen, 1897, pp.22-23).

Scientific knowledge, then, often elevates to the level of consciousness things, which, whilst they are in the compass of sensory
apprehension, are not normally inferred to have much epistemological value, and therefore are overlooked. But 'de-familiarising' the familiar is not the only transformative effect of science. It has also been argued that its theories infuse 'vision'. That is, theories not only foist 'meaning' upon what is apprehended, but also act to unify, structure and order what is actually apprehended at the retina. The 'lenses' in the scientist's "spectacles", then, not only have the power of magnification, but also the power to 'colour' the interpretation of what they magnify. They are, so to speak, tinted lenses!

But science is only one amongst a whole gamut of epistemic behaviours. It must be asked, then, before accepting the proposition that all knowledge invades 'seeing', whether these transformative effects are indigenous to knowledge in general, or just to the sciences? Does psychology, for instance, similarly 'de-familiarize' the world it concerns itself with? Are the arts and the humanities also capable of influencing the outlook on the world? In short, do other modes of knowledge, not just the sciences, have the potential to load 'seeing' with theory?

2.6 OTHER VARIETIES OF KNOWLEDGE AND SEEING

It has been argued that scientific knowledge tends to alert individuals to phenomena which normally are not regarded as having any particular epistemological significance. Science, then, tends to dispel the syndrome-of-overlooking from the midst of consciousness and create awareness about that which is commonly taken for granted; it breathes new light into the realms of ordinary gazing. It is for this reason, it has been argued (Kohler, 1947), that psychology
took such a long time to develop into a mature and independent science. Its initial territory was a realm of ordinary mental events that could be adequately comprehended without the need for sophisticated scientific treatment. There was nothing a scientific psychology could really add that men, by dint of common sense and domestic lore, did not already own. In its beginning, then, psychology had to distance itself from being the science of the obvious; it had to throw off the shackles of the common sense attitudes to the mind; it had to penetrate through the patina of the familiar before it could make any real headway as a science. In the same way, Chomsky (1972, pp.26,63) has argued, linguistics has been dogged by its practitioners being prone to 'over familiarity' with their subject, language. As a result many things have escaped their notice, such as the obvious necessity for a universal grammar! Had linguistic theorists been able to put some "psychic distance" between themselves and language, and succeeded in making language "strange" rather than familiar, that might not have been the case.

If Kohler and Chomsky are right, then, in the human sciences the familiar might be more of a hindrance than a harbinger of new knowledge. But then it might also be a case of being able to transcend the familiar to return to it with renewed insight. Once that is achieved, it might be possible, as in science, to see the symptoms of greater epistemological truths residing in the more familiar aspects of social and mental behaviour. Certainly this is one of the virtues that has been claimed of educational theory (Entwistle, 1977, p.226). It does not help teachers in a direct way, as physics does engineers, but simply sensitizes them to problems of practice that previously lacked significance. Educational theory, then, has an attention draw-
ing function. For it brings into focus aspects of the learning situation that close familiarity has stolen the limelight from. As a theory, education transforms by awakening, and in this sense accords with one of the properties of scientific knowledge: that it raises to a level of consciousness things that have been customarily overlooked.

But having brought the overlooked into the arena of awareness, do the human sciences then go on to impute an interpretation such that what is looked upon is seen in a particular epistemological light. It has after all been suggested that the human scientist's "spectacles", like those of the physicist's, also magnify, but do they also, according to the 'lenses' used, tint and colour what is seen? In psychiatry, Szasz (1977, pp. 721-722) is most adamant that they do. He argues that the idea of a disease called 'schizophrenia' was invented, not discovered. Mental diseases only began to 'exist' after they had been invented by pioneers like Kraeplin, Bleuler and Freud. Before that, it appears that they did not actually afflict the minds of ordinary men. It is only since the era of psychoanalysis that the symptoms of anguish, torment, depression and so forth have been seen to have an aetiology in a 'disease' like schizophrenia, for which sophisticated treatments and drugs have been devised as cures. But Szasz argues these treatments and drugs are treating a neologism Bleuler invented, not a real disease. It is only because pioneer psychiatry "managed to bring about the great epistemological transformation in our medical age: that is to say, from histopathology to psychopathology" (Szasz, 1977, p. 721-722) that society has now come to regard the problems of the mind as illnesses, which in the technical sense of the word they are not.
Whether Szasz is right, that psychoanalysis pulled off a grand piece of epistemological deception in making us believe in the existence of mental illness, is an issue that remains well beyond the scope of this study. But plainly Szasz is right to the extent that psychoanalysis did provide a lens through which to see the probable provenance of certain forms of perverse behaviour. And the fact that these behaviours can be seen as symptoms of schizophrenia, or, as Szasz would prefer, simply the failure to become competent at existence, does show that the lens, just as in the physical sciences, can be modified or replaced.

Whilst the effects of transformations in the human sciences would appear to be less well defined than in the physical sciences, it does seem that the human sciences have the capacity both to transform outlook and to influence the way things are seen and construed. Is this a capacity that can be equally extended to the arts? Are they, also, epistemological endeavours that are spectacle and lens dependent?

From the spectator's point of view it does seem that they are. It has already been noted (see 2.2), for instance, how perspective appears to be a culture bound sensitivity that is absent in cultures which have not developed it as a mode of pictorial representation. It seems in order to understand and interpret the way depth is encoded by perspective, people need to be exposed to painting and drawing wherein it prevails. And this is true of other devices used in painting, not just foreshortening (Gombrich, 1960, p.360). In fact it seems that the whole experience of 'reading' a painting is dependent on a familiarity with the vocabulary and syntax it uses to represent. Seeing a painting, then, is a thoroughly theory laden experience; it relies on what Aldrich (1963, p.21) has called "categorial aspection" or
schooled looking. It is a matter of a painting's beholder playing his share in its 'creation', if he is to comprehend fully its pictorial verity. For painters are, above all, *trompe l'oeil* merchants who juggle the beholder's categorial aspections and make shortcuts to representation, which they anticipate the beholder will have the capacity to flesh out and make more corporeal. It is a matter of the beholder projecting his life and experience onto the arrested image and supplementing from his experiences what is not actually present in the painting (Gombrich, 1973, p.17). Paintings, then, capitalise on what psychologists call the "etc. principle". As such, they can be regarded as icons or anticipatory cues, that should stimulate into existence in the beholder - should he be laden with the appropriate aesthetic predispositions - the image the artist intended to create. But as Gombrich (1960, p.234) also points out, it is the skill of the artist that he knows what to omit and still leave the beholder with enough to 'complete' the image. The artist, then, must learn to identify with the categorial aspections of the beholder if he is to play on them, just as the beholder must identify with those of the artist if he is to realise how his aspections are being exploited and used to aesthetic effect. The artist must know when to leave a 'visual etcetera', just as the beholder must know what it means when he sees one. Without that agreement, artistic communication would collapse, and does so whenever an artist initiates a new trick, a new etcetera principle, and the beholder has not learnt how to be
Unless epistemic behaviour of the 'seeing as' kind is present in experience, it is being argued, the aesthetic response to a painting is diminished. Without the appropriate categorial aspections, the aesthetic import of a painting is dull and indistinct; it is atrophied rather than round. But is this true of the other art forms? Is literature, for instance, only one tenth of the aesthetic experience, if there is no element of, to paraphrase Wittgenstein, 'reading as', in it? And is the experience of music similarly incomplete if it is not supplemented by a 'schooled ear'? Are there 'hearing as' components in the rounded appreciation of symphonies and sonatas?

To take the case of literature first: competence at 'reading' it, like that of painting, is a matter of understanding the conventions that govern the way it realises the world and the human condition. For there is a 'language' to literature that is above and beyond the language it is written in, which must be "first internalised" if the reader is to "convert linguistic sequences into literary structures and meanings" (Culler, 1975, p.114). It is only if the reading is "theory laden" that a piece of literature comes fully alive, and begins revealing its narrative 'subconscious'. Only in that way can the bridge

* As was the case with Kandinsky's first experience of one of the series of haystacks that the French post-impressionist, Claude Monet, painted. According to Kandinsky's (1964, p.26) autobiography, previous to his experience of the Monet, he had only known exclusively Russian naturalistic art. He was therefore ill-prepared aesthetically for the experience of post-impressionism. His initial reaction to the Monet was one of non-recognition. It was simply a painting from which the "object" was missing. It was to Kandinsky's eyes, for all intents and purposes, an abstract painting. That was because, in gestalt jargon, he was unable to disinter the 'figure' of the 'haystack' from the 'ground' of the painting. It was all one to him. Monet's trompe l'oeil had failed.
between the language of literature and the language of its interpretation be crossed. And just as in painting, poets and novelists sometimes demolish that bridge by introducing new and unexpected literary devices. Thereby they temporarily lose their 'readers', until the latter develop the theoretical spectacles with which to read the meanings harbouring in the new literary device. In fact it has been argued that poetry functions precisely to negate expectation and create surprise. Only in this way, does it "stimulate new awareness of the world" (Martin, 1975, pp.162-164).

Some measure of antecedent 'epistemic behaviour' is also required to hear music properly. As studies in ethnomusicology have shown, there "can be several possible structural interpretations of any pattern of sound, and almost an infinite number of individual responses to its structure depending on the cultural background" of its listeners (Blacking, 1976, pp.19-21). For instance, whilst many cultures exploit in their music the "dominant-tonic-dominant" sequence, the physical registration of that sequence is not always accompanied by relaxation at the tonic, and tension at the dominant, as it is for the listener 'trained' in Europe. In the Nande culture, this response is completely reversed (Blacking, 1976, p.17). In fact it seems there are as many ways of playing and listening to music as there are languages in the 'Tower of Babel'; and that to derive the full aesthetic impact from any of them requires a 'trained' ear. For music would only appear to give rise to affective feelings if the 'ear' is already attuned to the music, and charged with expectations about what it is that will be heard (Meyer, 1956, p.29). Indeed much of the
pleasure of music seems to spring from it conforming to our expecta-
tions, to our theories about it.*

2.7 EPISTEMIC VISION: SOME QUESTIONS OF ORIGIN AND USE

The last five sections have attempted to demonstrate that whilst
the mind might have at its core a series of genetically encoded
'grammars' that universally guide perception and rationality (see 2.1),
experience of the cultural and topographical 'habitats' furbishes
the mind with sensitivities and rationalities that are specific, and
not necessarily all that universal. So that if the mind is never
totally rasa, it is also true that the initial script on the tabula,

* Meyer (1967,pp.272-273) has argued that one of the reasons why contem-
porary music is rarely thought by the lay public to be a pleasure
giving experience is its constant preoccupation with breaking every
knowable musical rule. It is so unpredictable, it is so impossible
to anticipate what contemporary music will do next, that the average
listener cannot formulate any hearing theories to deal with it.
Instead it remains a closed book of cacophony without any perceivable,
and therefore pleasurable, aural patterns to it whatsoever. On the
other hand, as the psychologist Valentine (1962,pp.414-415) has demon-
strated, it is possible to build up a gradual receptivity to such
music. He discovered that when exposed to continuous sessions of
discordant music his subjects became as familiar with its "behaviour-
al patterns" as with their favourite symphonies. Indeed, for some,
discord became as much to their taste as concord had formerly been!
This experiment of Valentine tends to be confirmed by the rather
eccentric musical education a pioneer of contemporary music, Charles
Ives, experienced at the hands of his father. As a matter of prin-
ciple, Ives senior subjected his son to all sorts of discord and
dissonance, in the belief that there was as much beauty and aural
interest in them as any piece of conventional harmony and counter-
point. So whilst Ives senior would play the accompaniment of
"Swanee River" in C his son Charles would sing it in E-flat! "This
was to stretch our ears and strengthen our musical minds, so that
they could learn to use and translate things that might be used and
translated (in the art of music) more than they had been" (Ives,
1973, p.115) - which of course Ives went on to do in the symphonies
and sonatas he wrote.
as the mind comes into contact with its physical and cultural surroundings, is quickly supplanted, embellished and written over, rather in the fashion of a 'palimpsest'. But it would be a mistake to think that the various 'caligraphies' of experience, which are responsible for the 'palimpsestic' effect, are at all mutually exclusive; they are not. There is not, for instance, a strand of epistemic vision that is just due to topography, another that is just due to language and so on, without there ever being any question of possible interaction between the various 'furnishings' of experience. Interactions do happen, such that sometimes the visions that are due to topography, knowledge and language can all serve to modify one another in varying degrees. An example from geology will bear this out, and how it is that sometimes an epistemic vision can be indebted to topography for the view of the world it finally adopts.

Geologists trained in the Middle West of the United States, far away from the manifestations of dramatic coastal erosion, were always inclined to the view that high plains or plateaux were formed by sub-aerial denudation. On the other hand, their more littorally experienced colleagues in Britain - who had the sea all around them and could observe the evidence of its enormous erosive power - took the view that only the sea could be responsible for such geological formations (Pantin, 1968, pp.5-6). One topography, then, can cause one knowledge, another another, and yet both can be equally legitimate in the circumstances in which they were 'born'. And, as was suggested earlier, presumably what is true of topography is true of language. It, too, can covertly load knowledge with predispositions and prejudices that in their way help to influence the way segments of the world are regarded. Thus it would seem likely that 'epistemic vision' finally represents
the outcome of the sum total of experience, not just portions of it. But having acknowledged that, it is also true that certain types of experience have a more pronounced impact on that vision than others. Those, for example, which are due to knowledge have much more of an impact than do language and topography. Indeed, knowledge often serves to nullify the malevolent influences that occasionally spring from the latter.

Because it serves to broaden the compass of outlook much more than anything else in 'experience', it is with knowledge, and the modifications to outlook that it generates, that this study will in the main be concerned. Previous sections have already demonstrated that under the influence of knowledge, outlook is developed. This entails that the outlook is rendered sensitive to aspects of the familiar world, which, without the imperative of knowledge, would be overlooked. It has been noted how this is virtually the epistemological equivalent of wearing a pair of spectacles which colour and magnify aspects of the world. In a sense these spectacles are the theories which load vision and cause it to draw epistemological inferences from the world. It is knowledge, then, which finally contributes the 'as' to seeing, reading and hearing.

There are, however, a number of unanswered questions and ramifications which flow on from regarding knowledge as an agent and source of perceptual transformation. For instance, is the fact that seeing becomes "theory laden", after exposure to knowledge, merely an extension of a mechanism that comes quite naturally to the mind anyway? Epistemic behaviour thus merely serves to exploit this mechanism. Could it also be that epistemic seeing is simply a heightened form of
ordinary perception, and given that it might be, are its traits somewhat analogous and governed by the same psychological principles? And if knowledge does partake in altering what the mind becomes conscious of in reality is there some way of describing how that alteration is effected? Is there some way, for instance, of showing how it is that "seeing as" comes about, and what "seeing as", as opposed to just plain seeing, entails in terms of the relationship between knowledge, consciousness and reality?

Answering this series of questions, as will be done in Chapters Three and Four, would thus help to explain the mechanisms behind 'epistemic vision', and what mentally happens as the transposition from seeing to seeing as occurs. Yet whilst it has been indicated that it is knowledge that holds the 'key' to that transposition, no mention has been made about how that key is obtained or turned! Some mention has been made of the 'trained ear' and of 'schooled looking', so that it could be inferred from such phrasing that it is education which is involved in that transposition. But in what ways does this view of education, as a kind of epistemological 'optometrist', supplying and fitting the spectacles of knowledge, accord with the conventional raison d'être of education? If it does, is it possible that the institutional arrangements of education reflect the transition from non-epistemic to epistemic vision? Such questions will be the province of Chapter Five.

The fact that epistemological transformation would appear to occur mostly in an institutional context introduces yet one more dimension to the process: the social. After all, education could be seen to exist solely to sponsor a discourse between those in the 'know' and those who are not. In effect this means that education would appear
to facilitate the transference of epistemic behaviour from generations who possess it, to others who do not. Is it education, then, that brings about bespectacled vision? And does this imply that teachers are in some way skilled at getting consecutive generations of students to look epistemologically at the world in the way they do?

But it has also been argued (see 2.4) that whilst the 'frames' of knowledge do not alter radically, the lenses contained within them often do. This raises the question of who it is that does that altering. Who is it, in what could be regarded as a knowledge community, that is ultimately responsible for creating new modes of "seeing as"? And how do these new modes serve to affect the relationship between extant knowledge, consciousness and reality? Is there some way of characterizing the genesis of new knowledge in terms of this relationship? Then there is the matter of how this new knowledge gets into circulation amongst all the members of the knowledge community. How is it that, so to speak, the new lenses of knowledge get to the mills of optometry? These are largely questions about the members (and their responsibilities) who comprise knowledge communities. Chapter Six will examine these questions.

The matter of 'epistemic vision', then, would appear to evoke a very broad conspectus of questions that, when raised, as they have just been done, in congeries, do not seem to have much affiliation with one another. However, there are some threads of connectivity that can be traced amongst them, and which enable these congeries to be reduced to one central issue, and that is the matter of knowledge enculturation: what does it mean and how is it achieved? And since that issue
of enculturation might harbour clues to the decipherment of the sorts of 'epistemic vision' discussed in 2.5 and 2.6, it is an issue that is of central importance to this study. It is worth asking, then, whether education or epistemology, since both these areas have raised issues about enculturation, have encompassed all the questions that the phenomenon of enculturation evokes?

2.8 EDUCATION, OR TRAVELLING WITH A "DIFFERENT VIEW"

Various metaphors have been used to insinuate that education and knowledge are close 'bed fellows'! Knowledge, for instance, has been described as the "stock-in-trade of the teacher" (Brubacher, 1962, p.74) and the "bedrock" upon which the superstructure of education is founded (Jenks, 1977, p.23). It has also been seen as a kind of Gothic cathedral around which the city of education (in true Medieval style) is built, so that its citizens can come to pray regularly at the altar of knowledge and seek, if not divine, then secular revelations about the world.

The quasi-religiosity of this final metaphor, which accords to knowledge almost sacrosanct status, is not without justification, for the "great God episteme", to use Popper's phrase, seems to have been an unrivalled deity in the pantheon of educational idols ever since the dawning of education. It is only now that the cult of knowledge in education is being smitten with critique and disillusion, and powerful movements of apostasy from it are beginning to emerge. The new educational idols thus tend to be existential rather than epistemological. There is much talk, for instance, of educating the emotions
and of broadening the compass of personal awareness. What Phenix (1964, p.193) has called "synnoetics" - the capacity to empathise with other beings - has become the gospel of alternative education. Yet despite these assaults on the traditional direction of education, the cathedral of knowledge still stands; it has not yet been demolished. Just like a real cathedral, then, it has survived the millennia, and seems destined to continue to do so. Indeed, it will be argued in this study, that if the frontiers of knowledge are to continue advancing, education cannot afford to capitulate to the apostates. For, rightly or wrongly, education is now hand-maiden to new developments in knowledge; and that, it will be suggested, has become its principal function.

Of course this is an unfashionable way of regarding education, even amongst those educationalists (mainly of a philosophical frame of mind) who still maintain a faith in the broadly humanitarian benefits that can be had from knowledge. It is after all, they argue, the very factor of the knowledge, and the understanding that education is empowered to deliver, which makes for man being rational and autonomous (Langford, 1973, p.14; Wilson, 1975, p.35; Peters, 1975b, p.3). Renege on that, and man is returned to the 'brute' condition. Education, then, on this view delivers man from the claims of his instincts and the prejudices of his irrational self. It alerts him to the powers of thought and reason, and releases him from the stranglehold of a life tied to what James (1940, p.81) called "raw perceptual experience".

This broadly melioristic picture of knowledge as harbouring the key to a worthwhile and meaningful existence represents a normative rather than a functional justification for education pivoting itself
about knowledge. As such it accentuates a role for knowledge in education of a rather different order from that which will be conferred upon it in this study. Nevertheless it is worth pursuing this role for a moment, for those who advocate it have views of knowledge that share certain similarities with that already delineated. Peters, whose advocacy of a normative justification for education is both thorough and exhaustive, has, in a number of influential essays (1965, 1968, 1973), consistently argued that education principally exists to initiate individuals into desirable states of mind. It is clear from Peters' various elaborations of what this means that he sees education as an enterprise dedicated to bringing about changed conceptual attitudes towards the world. "To be educated", he wrote in his inaugural lecture to the London Institute of Education, "is not to have arrived at a destination; it is to travel with a different view" (1968, p.110). And as he says elsewhere, to be educated is to have one's view of the world "transformed by the development and systematization of conceptual schemes" (1973, p.256). Since these schemes are indigenous to the various domains of knowledge, it is evident that Peters feels that men are transformed by what they know. Although he would probably be loathe to use it as a metaphor, it is clear that Peters sees knowledge as a kind of cognitive 'hallucinogen', with mind-expanding capacities, that permit men to perceive and apprehend aspects of the world to which they had no previous sensitivity.

In fact in the history of educational thought, Peters' notions about the effects of knowledge are by no means novel. Boethius was saying virtually the same thing in the Fifth Century! * There is

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* Boethius, for instance, wrote in The Consolation of Philosophy: "Everything that is known is comprehended not according to its own nature, but according to the ability to know of those who do the knowing" (1969, Book V).
then, nothing particularly new in attributing to knowledge the power to transform. Nor indeed is there anything new in the complementary proposal that transformation occurs via some form of enculturation. One of the most frequent catchcries of Peters, for instance, is "education as initiation". The vistas that knowledge unveils are not spontaneously revealed, but only become apparent as the child's awareness is "differentiated in accordance with the canons implicit in the inherited traditions" of knowledge (Peters, 1965, p.103). The doors of epistemological perception tend to open very slowly. It is their opening which Peters characterises as "initiation", and that in effect amounts to much the same thing as 'enculturation'. But whilst this characterization conveys the notion, apt or not, that being introduced to knowledge is like having the 'truths' of some mystery cult revealed to one, the connection between education and initiation is never explored by Peters in any but the most general terms. None of the 'rites' and 'rituals' that might be involved are ever specified; nor are what might be taken as the phases of that initiation identified. Yet given that the outcome of education is travelling with a "different view", the obvious thing would be to characterize its itinerary. Then there is the more serious omission of asking what kinds of views are seen on that itinerary. Peters talks of "desirable states of mind" and of "getting inside the public forms of knowledge", yet remains very unspecific about what those "public forms" are. But, then, he has always tended to leave the more detailed ramifications of the epistemological parts of his philosophy to Hirst.

Hirst's starting point is Peters' cul-de-sac. He, for instance, shares with Peters the belief that it is knowledge which has the
potential to transform both the quality and character of experience (Hirst, 1968, p.123). But whereas Peters seems content to let his analysis of education and knowledge rest at this juncture, Hirst is not. Thus it is a matter of some importance in Hirst's thinking about education to establish the number and epistemological character of the "public forms of knowledge". And this he does. For instance, he fixes the number of forms of knowledge, that have the property of "mutual irreducibility" at seven, and argues that any "liberal education" worth its while will be built around these 'seven pillars of wisdom' (Hirst, 1974, p.84; 1968, p.133). What Hirst does, then, is add prescription to Peters' formula for education. He accepts its general principle that education should lead to "desirable states of mind", and then proceeds to indicate where it is these "desirable states" might be found. But whilst Hirst at least represents an advance on Peters, his attempt to delimit what are legitimate "forms of knowledge" has met with criticism on a number of counts. On straight epistemological grounds, it has been said (White, 1973, p.75; Hindness, 1972) that the forms are not necessarily as autonomous as Hirst presumes them to be. Indeed, it has been argued that some are not even forms of knowledge at all (Gribble, 1970). Then it has been claimed (Elliot, 1975, p.51), that certain modes of thought are not exclusive to particular forms of knowledge, as Hirst seems to suggest, but operate throughout the whole spectrum of knowledge, e.g. appreciation.

But not all the criticism of Hirst is epistemological in tenor. Jenks (1977, p.24), a sociologist, sees Hirst's view of knowledge as being essentially trapped in a "positivistic" framework. He argues that whilst Hirst constantly recognises that knowledge has a public domain to it - as he does - he eschews consideration of the ramifications that flow on from it, preferring to remain firmly entrenched
in the logical features of knowledge. This causes an ethnocentricity to infiltrate Hirst's thinking, in that he cannot see the legitimacy of patterns of thought that remain outside the ambit of European culture. Anything that cannot be trammelled within a positivistic account of knowledge is taboo as far as Hirst is concerned. But generally what Hirst has failed to take into account in his reading of knowledge is that its legitimacy is often more likely to be determined by the epistemological values of people rather than logic.

But even if these criticisms could be accommodated, there still remain serious oversights in Hirst's thinking about education and knowledge, especially in those areas of "initiation" and enculturation that this study is attempting to examine. For in those areas, Hirst has only really analysed the epistemological nature of the stuff "initiation" and enculturation are dispensing: knowledge. He has little to offer on the rites and rituals involved in its dispensing; for discussions about the initiation of individuals into the public forms of knowledge is virtually absent from his writings. Hirst, then, only indicates what sort of epistemological views might be glimpsed through education; but like Peters he does not indicate how individuals get to the point where they can look out over those views!

Of course Hirst and Peters do not represent the whole world of educational thinking; but they are notable in the fact, that despite evident flaws and oversights in their thinking, they have at least recognised and tried to explain education's irrevocable bond to knowledge. And in many respects, as Jenks (1977, p.23) suggests, they and their 'epigones' are almost alone in the world of education in this, for although mind and knowledge are the two phenomena that are of major concern to education, the majority of educational theory seems
to eschew their consideration. Instead, education has tended to concentrate on the "epiphenomena" of knowledge and mind: on curriculum planning, on child development, on social deprivation and so on. And whilst such things help to ameliorate the practice of education, they do not really enlighten understanding of the purpose and meaning of education. This Peters and Hirst have to some extent done, but in their earnest desire to supply a normative justification for giving knowledge such a prominent place in education, they have camouflaged a more underlying and functional purpose in education; and that is the advancement and perpetuation of knowledge and knowledge communities. About that purpose, Peters and Hirst, whilst they do occasionally acknowledge its existence, offer only the sketchiest of accounts. It might, then, given that educational theory is not proving to bear much fruit on the issue of enculturation, be worthwhile to look askance from education to see if epistemology— which, after all, is that part of philosophy which deals with knowledge— might have amongst its current concerns something related to enculturation and its effects.

2.9 THE STATE OF THE EPISTEMOLOGICAL ART

Like many of the phenomena that were formerly the sole prerogative of philosophy, discussions about the nature of knowledge have increasingly fallen within the province of the human sciences. This cultivation by the human sciences of what once were pre-eminently epistemological problems has not entirely extinguished the role philosophy might play in understanding knowledge. If anything it has served to distinguish those aspects of knowledge which yield to philosophical
treatment from those which the human sciences, like sociology and psychology, might more adequately deal with. For as has tended to happen in other fields of philosophy — philosophy of mind and natural philosophy, for example — this encroachment by the human sciences has led to a more intense cultivation by epistemology of those territories that psychology and sociology lack the appropriate methodologies to command (Korner, 1969, pp.278-279). And in case there should be any confusion about where the boundaries might lie, philosophers in general, until quite recently, have been keen to demonstrate that their epistemological territory is of a decidedly different topography from that colonised by psychologists and sociologists (Reichenbach, 1961, p.3; Popper, 1974, p.31). Nor is this particular boot totally on the philosopher's foot. Psychologists and sociologists have also felt a certain uneasiness about crossing into what they take to be properly the territory of philosophy (Parsons, 1951, pp.360-361; Berger and Luckmann, 1973, p.14; Feigl, 1959). By common consent, then, there seems to have been something of a disciplinary "apartheid" practised when it comes to matters connected with knowledge. Philosophers thus have been somewhat reticent to consort with psychologists and vice versa, no doubt fearing that they might "contaminate" each others' pursuits (Kaplan, 1971, p.64).

It has been said that psychologists do statistics to prevent their discipline degenerating into philosophy (Goldmann, 1970, p.22). Disparaging though that remark was intended to be to philosophy, it is sententious enough to conceal a basic truth about the nature of philosophy as distinct from psychology. For in their desire to render their discipline scientific, psychologists do play with numbers and
statistics. In fact statistics are the meter readings of psychologists; they are the portals to a world of facts that cannot ordinarily be observed; and it is upon statistics that the empirical truths of psychology tend to rest. This is unlike philosophy, which is much less concerned with merging its identity with science. As a consequence, it has less apprehension about treading in areas where psychology fears to tread. And not constrained by the aegis of science, philosophical truths therefore tend to be purchased from speculation rather than observation. A first point of demarcation between psychology and philosophy, then, centres on their respective methodologies. An epistemology that is due to philosophy thus will tend to be conceptual, that to psychology empirical.

But the differences do not cease at rival methodologies. There is also the matter of preferred area of epistemological concern; and over this not only are differences encountered between the human sciences and philosophy, but also within philosophy itself. It is a matter of knowledge - the common object of concern - being seen from a variety of perspectives. In sociology's case that perspective revolves around the "social construction of reality" and the way it is that knowledge, which is indigenous to different sectors of society, generates different perspectives on reality (Berger and Luckmann, 1973, p.115). Psychology's perspective, on the other hand, probes some of the inner cognitive mechanisms that might be responsible for that knowledge; it looks at the way it is essentially acquired, sired and stored. Still different again, philosophy ponders less about the cognitive and social attributes of knowledge and more about those which could be attributed to its logical features (Woozley, 1967, p.14). It is
pledged to explore such areas as 'What is knowledge?', 'Does it have any a priori components?', 'What is it to know?' and 'How does knowledge come to bear truth about reality?'

Although most definitions of it eschew the notion that knowledge 'maps' reality, preferring to stress the fact that the assertion 'to know' involves satisfying certain truth conditions (Werkmeister, 1968, p.266; Hamlyn, 1970, p.5; Chisholm, 1966, p.18), it is surely one of its more ineluctable features that knowledge, though it be a conditional assertion, does attempt to chart in some way the 'behaviour' of reality. Of course, the conditions that constrain knowledge assertions are an all important part of the anatomy of knowledge, for they help to control its veristic quality. But after the constraints have been applied, what remains is a knowledge that in some way reflects or comes to terms with reality. The two, reality and knowledge, are indissolubly linked; they are companions in the epistemological process (Harré, 1970, pp.279-299).

Since it is reality that is being mapped by knowledge, questions about the epistemological authenticity of the latter evoke questions about the nature and status of the reality being addressed. Whilst it is highly improbable that they are likely to be incompatible, the mere fact that knowledge addresses itself to what 'appears' to it to be plausible 'reality', means that knowledge, if not exactly subservient to metaphysics, is one of its principal satellites (Yolton, 1965, p.1; Machan, 1970, p.258, Harré, 1974, p.9).

That knowledge, then, might have to surrender its assertions to metaphysics before they can be finally ratified, suggests that the truths of knowledge are ultimately dependent on the view of reality
that is held. If it is held, for instance, that the 'flesh' of concrete reality secretes a universe populated by ideas and forms that only the scalpel of rationality can excoriate, then a knowledge derived empirically, that takes as its subject matter the flesh of concrete reality, will be, metaphysically speaking, an untenable sort of knowledge. Similarly, the strict empiricist who believes there are no ideas except in the experience of things, will frown on the rationalist assumption that there are, as its etymology suggests, in metaphysics, 'things beyond the physical realm'. For the empiricist, knowledge will have its roots in a physical reality that is available to the senses, not a noumenal one that is not. But the ultimate arbiter as to whether such a reality exists, or is an illusion, as the neo-Platonists would have said, is metaphysics. This then would suggest that epistemology is ultimately reducible to metaphysics.*

On the other hand, both knowledge and metaphysics have their incipience in the mind. And whilst it might be possible to divorce an 'out-there' reality from the parameters of the mind, in truth that reality is only as good as the parameters of the mind allow (Heisenberg, 1971). As Russell (1973, pp.1-7) once pointed out, a distinction must be made between the world of matter and that world as it actually appears to human beings. The two often do not coincide, for the mind imprints its own characteristics upon reality, a fact which makes it difficult to appreciate things as they actually are. How much the

* Or in these days of Berger and Luckmann (vide supra) perhaps sociology. After all, if anything is proof of a socially constructed reality, it is Plato's metaphysics. Plato firmly believed that it was only given to certain members of society the privilege to see the immanent forms beyond the physical realm. The rest had to make do with the shadowy world of things; and that was a world from which opinion, not knowledge, originated (Plato, 1973a, Book VII, 7).
mind serves to subvert the appearance of things depends a great deal on the philosopher being read. For Kant it was considerable, for Locke a lot less. But whatever the case, the epistemologist has to recognise that mental questions can be as much the orbit of his concern as the nature of the reality to which knowledge addresses itself; and in dealing with such questions epistemology comes perilously close to becoming a "chapter of psychology" (Quine, 1972, p.18). However, they are not so close as to becoming the chapter of the same book. Or if they are, then they are written in different styles. For as has been noted, the approach of epistemology is speculative, psychology mainly empirical.

The official territory of epistemology, then, would appear to occupy a region bounded at one end by metaphysics and at the other psychology. But rather than being evenly spread over this territory, most epistemology tends to reside near one or other of these borders, so that it either concentrates:

(I) on the logical means by which knowledge tends to transcribe reality; and in doing this it tends to disregard any psychological factors that might infiltrate that transcription. An epistemology of this kind, then, tends to live according to the homily, "knowledge without a knowing subject" (Popper, 1973a, p.109), or

(II) on discovering what it is about the state of mind 'to know' that differentiates it from other mental states. In contrast to I, this kind of epistemology concentrates on finding out what it is a "knowing subject" contributes to knowledge; and in doing so, it stops just short of turning into psychology.
If this represents the current state of the epistemological art, then plainly it is not going to say very much about processes like enculturation, which, it has been imputed, arise from the coming together of mind and knowledge. That epistemology, which does in fact tend to be divided about the types I and II just delineated, is given further credence by the fact that a number of epistemologists have felt the "diremption" between I and II to be an uncomfortable one. Not only that, but they have also felt that it might not be jurisprudent of philosophy to cut itself off from psychology any longer (Kaplan, 1971, p.64; Hamlyn, 1971, p.12). There are moves afoot, then, not only to create liaisons between the "object" (I) and "subject" (II) polarities of epistemology, but also to remove the barriers that, in the past, have tended to divide epistemology from psychology.* It is 'have tended' because, although this segregationist policy has prevailed amongst orthodox epistemologists, there is a scion of epistemology, mainly of a phenomenological and 'subjectivist' kind, which although often maligned by orthodox epistemology, has on principle tried to bridge the gap between psychology and epistemology. And that is the epistemology practised by Polanyi and his disciples.

In very broad terms, Polanyi finds it difficult to countenance a totally objective description of knowledge which does not also entail recognising the human qualities that contribute to it. To talk

* Indeed, there is some evidence to suggest that epistemology could benefit from such a 'fellowship'. Had, for instance, the kind of experimental psychology that Piaget practises been in general currency in the 1920's, when the members of the Vienna Circle were formulating the tenets of Logical Positivism, they might not have been so dogmatic in advancing the belief that language and thinking are contingently necessary to one another. Piaget's demonstration of the existence of pre-linguistic thinking would have made nonsense of this, one of the most treasured pronouncements of Logical Positivism (Piaget, 1971a, pp.8-9).
of a thoroughly de-anthropomorphised account of knowledge is to talk nonsense, because, with the 'best will in the world', it is impossible to escape from the subjective factors which introduce themselves into the 'siring' of knowledge. In all knowledge there is an ineradicable "personal component" that upsets the possibility of its ever being de-anthropomorphised! Knowledge must therefore be seen through the perspective of the human framework and its peculiar cognitive propensities, if it is to be seen at all. There can be no such thing as a wholly objective knowledge, for the possibility of its existence is made specious by the personal subjectivity of man's judgements and valuations. Even an apparently 'objective' scientific pursuit like observation is fringed with a subjectivity that inhibits an absolutely objective registration of reality. Even the act of reading a scientific meter is tainted with subjectivity. Thus the scientist keen to assign a wavelength to the colour blue, so that he can interpret the readings on his spectrometer properly, must decide which, out of a myriad of possible 'blues' most nearly represents the quintessence of blueness (Greene, 1974, p.163; Polanyi, 1962, p.119).

Science, then, has not made the value judgement defunct.

Polanyi's 'brand' of epistemology tries to transpose the insights derived from psychology - notably gestalt psychology - on to the problem of knowledge (Polanyi, 1969, p.29). Polanyi, however - and this makes his theories about knowledge particularly apposite to this study - was never content to reside solely in the subjective polarity of epistemology; for he did not allow his attempts to analyse the "personal component" in knowledge to obfuscate the fact that knowledge also has a "civic" phenomenon, controlled by external conditions and
rules (Polanyi, 1962, pp.208-216). And it was these conditions and rules, which Polanyi believed ultimately made a measure of objectivity at all possible in knowledge. The knowledge act, then, whilst it might have elements of the personal in it, is finally trammelled by appeals to consensus and public controls. Without a certain amount of submission to them, complete epistemological anarchy would prevail. That it does not is because the personal components of knowledge are held in check by the public. Members of a knowledge community, then, are contracted to observe controls and ordinances in their dealings with knowledge; they must also ensure that those controls and ordinances are transmitted from generation to generation, if the orderly epistemological 'conduct' they foster is to continue. That is one of the functions of "cultural apprenticeship" (Polanyi, 1962, p.207); for to learn a discipline is to learn that it is 'disciplined', it is to become acquainted with a set of rules and regulations that prevail there. Travelling along the road to knowledge is not merely a matter of becoming aware of different views, it is also matter of observing the 'highway code' that applies on that road!

Polanyi's epistemology tends to lie at the crossroads of sociology and psychology, which makes it more qualified than some of the more orthodox types of epistemology to enlighten some of the questions about the function of education and enculturation that this study is trying to deal with. Furthermore, whilst Polanyi's anatomy of knowledge has occasionally been applied to aspects of education,* its

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* Broudy (1970) has done so in relation to aesthetic education, whilst Diller (1975) has examined Polanyi's notion of "apprenticeship" and its possible import for a differently biased form of education. Most recently, Dunlop (1977) has argued that education should be seen in terms of Polanyi's general theses about learning and knowledge.
appositeness to the more overall questions about the function and nature of education has been rarely recognised. Philosophy of education's "parasitism", whilst it has extended into positivism and analysis, has not yet caught up with Polanyi's "subjectivism", nor either with a whole gamut of equally pertinent insights on education that are harboured in philosophy and sociology of science.* The problems of enculturation and initiation have in fact been largely left in abeyance by philosophy of education, due possibly to the fact that in matters of knowledge it has tended to pay most fealty to Types I and II epistemology. This has led philosophy of education down avenues of analysis of ideal knowledge and mental states, which, whilst it has served to apprehend what is perhaps meant by knowledge and knowing in the most abstracted sense, has to some extent distracted it from coming to terms with what 'real' knowledge in the 'actual' institutional settings of education does, and why it does it.

Yet there is now in epistemologies like those of Polanyi, and in philosophy and sociology of science in general, plenty of empirical and theoretical evidence about the institutional features and functions of knowledge communities - and they embrace education - which could yield more credible and realistic understandings about what the function of education is. It is to this evidence, then, that this study will turn.

* Notable in these fields is the work, and it will be often referred to, of Toulmin, to whom Hirst (1974, p.100) in fact does acknowledge some indebtedness, Kuhn, Agassi, Hanson, Merton, Hagstrom and Crane. And if the bias does seem unduly scientific, when some more general purview of knowledge has been the declared objective of attainment, it is because sophisticated analysis of comparable distinction have not been encountered in other disciplines.
2.10 GENERAL SYSTEM THEORY, AND A LOOK FORWARD

This study will attempt, then, to build a model of the process of enculturation from the perspectives (a) of the individual knower and (b) of the community of knowers in general. It has been argued in this Chapter that whilst education is a central force in generating enculturation, as a discipline it has a relatively primitive understanding of the processes involved. Its philosophy has come closest perhaps to acknowledging that education is in the business of transformation, but rarely has that philosophy gone beyond that acknowledgement and tried to elucidate a further understanding of that transformation. But then philosophy of education for some time now has been in a "theory evaluating" rather than "theory building" mood (Broudy, 1969, p.115); it has been to some extent trapped in linguistic analysis, and where knowledge is concerned, positivism. By its very nature, this study will don a much more "theory building" tone, and perhaps eschew some of the analysis that has been current in philosophy of education. It will take as a mentor, for its generally broader methodological approach, the style of General System Theory.

Notably General System Theory has, in rather 'manifesto-ish' tones, attempted to countervail the proliferation of sub-disciplines, that is so characteristic of the atmosphere of modern knowledge; it has looked for principles of "homology" between them, and seen itself as a "grand unifying science" that is opposed to the advance of atomisation in knowledge generally (Bertalanffy, 1971, pp.31, 37; Laszlo, 1972a, p.13). System theory, then, is dedicated to a holistic rather than a discrete appreciation of the world; it lives according to the Aristotelian motto: that the whole is more than the sum of its
parts. And whilst the tone of this ambition is perhaps rather over inflated, system theory does hold out the possibility that a problem can be approached from a much broader perspective than perhaps the more orthodox disciplinary approaches might allow. System theory, for instance, does sanction the practice of approaching problems from a variety of disciplinary viewpoints (Laszlo, 1972a, p.3); and it has been indicated in this Chapter that if the problems of enculturation are to be fully understood it will be necessary to do just that, and cross a number of disciplinary paths.

But it is not merely because system theory would appear to sanction a methodological style apposite to the needs of this study that its services will be called upon. There is also the fact that system theory offers a series of concepts and theoretical ideas whose compass can be extended to the understanding of knowledge communities. For whilst the original ambit of systems concepts and theories were designed with biological systems in mind, those concepts and theories have been shown to have an applicability to broader cultural and social systems as well (Bertalanffy, 1971, p.209; Rapoport, 1968, p.xxi). Human social aggregates exhibit all the features of organised systems and a knowledge community is as much a social aggregate as any other organised system, and as will be shown, is subject to the same system properties. But it is not only social aggregates that can be treated "systematically". The psychological behaviour of men themselves can also be shown to exhibit system properties. That behaviour is an aggregate of parts; and it is how this aggregate of parts develops and reacts to knowledge that is examined in the next chapter.
CHAPTER THREE

FROM NEGENTROPY TO KNOWLEDGE

"The Child's Toys & the Old Man's Reason Are the Fruits of the Two Seasons"

(William Blake, Auguries of Innocence)
3.1 INTRODUCTION

Although in some extreme forms of rationalism (e.g. Platonism), there have been attempts to sever the connection knowledge has with a sentient reality, and to prove that all genuine knowledge is a subspecies of 'noesis' rather than experience, the fact that some sort of ontological experience is necessary before noesis can proceed means that all knowledge has its incipience, at some stage, in a variety of experience of some kind. There might be a subsequent desquamation of these origins, as knowledge becomes progressively more noetic and less experiential in character, but in its crudest and most rudimentary form all knowledge is furbished from an experience of reality.* But experience, which is itself a product of the mind, having its own particular mental traits, only represents the starting point of knowledge, that is all. The prerequisite experience, or the disposition to be aware and to take notice of things, as it has been described (Werkmeister, 1968, p.82), does not in itself lead to the spontaneous generation of knowledge. All animals, out of biological necessity, are capable, with varying degrees of percipience, of being aware of and of taking notice of

* Not that this proposition is wholly inimical to the tenets of the Rationalist point of view. Plato (1973a,Book VI, 6) does acknowledge that the path to knowledge commences in a sentient reality. It is just that for Plato reality was essentially spurious, and therefore any knowledge that was generated from it was also spurious. In order to secure genuine knowledge, man had to look askance from the sentient reality to a realm where truth was revealed through the medium of rationality and dialectica, rather than experience. Whether such a rarefied noesis is possible is another matter. Certainly, Euclidian geometry, which for many Rationalists represented the acme of their thesis about knowledge, appears to have had its origins, not in the mind, as the Rationalists were pledged to thinking, but in the solution to the very practical and 'experiential' problems of mensuration and surveying (Toulmin, 1972, pp. 432-435).
some segment of their surrounds. But if experience is an entrée to knowledge, then only man would appear capable of digesting that entrée such that what eventually springs from it is knowledge. If man, like the rest of the animal kingdom, obtains food for his body from the world, then he alone, from experiencing the world, derives 'food for thought' and knowledge. Only his particular mental capacities seem capable of transforming experiential 'fodder' into an epistemological 'energy' that, as was concluded in Chapter Two, can transform the way the world is regarded. But what was not indicated in that chapter was how and under what conditions experience eventually becomes a 'nutrient' for a new way of looking. Are the processes of 'epistemic seeing', for instance, somewhat analogous to those that govern ordinary seeing? Do they have their genesis in the same psychological mechanisms from which experience in general is 'manufactured'? Is it possible that knowledge is simply a form of experiential coherency, par excellence? It is to this conspectus of questions, then, that this chapter will turn, in anticipation that answers to them will yield an understanding as to what mentally happens when men are released from the 'manacles' of initial perception, and become 'chained', instead, to knowledge.

3.2 PERCEPTION AND HOMEOSTASIS

In endeavouring to understand the nature of living things, biologists have frequently anchored their insights in some basic philosophical principle or other. This principle, which dictates the biologist's attitude to life in general, acts as a kind of cynosure, guiding his preconceptions about, and research into living things. Thus with different 'cynosures' to guide them, rival schools of biological thinking have tended to emerge. The latest
manifestations of this rivalry centres around whether the nature of life can be best understood treating it 'reductionistically', or holistically.

Biologists, who belong to the former school, believe that the true 'blue print' of life can only be discerned by analysing, preferably by the methods of physics and chemistry, the molecular fabric of living things (Greene, 1974, p.202; Olby, 1972, pp.232-233). The matter of life is contained in molecules like DNA, and its understanding comes from insights into their fundamental structure. Biologists of the contrary, and holistic frame of mind, generally remain unsympathetic to this atomistic policy of the 'reductionists'. They see the attempt to reduce life to so many long chains of DNA as exacerbating the understanding of living things as completely unified beings. Their's, then, is the creed of the General System Theorist (see 2.10): that the "whole is more than the sum of its parts": and they generally take issue with the "reductionist" principle that life can be inexorably reduced to so much physics and chemistry, believing that that pursuit rests on two false assumptions:

(i) that living things are nothing more than aggregates of chemicals, and

(ii) that they are therefore subject to the same physical laws that govern the rest of the inanimate universe.

DNA might contain one 'code of life' and offer explanations about the mechanics of protein replication, but in itself it does not offer explanations about how it is an organism conserves its 'unity' through what amounts to a sometimes complex and creative set of interactions with its surrounds. Physics and chemistry might adequately describe DNA, but to infer from that that living things
are totally answerable to physical and chemical laws reveals, according to one of the holistic biologists (Bertalanffy, 1967, p.62), a gross misconstrual of their real nature. This equation between living and non-living things, that the reductionists seem eager to make, is really quite untenable in Bertalanffy's view. Because living things are radically distinctive in their rapport with reality, and are able to achieve physical states and conditions denied the inert and non-living 'universe', biology according to its holistic practitioners, will never fully be subsumable under physics and chemistry. It will always retain its independence from them, because the living things that biology deals with, whilst they might be composed from some of the same chemistry that pervades the rest of the universe, are really the physical exceptions in it.

The exceptional character of living systems springs in the main from their apparent capacity to contravene, temporarily at least, the Second Law of Thermodynamics. According to this Law, the universe and the material substance from which it is composed, are all on the inexorable decline into a condition of maximum disorder or entropy. If there is a teleological principle rife in the universe, then the Second Law spells complete and utter degradation as being the final fate of things: for in effect the eschatological complexion of the universe will be maximum entropy. Living things, however, are temporarily able to delay this fate. By virtue of their capacity to interact with their surrounds, they can arrest the onrush of entropy, and introduce increased order into themselves, and sometimes, their surrounds. Living systems, then, have the ability to inhibit the progress of entropy formation. Indeed it is this ability of living things to introduce order and produce what
Schroedinger (1967, p.74 et seq.) has called "negentropy" (negative entropy) that could be said to constitute, in 'vitalist' terms, the proper _elan vital_ of life. And whilst it has been argued (Popper, 1976, p.137; Pantin, 1968, pp. 36-42) that some non-living things * are equivalently capable of manufacturing negentropy and of defying the Second Law, the epitome of that capability and defiance is only really encountered in living things. For living things need to be able to countervail the force of the Second Law and combat the overtake of disorder, if they are to survive as unified organisms.

Living things, then are able to procrastinate, for the duration of their existence, enslavement to the Second Law. But this procrastination is not a stagnant process, attained without struggle or effort, for in order to prevent the Second Law taking effect, living systems must engage in a "dynamic interaction" with their surrounds. They must be able to function as an "open system", and thereby have the capacity to assimilate from their surrounds the energy and the chemistry they need to regulate themselves as "going concerns" (Werkmeister, 1968, p.412); they must constantly have the capacity to re-instate the condition of so-called "homeostasis", when that is disturbed or thrown out of balance. The Second Law, as Brillouin (1968, p.149) points out, in effect means "death by confinement". For if the disturbance to homeostasis proves too great and beyond the power of external reconciliation, or if the living system becomes irrevocably separated from the reservoirs of life supporting chemistry, homeostasis will become impossible to maintain and the living system will die. It is not until the

* e.g. self-winding watches, thunderstorms, thermostatically controlled heating systems (Boulding, 1956, pp. 66-75).
point of nemesis, however, that the system finally surrenders itself to the tenets of the Second Law, and positive entropy asserts its power to cause chaos. In the meanwhile, however, by "sucking orderliness" from its environment, the living system is able to maintain itself stationary and at a fairly high level of orderliness. Thus whilst the rest of the universe is in a process of "winding down", living systems, by feeding off negentropy, are able to keep themselves "wound up" (Laszlo, 1972a, p.43; Katz and Kahn, 1966, p.92; Bertalanffy, 1971, p.28; Schroedinger, 1968, p.146).

Perception, it was argued at the beginning of Chapter Two, provides a life-line to reality; it is a biological endowment that allows a living system to make contact with its environment. It has been argued in this section that it is contact and interaction with their surrounds which enables living systems to acquire negentropy. In a very real sense, then, the life-line to reality provided by perception is just that: for if a living system is to regulate its homeostasis, and stave off entropy, it must be perceptually alert and attuned to those segments of its surrounds that can supply it with the 'raw materials' of negentropy. This nexus between perceptual sensitivity and existential need, which is apparent in all living systems, was first examined by the German biologist, Jacob von Uexküll, who called it Umwelt-Lehre. "It essentially amounts to the statement that, from the great cake of reality, every living organism cuts a slice, which it can perceive and to which it can react owing to its psycho-physical organization" (Bertalanffy, 1971, p.240).

In living systems, then, there tends to be a specificity of receptor focus, which, whilst it can cause considerable sensitivity
to certain regions of the world, both limits and debars that sensitivity to others. Different organisms and species therefore often experience different and sometimes incommensurate views of the world, due to their different needs and different anatomical make-up. Thus in the world of a fly, says Uexküll, there are only "fly things"; in the world of the sea-urchin, only "sea-urchin things" (Cassirer, 1973, p.23); and neither has the vision of the world quite like that of the tick's, which focuses solely upon the butyric acid secreted from the glands of certain mammals.

Each organism, then, tends to inhabit an "environmental shell" (Taylor, 1971, p.113), whose perimeter and outer limits are determined by the organism's perceptual capacities. And whilst in the simpler organisms this "shell" might not be particularly capacious, it often accommodates aspects of the umwelt (ambient) that are denied to the perceptually more sophisticated and discriminating organism. The tick's rather threadbare world, for instance, might be rather lack-lustre and bland when compared with the more enriched sensory experience of a higher organism, but as far as achieving homeostasis is concerned the tick need only be aware of butyric acid. The world beyond it is largely irrelevant to the tick's existential needs: hence, it remains blind to it. And although the higher's organism's 'sensory spectrum' might encompass a much broader arena of reality than that of the tick, the same principle of sensory censorship determines how broad that spectrum is. The complex organism is not omni-sentient; its outlook on its local umwelt is just as ontogenetically ingathered as the tick's. Even though its "shell" might be very much more voluminous and embrace much more, it lives just as much in an "environmental shell" as the simplest of simple
organisms. Moreover, whilst the higher organism might be sensitive to a great deal more of the "cake of reality", there are many slices of it that simpler organisms can 'see' which it cannot. Human beings, for instance, might have a celebrated sensitivity in the optical parts of the spectrum, yet they remain 'blind' to the infra-red and ultra-violet sectors of it. These are realms of electro-magnetic radiation which lie beyond the capacities of their senses. But this is not true of the pit-viper, which can see infra-red radiation! Nor of the bee, which is not only sensitive to the ultra-violet regions of the spectrum, but also to gradations and divisions of colour in the optical parts of it that are not developed in humans at all (Pantin, 1968, p.33).

The perceptual range of its senses, then, can be said to determine the limits of an organism's 'ontogenetic universe', which in its turn is likely to be a reflection of its 'ontogenetic needs'. But even though within these relatively circumscribed limits a higher organism, like man, has the capacity to be conscious of a relatively broad segment of reality, in real terms he is only aware of a small speck of the range of electro-magnetic radiation in the universe.* His senses conceal very much more than they ever reveal (Koestler, 1974, p.49). And even that segment of reality that is open to his gaze is likely to have filtered from it many of its most salient features. But whilst man's sensory domain might be subject to all

* Not that this has proved an insuperable handicap for man. He has frequently pledged his ingenuity to devising instruments for increasing the dominion of his "ontological universe"; that would bring into view aspects of reality and its various electro-magnetic radiations that lie beyond the ambit of the unaided senses. The telescope and the microscope are obvious examples of such "sense extending" instruments (Harré, 1974, p.19).
sorts of gross censorship, within their comparatively restricted
domain, the senses themselves have the potential to react to the
seemingly imperceptible. Their powers of discrimination and focus
have exceedingly low thresholds of sensitivity. The sensory surface
of the nose, for example, is capable of being affected by vanillin,
one part by weight in $10^7$ parts of air; and as far as sight is
concerned, it only requires an amount of energy equivalent to $10^{-11}$
erg to excite the sensitivity of the retina (Cannon, 1968, p.256).
And then once excited, the retinal nervous system possesses a really
prodigious assemblage of neuronal resources to convert reality into
a 'picture' the brain can register. The retina, for instance,
consists of something like $10^8$ sense cells that individually and in
consort with one another serve to convert 'reality' into an
abstraction of colour contrast and brightness. Then there are a
further $10^6$ nerve fibres in the optic nerve which transmit that
abstraction to the brain (Popper and Eccles, 1977, pp.263, 432).
In fact when the potential of all this nerve 'machinery' is added
up, it seems that the eyes are capable of receiving $10^{1556}$ types of
images!! Fairly obviously if the brain is not to be drowned in a
massive 'tidal wave' of visual information, it has to be protected
from the 'glut' of imagery the eyes have the potential to produce.
Of course, the mass of the information received at the eyes is not
useful in any way. It can be overlooked without much threat to
homeostasis being incurred. It forms, then, the background 'noise'
of vision; and therefore by a process Foerster (1968, p.172) calls
"computational economy", it can be subtracted from the focus of
attention, and thereby leave a man to concentrate on the things
which really count in his field of vision.
At the interface between the receptors and reality there is a dominion that is vastly over populated with images and sensations. But as investigations into "cutaneous perception" have indicated, the pathway from the primary sensory areas - those of touch - to the cortex are a mass of synaptic relay stations that inhibit weaker "excitatory actions". When the skin touches an ill-defined edge, a more sharply defined signal tends to be received at the cortex, because the signals from the weaker excitatory actions have been eliminated (Popper and Eccles, 1977, pp.253-255). The transmission line from the receptors to the brain, then, practises, as it were, a progressive 'genocide' on the large population of sensations that are registered at the skin. Only the strongest signals survive. What happens, in effect, is that during successive "synaptic relays" certain input sensations are switched off, "according to the exigencies of the situation" (Popper and Eccles, 1977, p.255). The final "read out" of touch at the brain, then, is a thoroughly abridged version of that received at the skin.

From what was said about "computational economy", and the tendency to switch off homogeneous perturbations, it would seem probable that analogous processes of sensory abridgment operate in the arena of vision. Indeed, given the generally supererogative character of vision (vide supra) they would need to, if a man is not to be totally overwhelmed by all the surplus visual information in his surrounds. But if the processes are somewhat analogous, then they are a good deal more complicated and less well understood than those associated with "cutaneous perception". It is still not certain how the brain assembles a vivid 'picture' of reality from the "punctuate mosaic" of brightness and contrast received at the retina (Popper and
Eccles, 1977, p.270). It is true that that picture is likely to be an abstract of, rather than a replica of, reality. During the creation of that abstract, then, certain excitatory signals at the retina are likely to be inhibited in order to strengthen the visual significance of others that will form the framework of the abstract. But then there is the question of how or what decides which signals inherited from the retina are to be retained or inhibited? Presumably, since the signals themselves constitute just one incessant bombardment from reality, there must be some cortical operations beyond the retina which finally intercede to decide which signals are placed out of sight. Those operations, then, would possess the power to elevate the significance of certain signals coming from the *umwelt*, whilst relegating others; they would have the capacity to abstract meaning from the welter of sensation that is awareness. Eccles (Popper and Eccles, 1977, p.363) notes that this new sort of "ghost" in the neuronal machinery would be enthroned in what he calls the "self-conscious parts of the brain". The 'ghost's' domain of power would reign over the integration of that immense diversity of material which arrives at the cerebral cortex. But though such a ghost might be wandering somewhere in the multitudinous avenues of the brain, it has to be asked what criteria it is that that ghost uses to carry out the abridgment of sensory data, and once having made that abridgment, how does the ghost conjure from it a 'picture' of reality inside the brain?

Eccles considers that the abridgment of sensation is largely guided by the pressures and exigencies of circumstance (*vide supra*). It is need and want, then, that are likely to alert and excite attention to certain regions of the world, whilst suppressing and
inhibiting attention to others. And it has been noted in this section, that the most archetypal needs and wants, afflicting all living systems, including man, are those that surround the pursuit of homeostasis. If an organism is to maintain that, and defeat 'slaughter' by entropy, it must have the capacity to interact with its surrounds, and obtain the appropriate orderliness from its *umwelt*. Initially, therefore, what the self-conscious parts of the brain will endeavour to "read out" from the reception areas of the body, will largely be related to the exigencies and pressures brought on by the need to maintain homeostasis. Sensory awareness, then will tend to strengthen those signals and excitations that are the hieroglyphs of negentropy, and weaken those which are not.

The capacity to attribute different negentropic weight to these different hieroglyphs is again a self-conscious act that occurs beyond the realm of the retina. It cannot be explained in terms of the assimilation of brightness and contrast, but only in terms of how that colour and brightness is abstracted and translated to make the hieroglyphs of experience. And since it seems probable (see 2.1) that the cortex is only equipped to recognise a few primitive shapes and forms, it is likely that a great amount of perception is learnt behaviour. It develops heuristically through a process that Popper (Popper and Eccles, 1977, p.429) has postulated is much like the process of "making and matching" that Gombrich (1960, p.320) has asserted is the way a painter assembles his 'pictures' of reality. The self-conscious part of the brain tends to conjecture, from the information it already has in its possession, what reality might be like, and then compares this conjecture with the "punctuate mosaic" of reality received at the retina. Where the two coincide, the brain will assume that it has
secured a reasonably accurate portrait. Where the conjecture does not co-incide with the "punctuate mosaic", an appropriate modification to the conjecture will be necessary in order to reconstitute the retinal information.

If there is a 'ghost' in the neuronal machinery, then Popper's and other theories about perception (notably, Sherrington's, Bruner's, and that of Hanson, which was discussed in 2.4) would indicate that that 'ghost' is invested with 'clairvoyant' powers. It is ever conjecturing about what it will see next and trying to anticipate what 'reality's' next move will be. There is, then, as much 'foresight' as there is 'sight' in perception. Through experience there is a constant thread of anticipation running, as the mind speculates about what it is it is making contact with in reality. There is a strong element of expectation in perception; it is forever fraught with anticipation. It is, as was noted in 2.4, imbued with theories with which to analyse the world as it is imbibed. Normally the onrush of experience does no more than confirm our theories about reality. There is no need for any radical modifications to them. What was 'made' of a segment of reality in the past still 'matches' with its current behaviour. The mind therefore can, so to speak, rest easy about that segment of reality, secure in the knowledge that it is doing what is expected of it. There is no need for the mind to be alert to any sudden and unexpected changes in its behaviour, for the mind knows there will not be any. It therefore can make on more "computational economy" (vide supra) in the myriad of images it has to cope with. Not only does this help to reduce experience to more and more manageable forms, but it also means that the mind can be doubly alert to those quarters of reality that suddenly violate its
expectations (Bruner, 1974, pp.18, 70-71). Then all the "mental alarm bells go off", and the mind can devote its full attention to the regions of reality upsetting all prior expectations.

The capacity to have preconceptions about the nature of reality, and the range of its possible behaviour, would appear, then, to be part of the repertoire of simply being human. Sherrington (1906), who called this capacity of man's "propriorception", saw it as being one of the fundamental necessities of life. In this section, it has been argued that as a necessity of life propriorception enables man to cope more effectively with the 'information explosion' in his surrounds; and as a consequence of that, he is able to achieve more effectively the much more fundamental necessity of life, homeostasis. The need regularly to secure and maintain homeostasis is a constant requirement of all forms of life, including man. Therefore man's other preoccupations, whether they be social, emotional, technological or epistemological, only develop and emerge, as will be made clearer in 3.3, when the exigencies of homeostasis have been satisfied. Moreover, these preoccupations must be regarded as only capitalising upon and exploiting those endowments that nature, in the first place, no doubt only intended to be used for the acquisition of negentropy, not things like knowledge. Epistemological activity, then, is partly an extension and refinement of those activities needed to maintain homeostasis. How it is so will be the subject of the next section.

3.3 FROM NEGENTROPY TO KNOWLEDGE

Assimilating negentropy from their *umwelt* is for all organisms, whether simple or complex, the most preliminary and basic of all interactions. Without it, nothing else is possible. This "gross interaction", as it has been called (Angyal, 1958, p.59), then, has
one bald concern, and that is to service the homeostatic requirements of a living system. It does little else but provend existence to the living system. "Gross interaction", then, is the most organically primitive of possible interactions with the environment, and in terms of Maslow's (Cotgrove and Box, 1970, p.93) hierarchy of needs it occupies the base of a pyramid that has at its apex "self-actualization". Compared with "delicate interaction", which is Angyal's second of possible interactions with the environment, "gross interaction" has a purely predatory character. During "gross interaction", then, the environment is preyed upon for purely existential reasons. The organism gets nothing from it other than what it needs to maintain homeostasis. This is unlike the outcome of "delicate interaction" which goes well beyond satisfying existential exigencies; for it supplies the organism with a "range of information" about its surrounds, which may or may not be pertinent to its existential well-being. "Delicate interaction", then, has little to do with the upkeep of existence.

The freedom, however, to engage in "delicate interaction" rests on first satisfying a range of existential needs and wants. Unless they have been attended to, thereby neutralising any threats to homeostasis, an organism cannot really progress from gross to delicate interaction. Unless the self-preservative drives have been satisfied, the organism will remain too preoccupied with gathering the requisite negentropy for biological survival. "Delicate interaction", then remains essentially an activity that is surplus to the mainstay of life. It is something done after the wants of homeostasis have been acquired; it uses any 'energy' or time that might remain after life's appetites have been satisfied.
Delicate interaction, then, is extra to survival. It is nature's way of filling the time left after the resources needed for life have been acquired. Most higher animals engage in delicate interaction at some stage in their life, but most particularly when they are young. That it should be particularly pronounced when animals are young and immature is perhaps because most of their existential wants are catered for by their parents. Such animals, then, have all their survival needs under control, and have plenty of surplus energy that needs an outlet (Storr, 1972, p.120). The supply of negentropy thus being guaranteed, they are to some extent emancipated from bondage to "gross interaction"; they are thus free to indulge, and thereby use up their surplus energies, in delicate interaction. One form of delicate interaction, which yields plenty of information about the surrounds, and which is particularly pervasive in the young animal's behaviour, is play.

While the animal is young, play is habitually engaged in, and continues to remain, although to a less marked degree, an activity of adult life as well. That play might satisfy an instinct of curiosity about the world, and lay the foundations for a knowledge about the environment is plainly evident in the differences, and the significances derived from it, between the play of young children and chimpanzees. As Buytendijk (Greene, 1974, p.176) showed, they both have the capacity to delight in the same toys, and play superficially with them in much the same way; but only the child would place a toy aright when it toppled over. Only he made any conscious attempt to shape the world in accordance with the values and norms he was discovering existed there. The young chimpanzee always remained indifferent to such; it was a matter of no consequence to him whether the toy was upright or
fallen. It was simply something to drag, not something to interpolate as having one position of stability that might be more correct than others. The chimpanzee, then, is inclined to leave the world as he finds it; but the child is conscious that it has regularities and patterns, from which benefits can be obtained if they are conserved and returned to when disturbed. The child soon learns that in the world things can be at his 'beck and call'; he discovers that by manipulating the world he can have some measure of autonomous control over it. Thus he begins to make epistemological projections about the world, and conjecture what will happen to it if he takes certain courses of action. There is, then, in a child's play a heuristic mentality, that subsequently becomes the springboard of knowledge.

The pursuit of physiological homeostasis, which characterises "gross interaction", is largely an "instinctive and biochemically preprogrammed" activity (Laszlo, 1969, p.46). Once it has been achieved and the needs of negentropy have been secured, men, like any other organism, are free to participate in activities that are, biologically speaking, unnecessary. One of these activities is play, and through it men begin to read the world in more than purely survival terms. And what that ultimately offers is the possibility of introducing negentropy back into the same world from which negentropy was acquired in order to regulate homeostasis. But if through play a knowledge about the world can be gained that enables further control and orderings of it to be made, it would be a mistake to think that epistemological activity is simply a 'grown-up's' version of play. Of course there is, as Huizinga (1955) argues, a play element in all cultural and epistemological activities, but it is only an element, not an all dominating principle in those activities. For one thing, as
Loizos (1966, p.4) points out in relation to animals, play is hardly the most economical way of gathering knowledge. If that was its sole point, there are many more efficient ways of securing information about the environment than simply playing with it. And if knowledge is an offshoot of play, it is an offshoot that arises by accident, rather than by design. For play, above all, is an "intrinsically worthwhile" activity, that has no end other than itself. Moreover, it tends to court the delights of "irrationality". "It confirms the supra-logical nature of the human situation" (Huizinga, 1955, p.4). whereas of course knowledge is supremely dedicated to understanding the logic of that situation.

Play, then, only points the way to knowledge; it is not the most effective way of actually getting it. *Homo ludens* is but a stage on the way to *homo becoming sapiens*. Indeed, the tendency for play to oppose the dictates of reason and logic would often make it a very unsatisfactory preparation for the pursuit of knowledge. Yet men, like animals, play all their lives. It is not an activity that is restricted to childhood. But if play does not nurture knowledge, except in a very peripheral way, and it does not have any other purpose apart from itself, why is it such a compelling element in man's existence? Surely there must be something more to play than it being a time filling exercise. Storr (1972, p.122), who has asked this very question, suggests that that in fact is its prime purpose. People play to offset, amongst other things, boredom; they engage in it to use up the surplus time left after gross interaction. But why should that be at all necessary? Could not man equally languish in the luxury of prolonged *ennui* and idleness? It seems not; for man would languish all right, but in a psychologically very harmful way.
As experiments designed to monitor the effects of sensory deprivation - a most exaggerated form of boredom - have shown, when subjects are exposed to prolonged periods of darkness and silence they suffer devastating psychological changes (Zubek, Pushkar, Sansom and Gowing, 1966). Hallucinations are not uncommon, temporary amnesia is often experienced and very significant fluctuations of EEG activity are readily measurable. The ordinary brain functions, then are disorganised and disrupted to a remarkable degree by profound sensory deprivation. When these functions are not fed with the constant stream of varying sensation that is ordinary experience, it seems, they easily go into disarray. The optimum condition is that that sensation should be varying, for without that, as other experiments (Evans and Piggins, 1966) have shown, perception can be as disturbed as it is when it is subject to no sensation whatsoever. If, for instance, the eye is artificially fixated upon a single and stabilized image, and given no opportunity to move, vision of the image gradually fades, until it ceases altogether.

What these experiments tend to indicate is that perception tends to malfunction, unless it is constantly supplied with a steady stream of varying stimuli (Laszlo, 1972b, p.366; Zubek, Pushkar, Sansom and Gowing, 1966, p.294). Take the big buzzing confusion away from the reception areas of the body, and operations in those areas, together with allied functions in the brain, soon start to go awry. It is a matter, then, of finding an optimum level between over-stimulation and under-stimulation; for in the former case, as was noted in 2.4, sensory perception is as much impaired as it appears to be when under-stimulated. Babies, for instance, like those who regain their 'sights' after a prolonged period of blindness, tend to 'see' so much that they
end up 'seeing' nothing. To their uneducated eyes, there is so much visual information in the world, that they do not really know where to commence looking in order to make sense of it. It is a 'cataract' of over-stimulation rather than of the eyes which stops them seeing things.

In 3.2 it was argued that the senses, in conjunction with the self-conscious parts of the brain, are able to countervail the effects of being overwhelmed by the weight of information 'coming in' from the world by filtering a great deal of it out of view. There are plenty of processes of 'inhibition' operant that not only ensure that the brain receives the strongest perceptual signals possible, but also that they are the ones the brain is immediately interested in. The existence of these processes means that the vast dross of superfluous visual information received at the retina does not impinge upon the brain, but by-passes it. These inhibitory 'circuits' are helped in their 'work' to reduce experience to more manageable forms, by the tendency of the mind to anticipate and predict what it is it is 'seeing'. What the mind is all the time expecting, it does not have to concern itself with. It can make a computational economy in that area of experience, and instead concentrate on that to which it needs to give its full attention.

'Seeing', then, involves being able to dam up some parts of the 'cataract' of stimuli that are constantly awash over the senses. But from what was said about sensory deprivation, if that damming were to proceed too far, so as to inhibit most of the incoming stimuli, all sorts of malevolent consequences would soon follow. The mind, it seems, can only take so many computational economies before it starts reacting adversely. It is as though perception too has a level of homeostasis, which must be maintained and 'nourished' with appropriate
amounts of stimulus 'energy' if disorder and entropy are not to overtake it. If the senses, then, do not actually die if they are put into confinement, they certainly suffer.

During the periods of gross interaction this does not happen because the senses are likely to be well nourished with sensation. Since it is homeostasis that is at stake, perceptual arousal is likely to be very high and mostly alert to those excitations that promise a source of negentropy. The levels of computational economy will therefore be comparatively few. Sensory 'starvation', and some of the effects thereof, will be unlikely to occur. The maintenance of physiological homeostasis will simultaneously maintain that of perception too. However, not all living systems, as has been noted, are engaged for all of their time in gross interaction. For those organisms which can achieve homeostasis comparatively quickly, gross interaction need not be a permanent preoccupation. When the exigencies of survival are not a 'full-time' job, the organism is likely to have 'time on its hands'. It is during such periods that the organism can participate in activities which are seemingly surplus to its survival (Grey-Walter, 1963). But there is a sense in which those activities are very necessary to the continued alertness and sensitivity of perception.

When a living system is disengaged from gross interaction, its senses are also likely to enter a phase of disengagement. Since the surrounds will tend to lose their significance for homeostasis - that having been achieved - there will be a level of 'switching off' to many of the perturbations that occur in the organism's surrounds. The cataract of stimuli coming in from the surrounds will increasingly be dammed up. The world will be increasingly regarded as a reservoir
of uniform and unvarying stimuli. And that is a situation the brain is prone to react against. For, as has been noted, it tends to react adversely to circumstances of extreme under-stimulation; and it will tend to do anything to overthrow the sensory torpor and instigate a renewal of input stimuli into it.

The general unease felt with boredom, then, is no more than an attempt to compensate for too much computational economy and under-stimulation. It is the mind ailing under the condition of sensory malnutrition. It is a seeking after a renewal of sensory excitation. It is the way in which the mind reacts when it wishes to swim again in a cataract of interesting and vigorous stimuli.

For an organism like man, gross interaction has tended to become largely an activity of his prehistory. It would have preoccupied him for large sections of his time when he was a 'hunter-gatherer', and had no certain way of acquiring food except from the things which grew and ran around him. But for a great percentage of mankind, man's career as 'hunter-gatherer', for the time being at least, is over. Whilst of course man still needs to attain physiological homeostasis, the versions of gross interaction he now engages in to do that are far less time consuming. Moreover, those interactions tend to be of an indirect and substitutive kind. For with the increased distribution of labour and specification of tasks in society, fewer and fewer members of society are directly involved in servicing man's negentropic needs.* These services, as their rendering has become

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* It is perhaps one of the less commendable paradoxes of Western culture that those who service the needs of homeostasis are frequently considered to occupy one of the lowest and least prestigious ranks in a society. Indispensability is not a good qualification in Western society; for the hierarchical arrangements of most societies (both ideal and real) tend to give little
more efficient, have in their turn led to the liberation of more and more sections of mankind from the need to engage in gross interactional types of employment. It is as though, through the great improvements in negentropy production, gross interaction, for increasing sections of mankind, has itself become a matter of computational economy.

Now it has been argued that when the need for gross interaction is displaced, compensatory activities must ensue if perceptual homeostasis is to be regulated, and some of the malign effects of sensory 'starvation' are to be avoided. One of these activities, it has been noted, is play; another, it will be argued, is knowledge. Sometimes play and knowledge can in fact have beneficial impact upon gross interaction, as it does for instance in agriculture and recognition to those members of society who actually produce that energy from the environment which allows the rest of society to survive. This is very evident in the social organization of Plato's 'Republic'. There the division between the doers and the thinkers, the gross and delicate 'interactors', is pronounced, and defensible on the grounds that it was never meant to be otherwise. That there should be some who did all the agricultural and manual work, and others who should rule and reflect on the profound truths of the universe, merely reflected the natural order of things. To go radically against that order and expect the "bronze" and "iron" of society (the doers) to do the work of the "gold", Plato (1973a, Book III, 1) asserted would be the ruination of any stable society. The 'gold' in any society had to be "freed from all forms of manual work", for it was their purpose in life to be served upon, not serve. Besides, reflection on the lowlier and grosser tasks of human kind would lead to a debasement of their capacity to rule and to be philosophical. Therefore they had to be absolved from the need to engage in such tasks. Similar statements are also encountered in St. Augustine of Hippo. Pure philosophical thought, he considered, became tainted whenever it had to meddle in the more practical affairs of life. Thus music and medicine were liberalizing arts whilst they restricted themselves to theory; but directly music was played or medicine was practised these arts became illiberal and debased. But, then, as Howie (1969, p.274) pointed out, Augustine (as he himself acknowledged) was making pronouncements for a society in which all useful, and therefore in the main gross interactional work, was done by slaves.
husbandry, or in the ritualistic hunting preparations undertaken by
the African pygmies. About the latter, it has been said (Storr,
1972, p.140; Read, 1955, p.41) that the inclusion in these
preparations of the 'slaughter' of a mock antelope, drawn in the
sand, amplifies the pygmy's "appreciation of reality". It sharpens
their faculties in areas that are essential to the struggle for
existence. The ritual also offers a kind of laboratory in which to
try out the antelope hunt before it is, so to speak, tested in the
field. It enables a plan of campaign to be rehearsed before it is
actually staged. Therefore it is also a way of conjecturing what
might happen in the scenario of the hunt, when it would be too late
to make any radical alterations to that plan.

Whilst it could be argued that such a ritual, and others like it,
are no more than playful extensions of gross interaction, it is
possible to see in such rituals, and the psychological mechanisms they
are exploiting, the precursors of genuine epistemological behaviour.
That is what makes them of relevance to this discussion. It is
possible, for instance, to see in the pygmy's ritual at least, all the
basic psychological predispositions that are inherent in perceptual
behaviour (see 3.2), only in a more fully developed way. It has been
noted, for instance, how the immediate exigencies of a situation can
accentuate sensitivity to certain things in the path of vision. The
pygmy's ritual does this too. It accentuates the seeing of antelopes.
In doing so, it also permits a set of predispositions to be built up
about antelopes that will enable their behaviour patterns to be more
immediately and efficaciously anticipated. The ritual, as it were,
synthetically adds to the proprietorceptive tendencies that are a feature
of ordinary and natural vision. For, as was noted in 3.2, vision is
something that relies for a great deal of its efficiency on prediction and foresight.

When the preprogrammed operations of vision and instinct are rendered almost redundant by the quick attainment of homeostasis, it would appear that the mind commences developing its own programmes to satisfy the apparent 'greed' perception has for perpetual stimulation. Moreover, it would seem that these programmes exploit many of the same operations that infuse perception in general. What is endowed for the sake of gross interaction, then, becomes that which delicate interaction extends, refines and intensifies. It is as though, once having easily satisfied the imperatives of physiological homeostasis, man must have needs of creating another level of interaction and perception, which also has its own homeostatic requirements. Thus it will be argued in the next section, that in the constructs of delicate interaction the same properties of "making and matching" and sensory amplification, that are the necessary products of non-epistemic and gross interactional seeing, are also evident. Physiological homeostasis, which nurtures a vision full of anticipations and conjectures, also nurtures culture and knowledge, which in their turn have the capacity to infuse vision with anticipation and conjectures. It is as though man, on both the gross and delicate interactional fronts of his existence, is constantly building plans of what it is he is endeavouring to see. In fact it has been argued that man's most natural role is that of a "scientist psychologist", who is ever attempting to predict and control his surrounds (Bannister and Fransella, 1971, p.12; Kelly, 1963, p.4). He does this by creating "templets" which he then "attempts to fit over the realities of which the world is composed". Kelly (1963, p.9; 1970, p.9) calls these
templets "constructs", and he sees it as their function to anticipate events with increasing confidence and efficacy. It is one of the basic themes of life, he says, to improve the capacity of these templets to fit the behaviour of reality. In keeping with Kelly's so called "personal construct theory", there is nothing more natural in man's behaviour than the pursuit of computational economy. But what is also significant is that those templets in effect serve to economise on the amount of data that a man must concentrate upon in order to have a satisfactory rapport with reality. It is in fact quite natural for man to make plans or templets about the future because, not only are they easy to store in the mind, but they can be "projected into an infinite variety of unforeseen situations" (Miller, Galanter and Pribram, 1960, p.292), as for instance the pygmies tend to do in their antelope ritual (vide supra).

In the next section, it will be asserted that the apotheosis of the mental habits discussed in this and section 3.2 are encountered in man's epistemological activities. Knowledge, it will be argued, is the templet par excellence; and of all man's various 'crystal balls', its capacity to look into the future is the most reliable. But above all, it is one of the antidotes to that sensory starvation which would follow if man did nothing with the time he has on his hands after the obligations of gross interaction have been fulfilled. It supplies a new source for the negentropy that his perceptions, like his body in general, must secure if their homeostasis is to be regulated, and the sensory effects of entropy formation are to be avoided. Instead of turning to his surrounds for the fruits of survival, in delicate interaction man tends to turn to them for the fruits of knowledge.
3.4 KNOWLEDGE: ITS INTEGRATIONS AND ITS EXPECTATIONS

Sensation delivers the physiological framework from which knowledge is eventually cast. The beginnings of knowledge are held within the way the world is experienced. There might be a progressive withdrawal from these origins as "logico-mathematical schematizations" are gradually substituted for experience, but experience is still indispensable to the constructs of knowledge (Piaget, 1971b, p.73). The essence of its representational character might be slowly disguised as knowledge becomes more formal and abstract, but in all knowledge, no matter how removed from experience, there must be some vestiges of the world from which it was originally generated (Reichenbach, 1962). Knowledge, then only supplies a way of patterning the phenomena that are initially in ordinary experience; it is only the interpretation and integration, that forms ordinary perception, extended to the nth degree (Hanson, 1971, p.24; Werkmeister, 1968, p.413; Popper and Eccles, 1977, p.431).

It is simply what the mind normally does to manage experience realised to its utmost potential. Given then, that knowledge would appear to be a more highly evolved form of experience, it should be possible to discern the psychological 'signatures' that characterise experience (as discussed in 3.2 and 3.3) in knowledge itself. Finding these signatures will represent the objective of this and the final section of this chapter.

Man's capacity to enter into a transactional rapport with reality rests entirely with his biological endowments, his ontogenetic faculties. That these are necessarily circumscribed (see 3.2), and only have a limited "channel capacity" as far as registering all aspects of reality is concerned, has not prevented man securing a good
deal of autonomy over his surrounds. His appreciation of reality might be physiologically limited, but this has not prohibited man being able to shape, rather than be shaped by, his environment (Taylor, 1972, pp.211-230). By commanding the potential inherent in his innate faculties, man has been able to command the resources of his environment.

The instrumental mastery of the environment, which has evolved through man's invention of tools and technologies designed to harvest and harness the forces of nature and make the process of gross interaction easier, represents for Taylor (1972, p.230) "the crossing of the cerebral rubicon". But before he made that crossing and embarked on the course of cultural evolution, man must have secured some elementary 'knowledge' about his surrounds. For example, the persistent use of a simple tool, like a stone to pound animal flesh, requires some initial insight into the hardness and durability of the stone. Whilst such insights are hardly the epitome of epistemological sophistication, to know that something is hard enough to endure a certain amount of usage does constitute a "valid claim", a "warranted belief", and therefore on two definitions of knowledge, Hamlyn's (1970, p.5) and Werkmeister's (1968, p.3), qualifies as knowledge. Of course those two items of knowledge alone would not have resulted in a tool to pound flesh. That required a supplementary creative act; one that involved connecting the fact that stones are hard and durable with a circumstance in which these characteristics could be exploited. It involved making what Koestler (1964, pp.35-36) has called a "bisociative" connection between stone and animal flesh on the one hand, and recognising the fact that a stone's durability and hardness has the potential to pound flesh on the other. Establishing that conjunction
represents an example of "seeing things together".

It is sometimes remarked that the capacity to make such conjunctions and form unions between otherwise disparate aspects of the world is a marked feature of the self-conscious part of the brain (Krathwhol, 1958, p.43; Reid, 1961, p.14; Popper and Eccles, 1977, p.373). Bisociation begins with conscious experience, which, it was noted in 3.2, is largely a complex fused from the multiplicity of sensations received from the reception areas of the body. It then moves on to cement other fusions from the material of experience, and it is these that give birth to things like tools and knowledge.

Two points begin to emerge from the discussion thus far. Firstly, it is perhaps possible to regard knowledge, as Piaget (1972, p.157) does, as simply a rather specialised form of biological adaptation. It helps to secure for man adaptations to his surrounds which Nature, had She the time, might have eventually achieved, but which man, with his great ingenuity and capacity for invention, has accelerated. But Piaget's view of knowledge is arguably limited in that it only really accounts for those sorts of knowledge that have consequence for man's adaptation to the environment. It does not really account for those less instrumentally biased sorts of knowledge, whose import finally has little impact on man's capacity to expedite gross interaction. But knowledge, of whatever variety, is the result of biological adaptation, that cannot be denied. Unless man possessed the appropriate abilities to make epistemological sense of his interaction with the environment, then no amount of interaction, no matter how rich and discriminatory, would deliver knowledge from it. Knowledge is not synonymous with experience.

In many respects, knowledge is simply experience made more coherent
The search for a greater unity than that which inhabits perception, then, is ultimately the midwife to knowledge. This view of the origin of knowledge is quite consistent with the general behaviour of the self-conscious parts of the brain. It has been argued, for instance, how the mind, in order to make visual sense of its surrounds, is constantly trying to introduce a measure of unity and order into the plethora of data to which the sensory receptors are potentially open. This is not only desirable, but essential. For the mind only possesses a very limited handling capacity for information; and if it is to enjoy a reasonable rapport with reality, it must sanction a great deal of that to which it is potentially sensitive. One way of carrying out this sanction is to order experience and perception around basic schema or gestalts. This is what the ancients did when they looked up to the heavens and saw configurations of animals and gods (the signs of the Zodiac) in certain constellations of stars (Kohler, 1947, p.82).

The senses, then, initially encounter a jig-saw of a myriad of pieces, in which it is scarcely possible to trace any form or interconnection; it is a universe without any signs of the Zodiac in it. But as the mind scans the jig-saw puzzle that the senses invite in for inspection, the mind begins to discern order and connection in it. From such it is able to piece together the commoner units of reality. These units constitute the gestalts upon which many of the preconceptions and anticipations of vision are finally based. The gestalts, then, supply a way of distilling reality to a degree where it can be imbibed without swamping the mind with an excess of information. Knowledge, it will be argued in the remainder of this section, is simply one more refinement of that distillate.
Epistemological activity is an extension of that 'gestalting' process which the mind generally uses to cope with its experience of reality. But how far does knowledge extend the processes of ordinary perception, and what is involved in carrying out that extension? It has been said that the unification of experience, with which the mind seems permanently preoccupied, culminates in the output of knowledge. So is knowledge no more than a more holistic variety of experience? Oakeshott (1966, p.32) has suggested that it is. He has asserted that it is the degree of unity inherent in knowledge which finally differentiates it from the more common and mundane unifications of ordinary experience and perception. It is a second integration of the first integration of experience. But whilst knowledge might pirate a greater unity from experience, the vestiges of a recognisable experience, as has been noted (vide supra), tend to get relegated from knowledge. Knowledge starts off as experience, but during the interregnum between it being that and becoming knowledge, the picture of experience is gradually erased. The greater unity of knowledge is achieved, then, at the expense of the representational character of experience. Knowledge might, as was asserted in 2.7, modify the way the world is regarded, but the manner of that regarding tends initially to be through "conceptual" rather than "perceptual" gestalts (Hanson, 1971, p.29). Knowledge, then, is an abstract rather than a naturalistic icon of reality. Its unities will be 'reasoned', not 'seen', to exist.

If knowledge is an extension of certain sorts of mental behaviour, then it should exhibit, if only analogously, many of the same properties of structuration that the mind applies in its other 'contacts' with reality. However, it needs to be stated, as was noted in 2.3, that
knowledge in its most public form does its best to repress any psychological traits that the mind might impress upon it; and it is for this reason that it might be possible to distinguish a structure in knowledge that reflects (a) the idiosyncrasies of the mind and (b) the logic that tends to remove the idiosyncrasies of the mind.

But first, does knowledge display any of the features which are associated with the characteristics of perceptual gestalts and which are a marked property of the mind's workings? It has, after all, only been asserted, not demonstrated, that knowledge unifies experience.

It has been claimed that one of the qualities of perceptual gestalts is that they serve to give instantaneous form to a disparate collection of incoming stimuli.* They are the wholes, which in Piaget's words, "have a quantitative value different from the sum of the parts" (1971b, pp.56-57). It is the formation of gestalts, then, which leads to an integrated perception of the world; it is they which hold the key to seeing things together.

Associated with this power to structure and integrate experience that gestalts exhibit, there are accompanying qualitative features. Since the gestalt is in the business of reducing experience to simpler and more manageable proportions, it would be expected that one of its characteristic features would be the exhibition of simplicity and

* Whilst the stimuli that gestalt psychologists are usually thought to have in mind when they talk about the properties of perceptual structuration are visual, it has been pointed out that many of the same properties are observable in the perception of aural stimuli. It has been suggested, for instance, that the diatonic scale is no more than a kind of gestalt 'picture' in sound (Kohler, 1947, p.81). Again Rubin's "figure/ground" distinction, which is regularly applied to visual stimuli, also has an equivalent in sound. It has been argued that the "dead interval" between two melodies supplies the ground which allows the melodies to stand out and be perceived (Kohler, 1947, p.111).
The gestalt is often characterised as displaying regularity, symmetry, simplicity and generally good aesthetic form (Piaget, 1971b, pp.56-57; Laszlo, 1972b, p.380). It generally makes a pleasing arrangement of the various parts of reality it serves to unify; for it packs the parts of reality into forms that are rounded and complete, that display a good deal of closure or pregnanz. Gestalts that do not do this, that are rugged, unfinished and lack much aesthetic appeal, do not appeal to the mind. Thus it is possible to measure on an encephalograph the heightened state of nervous tension that accompanies the perception of an incoherent shape which lacks much pregnanz (Laszlo, 1972b, pp.376-378; Berlyne, 1971, p.129). Perceptual complexity and disorder, which defies ready reduction to a gestalt, raises arousal level and causes displeasure. Moreover, it is the sort of nagging displeasure that does not finally vanish until a gestalt that can cope with the complexity and disorder is arrived upon, whereupon a feeling of pleasure and satisfaction is forthcoming.

The gestalt, then, achieves a maximum of generalization with a minimum of omission; and provides a degree of pleasure, at its realisation, where otherwise there would only be agitation. That knowledge might have similar powers in it is not such an original proposition. It has been around at least since Kant. His description of knowledge, whilst of course it does not use the same vocabulary and theory as gestalt psychology, contains sentiments within it that sound remarkably gestalt-like in their tenor. He suggests, for example, that the sciences are forms of knowledge that possess a "systematic unity" about them. Each science houses inside it an "architectonic" that has the power to bring about their unity. It can make a union between parts of knowledge that would otherwise
remain a "disconnected and rhapsodic state" (Kant, 1969, p.471). The "architectonic", then, has the power to infuse unity into a given complexity and disorder, and in this respect has analogous powers to those of a gestalt.

Hanson's view of knowledge is also one which centres on the notion that it is knowledge which is ultimately able to give greatest coherency to experience. It is knowledge, then, that gives a "conceptual pattern recognition" to the "dots" of reality the senses collect for the sake of giving man experience. Boyle's law began with those "dots"; it was then turned into a compilation of facts and figures about the pressure, volume and temperature of a gas. But whilst those facts and figures had some sort of correlation with the "dots" of reality, they really explained nothing (Hanson, 1971, p.8). They were observations in search of an "architectonic" to connect them. There was discreteness in them, but no holism. That was provided of course when it was discovered that the pressure of a fixed mass of an 'ideal' gas at constant temperature is inversely proportional to its volume. Then all the facts and figures jumped into place as do the head and shoulders of a man in Figure 3.1 below. And what remained a pile of discrete and unrelated facts, before Boyle's law was infused into them, became afterwards a pattern of order or a certain scientific explanation.

Figure 3.1
The Hidden Man (Hanson, 1969b, p.14)
If the advancement of knowledge represents the pursuit of new theories, then that pursuit is realised in the glimpse of previously unseen gestalts (Greene, 1961, p.193). That was assuredly what happened when Kekulé discovered the cyclical structure of benzene. His often-reported day dream of a ring of snakes chasing each other's tails might not have much of the benzene in it, but for Kekulé it represented a metaphor of the gestalt that could explain how it was that atoms of carbon and hydrogen were arranged in a molecule of benzene.

Nor is the glimpsing of new gestalts entirely restricted to the physical sciences. For if the gestalt is the vehicle of generalization, the means by which the disjecta membra of experience become fused, then history, which is a discipline that stands or falls on its generalization, is full of gestalts. Indeed, if history did not attempt to synthesize the scattered remnants of the past, then it would simply remain a compilation of facts (Cassirer, 1973, p.177; Carr, 1974, p.64). History, then, looks for unity in the unique, and its practitioners are "chronic generalizers", who are constantly seeking out the 'head and shoulders' in the immense mosaic of the past.

History, unlike science, tends to deal with unique events. It deals with a world of limitless, not "limited variety"; it generalises essentially about non-recurrent events. This distinguishes it from science whose dominion tends to eschew the unique in favour of that which has a consistency and regularity about its behaviour. Science, then, tries to isolate from experience certain recurrent patterns and order, that, should certain antecedent conditions be known, can be predicted to occur again (Braithwaite, 1969, p.1; Hempel, 1966, p.75). Science, then, is an empirical form of 'crystal gazing', which appeals
to that aspect of man's behaviour (see 3.4) which tries to predict and anticipate the nature of his surrounds. It is a way of building those "templets", those "constructs", which man is attempting to overlay on the behaviour of (physical) reality. Boyle's law represents one such construct; another is the Theory of Relativity, and it is of note that Einstein considered that if the theory did not fit over reality and anticipate satisfactorily some aspects of its behaviour, he was willing to concede that, as a templet, the relativity theory was untenable. As it turned out, the theory did live up to Einstein's expectations. Observation did confirm that there was a "red-shift of spectral lines" due to "gravitational potential" to an amount predicted by the Theory of Relativity (Popper, 1976, p.38).

In 3.2, it was noted that perception contains as much foresight as actual sighting. This would seem to be equally true of epistemological behaviour. The conceptual gestalts that characterise this behaviour are as much to do with the future behaviour of reality as they are with the present. They provide a way of seeing how things might look if certain courses of action are taken. Thus knowledge serves to add still more to the repertoire of anticipation with which the mind, from the act of perception onwards, is constantly trying to charge itself. If man's behaviour, then, is largely future oriented, then the tendency to form conceptual gestalts of reality exaggerates that orientation still further. They are just one more way of achieving further computational economies. They are yet another way of prophesying experience, so that man can gain more profit from experience.

Like perceptual gestalts, then, knowledge would appear to have the capacity to reduce the components of experience to more manageable forms. This reduction reaches its high point in the scientific law, which not
only represents the distillation of reality to its most refined degree, but also exhibits the most reliability as far as anticipating the behaviour of reality is concerned.

In the light of these affinities between the gestalts both of knowledge and of ordinary perception, it is worth asking whether the former do not only have the capacity to structure experience, but, like perceptual gestalts, do so in an equivalently elegant way? Are the gestalts of knowledge similarly prone to simplicity, regularity and generally good aesthetic form? Certainly, as far as the conventionalists like Poincaré, Duham, Eddington (Popper, 1974, pp.78-79) and Mach (Polanyi, 1962, p.166) were concerned, knowledge, particularly scientific knowledge, was charged with elegance and simplicity. Indeed, when it was a matter of deciding which of two competing scientific theories, both of which adequately explained some aspect of reality, was the more veristic, the conventionalists suggested that it was attributes like the elegance and simplicity of the theories that finally decided the matter. The theory which had a sense of incoherency about it, and did not exhibit much \textit{pregnanz}, was often put to one side in favour of a theory which displayed all the qualities of \textit{bonne forme} and good gestalt.

In this connection, the notion that scientific theories can have an "intellectual beauty" to them (Polanyi, 1962, p.133), might have some psychological foundation to it. If the mind rebels against incoherency and the discursive, rambling form, and then infers that that might not be nature's style either, it would seem probable that there is a strong aesthetic component in knowing. Certainly, some scientists have felt this to be a component of their activities. Dirac (1963, pp.45-47) has recorded how Schroedinger, for one, arrived
at the wave equation for quantum mechanics, not empirically like Heisenberg, but through a "beautiful generalization of De Broglie's ideas". Schroedinger invested much more epistemological verity in a beautiful arrangement of mathematical equations than he did in a theory conceptualised empirically via spectroscopy. Aesthetic considerations took priority over those of observation. He had more faith in his ability to evaluate a theory's aesthetic aptness than he did its empirical aptness.

Summary. This section has attempted to demonstrate that epistemological activity, like perception, is an attempt to reduce the world to more manageable proportions. Indeed, it has been shown that many of the mechanisms that guide perception's reduction of experience continue to operate in knowledge. There is a certain amount of justification, then, in asserting that knowledge is an extension of experience and perception. In many respects knowledge is the most laconic way man has of expressing these two things. But it would be a mistake to think that the process is entirely one way, and that knowledge does nothing more than attenuate experience. If it did, Chapter Two could not have been written! For there it was argued that knowledge opens our eyes to experience, it does not cut it down, as has tended to be argued in this chapter. Before the discussion of the grass roots origins of knowledge can be finalised, some way of circumventing this apparent contradiction must be obtained.

3.5 FROM EXPERIENCE TO KNOWLEDGE AND BACK AGAIN

It was argued in 3.3 that, when the need for gross interaction fades, a perceptual vacuum tends to develop. The mind tends to feel very uncomfortable with such a vacuum, so it indulges in all sorts of compensatory activities that will fill that vacuum and prevent the
perceptual system degenerating into entropy. One of these activities, it has been noted, is knowledge. And it was shown in 3.4 that as an activity knowledge, just like perception, engages in a rigorous campaign to unify as much experience as possible. It seems that reduction and integration come quite naturally to the mind. An efficient rapport with reality depends upon it. Thus it has often been asserted in this chapter that knowledge constitutes just one extra integration of perception. It takes the reduction of experience, inherent in perception, just one step further. Knowledge, then is a conceptual metamorphosis of perception. But although knowledge might end up as all concept and no percept, it still nevertheless, as was demonstrated in Chapter Two, has a profound influence on the way things are seen. For knowledge is one of the richest sources of "theories" that finish up contaminating vision. So how is it, when knowledge is often several times removed from the sensible world, that it can re-introduce itself into our vision of things?

In 3.2, it was noted that one of the more necessary functions of perceptual behaviour is that of "excitation" and "inhibition". The gestalt is only a final product of a perceptual system that is constantly trying to extrude from vision all that is unnecessary to it. Perception, in effect, tries to function on a minimum of stimulus cues. It has to, unless it is to be overwhelmed by the welter of visual information for which our senses serve as gatekeepers. Thus it was suggested in 3.2 that the synaptic relay stations from the senses to the brain are "switching off" more sensations than are ever "read out" at the self-conscious parts of the brain. It is not only natural for perception to integrate, but to censor and abridge as well.

But on what bases is that abridgment carried out? In 3.2 it was
argued that it is largely immediate interests and the exigencies of circumstance that finally determine which stimulus signals are read out at the brain, and which are not. In the first instance, these immediate interests are likely to be mainly connected with survival and the requirements of homeostasis. But once those interests have been served, others are likely to take their place and determine what gets switched off and on during perception. When those interests are, in the main, epistemological is it likely that they too have control over the switchboard that is perception? Is it possible that knowledge can in some way encourage certain 'calls' from the world to be relayed to the brain, whilst preventing others? If this is so, then, the "excitatory signals" that are transmitted to the brain will be likely to have epistemological significance, whilst those which do not, will be inhibited.

However, such an epistemological sensitivity to the world - is not born ab ovo. As was argued in 2.4 in order for the layman to see the world in exactly the same way as a physicist he must undergo some preliminary training in physics. Without that he will remain insensitive and blind to much of what the physicist sees. Epistemological sensitivity, then, is a product of educated looking. Unless an appropriate background is present, the mode of looking which accumulates from a long period of disciplinary experiences will be absent. It is perhaps within the power of knowledge, then, to turn the eye to the world in a particular way; it can perhaps render the mind sensitive to particular excitations coming from the world, whilst inhibiting others. But can this power of knowledge be demonstrated?

This proposed effect of knowledge is in fact somewhat analogous to that underpinning the response to those 'ambiguous figures' which
gestalt psychologists use to illustrate the fact that the world can be perceived in a variety of ways. The seemingly same stimulus can give rise to different perceptual responses. Take, for instance, Figures 3.2 and 3.3 below:

Figure 3.2
(Popper and Eccles, 1977, p.65)
The American Indian/Eskimo

Figure 3.3
(Petrie, 1976, p.38)
Duck/Rabbit

Figure 3.2 shows ambiguously the profile of an American Indian and the back view of an Eskimo: at least, that is Popper's (Popper and Eccles, 1977, p.65) perception of it; whilst Figure 3.3 can equally be seen as a rabbit or a duck. However, neither image is seen simultaneously; always one is suppressed in favour of the other. Indeed, sometimes it is quite difficult to see the second image. But why is it that one image tends to be seen first or remains dominant over the other? What leads to the American Indian being seen first, rather than the Eskimo, or vice versa?
Of course it is possible that both Figures could remain to their observers simply an abstract melange of shapes, having no perceptual significance whatsoever. Supposing the observer had had no previous experiences of rabbits or ducks, and therefore had had no opportunity to develop a stereo-typic schema of their form. Would he see Figure 3.3 as anything at all? Presumably not. Significance would be altogether inhibited from the Figure. Again it is possible that an observer who had had plenty of American Indian 'experiences', and none of Eskimoes, would only ever see an American Indian in Figure 3.2. His considerable familiarity with Indians would serve to strengthen excitations indicating an Indian in the Figure, whilst it would suppress any significance in the rest of the Figure. But even if the physiognomy of the Indian is seen, need it be necessarily seen as an Indian? Not always. The author's own first response to the Figure was that it showed one of those monumental heads found on Easter Island. The Indian's headdress was only seen after Popper's caption to Figure 3.3 had been read! Presumably, perhaps because the author has recently reread Thor Hyerdhal's Kon-Tiki expedition, the images of Easter Island were much more in the foreground of his thinking than were American Indians. Had he seen a 'Western' the night before, things might have been different.

What this tends to show is that the observer brings a series of prior dispositions to the world, and these influence the way the world is finally perceived and appreciated. What knowledge does is simply add another dimension to these dispositions. It can excite our perceptual sensitivity to new aspects of the world, whilst inhibiting the appreciation of others.* It leads to certain images dominating

* This can have its disadvantages. Petrie (1976), who holds a similar
our appreciation of things, and others being submerged. Thus, as was noted in 2.4, Nansen saw epistemological significance in the same driftwood that Eskimos used as fuel, and his accompanying sailors were indifferent to this significance. It was a matter, as it were, of Nansen seeing a 'duck' in the driftwood, the Eskimo seeing a 'rabbit', and the sailors apparently seeing nothing of epistemological value at all. With the exception of Anderson, the same sort of situation prevailed amongst physicists before the positive electron was discovered (see 2.5). Most of the community of experimental physicists saw no epistemological significance in certain tracks on Cloud-Chamber photographs. It took Anderson to revise the picture, and show that where others had only seen pieces of dirt, there was in fact a positive electron. Anderson, then, saw the Eskimo lurking behind the American Indian. He was able to overcome the epistemological 'theory' that had inhibited seeing the dirt as a 'positive electron'. He was able to turn a normally inhibited signal into an epistemological excitation. In doing so, he changed the view of the atom.

The way an educated man apprehends reality, then, is as much centred in knowledge as it is in experience. The one augments the other. Our sensitivity to the world is never an entirely separate process; it is always accompanied by knowledge. Interpretation constantly informs our vision of the world, and that interpretation is in the main generated from our epistemological background.

view of knowledge to the one developed here, has argued, for instance, that because different disciplines tend to foster rather different "cognitive maps", the possibilities of interdisciplinary communication are limited. Unless communicants can learn to see each other's "observational categories", members of different disciplines will tend to have incompatible viewpoints on the same problem. And that would be anathema to the principles of "multidisciplinary effort".
But there is nothing absolute about that background. It is open to suggestions from experience, just as experience is open to those of knowledge. Indeed, as will be shown in Chapter Four, there is a good deal of reciprocity between these two elements of consciousness. Thus, just as knowledge serves to modify experience, so experience can serve to modify knowledge and our understanding of the world. There is, then, a constant 'to and fro' between the world of experience and the world of knowledge. Indeed, it will be argued in Chapter Four that this to and fro between knowledge and experience is the very life-blood of epistemological activity.
"Man is eager after knowledge, and the love of legend is but the prelude to it."

(Strabo)

"All nature is but art, unknown to thee; All chance, direction which thou canst not see; All discord, harmony not understood."

(Alexander Pope, Essays on Criticism)
4.1 KNOWLEDGE: A TRIANGULAR RELATIONSHIP

To suppose that the strands of the knowledge process can be separated is to misapprehend the nature of knowledge. For there is a marked degree of reciprocity between those strands that makes a mockery of any attempt to separate them, as if they were independent of one another. Any description of knowledge that does not accommodate this reciprocity, or does not acknowledge that epistemological activity is a marriage between reality, experience and knowledge itself, therefore will only represent a partial description of knowledge. What, however, is singularly true about the process is that that reciprocity is managed by "human intervention" and human intervention alone (Popper and Eccles, 1977, p.46). A human presence is the *sine qua non* of the knowledge process. The true epistemological 'celebrant' of the marriage between experience and reality, from which knowledge eventually springs, is the mind. For whilst it is possible to identify independent objectifications of knowledge in the content of books and journals, and to some extent observe empirical exemplifications of those contents in the behaviour of reality, without a mind to formulate and place a construction upon those contents, they would either not exist at all, or if they did, they would remain permanently inert and passive. The mind is the active agent in the knowledge process.

Within the internal confines of something called 'mind', however, it does seem possible, if only for clarification's sake, to distinguish separate strands - two to be precise - of the epistemological enterprise. From the point of view of the mind, for instance, there is an 'out there', beyond the corporeal limits of the body, that can
be usefully denoted as reality; and a similar, but separate 'out there', which has uncovered order in and explained aspects of reality, and which is generally called 'knowledge'. The interface between these two cardinal elements of the epistemological enterprise lies somewhere in the mind. But from what was asserted about knowledge and its impact upon the perception of reality, in Chapters Two and Three, as an 'interface', the boundary between knowledge and reality is exceedingly permeable; for it permits through it insights from reality and knowledge that mutually serve to modify one another. The traffic between reality and knowledge is two way; so that knowledge is not only an extension of experience, it can also serve to enlarge and extend the experience of reality. If experience represents an initial 'dialogue' with reality, then the vocabulary of that dialogue is eventually augmented with a lexicon that knowledge is able to supply.

The transaction, then, that occurs between reality and knowledge, in, so to speak, the 'market place' of the mind, is one of mutual support. Reality adds to the 'revenue' of knowledge, and knowledge in return adds new insights and levels of awareness to the experience of reality. However, it is always the mind which is instrumental in carrying out such transactions. To participate therefore in epistemological activity is to participate in a triangular relationship which has as its 'apex' the mind, and as its two vertices, reality and knowledge.

Whilst such a threefold description of the epistemological enterprise is not particularly novel,* the model of it to be developed in this and subsequent chapters, will show that not only can a threefold

* For instance, Mead (1934, pp.75-76) and Cohen (1944, p.28) both conceived models of epistemological meaning that indicate that
description of that enterprise describe — as no other descriptions have
done — the properties of knowledge in general, but also how it is:

(i) that knowledge is acquired and created,

(ii) that there are different varieties of knowledge in the
epistemological spectrum, and

(iii) that different members of disciplinary communities acquire
rather different epistemological responsibilities towards
knowledge.

But before showing how it is a 'triadic' model of knowledge can
accommodate these aspects of the phenomenon of knowledge, that model
first has to be developed and presented. Its development will be
embarked upon by first giving a more comprehensive description of the
three components involved in all forms of epistemological behaviour,
namely mind, reality and knowledge, or, as they will be called here,
respectively, the cogniser, the cognised and the cognition.

4.2 THE COGNISED (C_d)

That reality which comprises the universe of physical entities
will be called the 'cognised' (C_d). It constitutes the external world,
the 'out there' beyond the limits of the mind, the world of "rocks and
trees and physical fields of forces". It comprises all that is matter
and energy in the cosmos (Popper, 1973b, p.20; Popper and Eccles,
1977, pp.36, 359). But more than just the material constituents of

such meaning resides somewhere between a stimulus, the thing to which
the stimulus refers and the individuals for whom the stimulus has the
potential to have meaning. This is not so very different from
Einstein's "three-fold distinction between an external world, the
observer's perception of that external world, and our notions of it"
(Margenau, 1951, p.249). But of all the broadly "interactionist"
epistemological models that prefigure the one to be developed in this
study, those of Laszlo (1969, p.46; 1972b, p.387) and Eccles (Popper
and Eccles, 1977, p.359) — itself an extension of Popper's — show
greatest similarity to it.
the natural and man-made world, the cognised can also, when it becomes the subject of epistemological reflection, embrace the world of man and his inner psychological states. The cognised, then, consists of all those inner and outer 'environments' from which all knowledge is cast, and to which knowledge is ultimately always addressed. In short, the cognised consists of everything about which it is possible to have knowledge. But within that 'everything', it is also possible to discern three dominant classes of cognised. For as Laszlo (1972a, pp.30-33) and Eccles (Popper and Eccles, 1977, p.359) have pointed out, there are three major universes of physical entities:

(i) there is that universe in the cognised which consists exclusively of inorganic and non-living matter, and which after Laszlo, will be henceforward designated the "sub-organic" cognised ($C^1$). It comprises the whole of that material universe which is neither organic nor living, or a cultural product of man;

(ii) secondly, there is that universe exclusively populated by the world of 'living things'. It is the world of biological species and of their biochemistry and anatomies; it is the world of things organic rather than inorganic. It will therefore be referred to, again after Laszlo, as the "organic" cognised, ($C^2$);

(iii) lastly, there is that universe which can be approximately designated as comprising all that which man creates out of his own 'mentality'. In its domain fall all those artifacts, like works of art, tools, books, machines, which are the physical exemplifications of man's creativity. Included in this domain are also
the less tangible manifestations of that creativity, like society. Everything in fact that is essentially a cultural progeny of man belongs to this last domain of the physical universe, the "supra-organic" cognised $(C_{d3})$. If the "sub-organic", "organic" and "supra-organic" represent the basic genera of the cognised, then it is possible to make further differentiations in these genera by considering the spatio-temporal features that generally mark the physical entities of the universe. Some of these entities, for instance, will constantly recur both in time and space. There will be no end to the ubiquity and regularity of their behaviour. Many of the entities that inhabit the sub-organic cognised $(C_{d1})$ are like this: that is what makes them potentially 'law abiding'. But not all of the universe is disposed to being so regular or ubiquitous. Other elements of it display obverse qualities altogether. Not only do they display non-recurrence, but that non-recurrence is limited to particular regions and localities of the cognised. Historical events are good examples, for they have a capacity for infinite variance whether they are looked at from the point of view of time or place.

It is also possible to differentiate the genera of the cognised in terms of their duration. Some of the cognised, for instance, will vanish in a micro-interval of time. They will exhibit almost imperceptible ephemerality; their existence will be over in an infinitesimal amount of time. On the other hand, there are events in the cognised which only take place over millenia. The evolution of animals is an example. The chronological plane it occupies is extensive, not limited. It is an event of history, but one in which
pattern is observable.

The existence of most forms of knowledge, in fact, is contingent upon the cognised not being infinitely variable (Werkmeister, 1968, p.104). If it were, then dirt-effects on Cloud Chamber photographs - to take a specific example - would be simply dirt-effects, and nothing more. The epistemological enterprise would be permanently stifled with the perception of a rife and impenetrable disorder. It would prove impossible to perceive any 'hidden men' (see 3.4) in the cognised. But this is not the case. For the cognised does, in all three of its possible domains, in some measure at least, exhibit a "limited variety" of behaviour patterns. The cognised is not always totally non-recurrent, nor is ubiquity a quality that is totally alien to it. Therefore it becomes possible to discern order and pattern in the cognised, and make predictions about its possible behaviour. However it always needs some agent of consciousness to do that ordering and make those predictions; and that agent occupies the second vertex of the triangular relationship that is knowledge.

4.3 THE COGNISER (C_r)

The agent of consciousness, who attempts to apprehend order in the cognised, will be called the cogniser (C_r). He is the knower in the epistemological drama, and as such is its principal and most indispensable protagonist. His is the role of a Socrates, not so much in a dialogue with his fellow philosophers, as in a soliloquy with his surrounds. It is he, then, who is ultimately 'midwife' to the truths that lie secreted in the 'womb' of the cognised. If the cognised is, so to speak, 'pregnant' with epistemological meaning, then it is the cogniser who 'delivers' the meaning from the cognised. Nansen carried
out such a 'Socratic' delivery when he saw epistemological significance in a piece of coastal driftwood; so too did Leverrier when he recognised that the perturbation of Uranus could only be due to the existence of another planet. But without a Nansen, a Leverrier to act as the 'midwife' to that knowledge, it would have remained 'unborn'.

Upon the cogniser, as was noted in 4.1, the existence of all epistemological activity depends. If he fades from the picture of knowledge, so too does the significance of knowledge itself. Whilst it is possible that the physical objectifications of knowledge, i.e. books and journals, could go on existing in the absence of man, their contents would remain, as it were, in 'suspended animation' until resuscitated by a cogniser. Knowledge might, as Popper (1973a, p.154) has tended to argue, because it retains the possibility of being actualised, have separate ontological status, but that status is only realised if there are cognisers around to actualise it. The ontology of knowledge only comes to mean something when the ontology of a cogniser is brought to bear upon it. Moreover, the ontology that is required to resurrect knowledge, whether that knowledge be from books or reality, is of a specific kind, with attributes all its own.

The ontology of the cogniser approximates to what Popper (1973b, p.20) has called "World Two". It is pervaded with a sense of consciousness and a variety of psychological states; it is commensurate with the way reality is perceived and experienced. But whilst these things underpin ontology, and are in some measure antecedent to knowledge, they are not, as was noted in 3.1, in themselves commensurate with knowledge. For knowledge is synonymous with a higher and more extensive integration than that which either experience or perception has the capacity to carry out. Not that the capacity to form more
synthesized unions of the cognised is wholly alien to the general workings of the mind. The need to abridge the narrative of sensation and generally make experience more manageable is a constant preoccupation of the mind. And it is this preoccupation that forms, as was noted in Chapter Three, the backcloth from which knowledge eventually emerges. For it was argued in that Chapter, that knowledge is just one more variation on what is a perennial theme of life; to construct the means of integrating and predicting reality still further.

The cogniser, then, is an 'alembic' to the cognised. Through him, the components of the cognised are progressively distilled. The apotheosis of that distillation is knowledge. It represents a précis of the dialogue the cogniser has with the cognised. It is experience reduced to its very quintessence, to its least common denominator. In order to reduce the constant burden of experience, the cogniser has need to minimise the proportions of the cognised. One of the outcomes of that minimization is knowledge, the third vertex of the epistemological triangle.

4.4 THE COGNITION (C_n)

Man, according to Popper (1973a, p.154; 1973b, p.20; 1976, p.181), in living in the one world, in fact ends up by living in three! There is first the world of physical states. That world has been called here the cognised. Secondly, there is the world of consciousness and mental states. Via that consciousness, a cogniser is able to experience the cognised. World Two, then, is the portal to the things of World One. Through its 'doors' passes the 'material' from which man eventually fashions the substance of his Third World. For that world consists of
the products of the human mind (Popper and Eccles, 1977, p.16). It is a new objective world formed from the psychological states that are peculiar to man; it represents an external realization of some of the subjective experiences of men. In World Three, then, are found not only language, tools, social institutions, customs, works of art, but also man's "theoretical systems ... critical arguments": anything that in fact is found in "the contents of journals, books and libraries" (Popper, 1973a, p.106; 1976, p.187).* World Three represents the material embodiment of man's creativity and his capacity to find order and pattern in his World Two experiences of the cognised; World Three represents the memory bank of his culture, and it contains his 'recollections' of his attempts to make sense of and control the cognised. A substantial part of that 'bank' is filled with knowledge, or what will be called here, 'cognition' ($C_n$).

Knowledge, it was argued in Chapter Three, arises as a defense against the twin psychological enemies of the mind: boredom and sensory overcharge. The mind is able to win the battle against 'overcharge' by a process of stimulus reduction. It removes from the centres of its attention all those stimuli that are irrelevant or redundant to the attainment of states such as homeostasis. But that reduction can sometimes go too far and leave the mind perceptually

* Lest it be assumed that the artifacts of the supra-organic cognised (see 4.2) and those of World Three are in any way synonymous or equivalent, it needs to be stated that consideration of physical status is the sole criterion for determining which class of the cognised an artifact belongs to. The physical status of artifacts, however, is quite irrelevant to determining whether they belong to 'World Three' or not. Rather it is their capacity to cause action, thought, ideas, communication that determines their membership there or not. Thus a book remains an object of the supra-organic cognised until it is read and its ideas are assimilated. At that stage it graduates to World Three status. In the same way works of art retain their membership of the supra-organic cognised until they are
bored; and that can be as potentially harmful as an overcharge of sensations. The mind wins its battle against boredom by seeking out new stimuli that will keep the perceptions alert and in 'good working order'. One means of capturing new stimuli, it was noted in 3.5, is to engage in epistemological activities. For one of the influences that has been attributed to knowledge is its power to render the perceptions sensitive to aspects of the world not normally in the foreground of vision. Knowledge, then, helps to widen the vista to which consciousness is open. But it does more than just broaden vision. There are other aspects to knowledge apart from its power to supply the senses with nourishment when they are in danger of 'starvation'. That is only its psychological function, not its epistemological function.

Knowledge has the potential to heighten sensitivity to the world. The assertions knowledge makes essentially concern themselves with the nature of the cognised. And whilst those assertions are often conditional and subject to publicly agreed criteria, what knowledge does with the framework of those criteria is try to uncover order in the flux of natural phenomena. It tries to strip the veil of mystery that clothes reality and prevents man seeing directly its innermost secrets; it attempts to seek out the true metaphysical blue-print of

looked at, whereupon they become part of World Three. It can be said, then, that the artifacts of the supra-organic cognised have a rather ambiguous status. They are physical entities all right, but they are ones whose physicality harbours the capacity to evoke ideas, actions, theories and so on. But the only arena in which the supra-organic contents of World Three have the capacity to carry out that evocation is in the World Two of a cogniser's consciousness. It should be further stated, then, that Worlds One and Three only come to have epistemological significance when they are a focus of World Two interest. In this respect, the outside world, of whatever variety, is potentially reducible to World Two.
the universe (Getzels and Csikszentmihalyi, 1976, p.139; Duhem, 1954, p.7; Agassi, 1975, p.37; Horton, 1974, pp.133-134). Whether that 'blue-print' eventually comes to be 'peopled' with elementary particles or gods, it still amounts to the same thing: an attempt to find the most likely ghost that haunts the mechanisms of reality. That represents the goal, the 'holy grail' of all knowledge, whether it be mythical, religious or scientific. It is not so much the underlying objective of knowledge which alters between the different forms of knowledge, but rather the criteria that determine whether the 'ghosts' in reality they respectively exorcise are spurious or not; it is those criteria which are subject to modification and which cause the epistemological differences between mythical, religious and scientific knowledge. But before examining those differences in more detail and the divisions which exist in the spectrum of knowledge, it is useful to discover whether a knowledge that attempts to angle order and explanation in the cognised is more properly a science than an art, and if it is so, why?

4.5 COGNITION: ART OR SCIENCE?

As classifications of the substantive content of knowledge, the arts and sciences are often seen as being the absolute antithesis of one another. Their methodologies and objectives are also often held to be dissimilar and irreconcilable. It is as though art makes a cult of subjectivity and unrestrained private expression; and science attempts to check fancy and imagination by reason and empirical demonstration. Equally, art is often seen as science with value and ethical dimensions added to it; science, with them taken out of it. Yet these ways of
distinguishing the arts from the sciences are comparatively recent in origin. They did not prevail, for instance, in the middle ages. Then a rather different, but nonetheless still apposite distinction was used to differentiate an art from a science.

The notion that an art, like any other form of knowledge, could in its own way obtain legitimate 'blue prints' of the universe, would have been foreign to the age of the 'Seven Liberal Arts'. For whilst it was true that the 'quadrivium' was intended to help students penetrate the natural order of things, it was only really a foundation for epistemological activity. One began with mathematics and eventually progressed to physics. In the same way, the arts that comprised the 'trivium' were not really areas of knowledge in the modern sense, but disciplines that aided the arts of communication, of speaking and of writing. Studying the 'Seven Liberal Arts' enabled students to become acquainted with, and to master the tools for getting and dispensing knowledge (Ackerman, 1967, p.14). They were repositories of technique rather than knowledge. But the actual gathering of that knowledge, or the partaking in what was called "scientia", was a higher form of epistemological activity, to which the techniques learnt in studying the 'liberal arts' were often applied. As the Medieval philosopher, John of Salisbury pointed out, an art was a system of reason that was a "substitute for the spendthrift and redundant ways of nature, a concise, a direct method of doing things" (McGarry, 1955, p.33). It was primarily a device, a method for structuring experience. But what gave rise to the need to structure experience was "scientia" or the capacity to make certain formulations about the nature of things. Thus, whilst all men who were trained in the 'liberal arts' became artists, only a
very few reached the level of "scientia", where they had the insights into the nature of the world characteristic of scientists. In order to attain and communicate those insights, however, they required the techniques of the 'liberal arts' (Ackerman, 1967, p.20).

Historically speaking, then, an art was an epistemological activity in which knacks and techniques tended to predominate. It is this sense of the word that has been retained when the 'art' of cooking or painting is spoken of. It is, of course, quite within reason to speak of the 'science' of cooking or painting, but the ramifications are very different. Whilst it is possible to imagine cookery treated scientifically, and to envisage that that science would encompass such things as the calorific values of food and the chemical changes that occur to it when cooked, it would be only in a roundabout and indirect way that such knowledge would improve the preparation of meals. For only mastering the techniques and arts of cooking would do that.

Yet artists often see their activity in quasi-scientific terms. John Constable, the landscape painter, referred to his paintings as experiments in "natural philosophy" and as inquiries into the laws of nature (Gombrich, 1960, p.175). And the art students that Getzels and Csikzentsmihalyi (1976, p.18) made a longitudinal study of, frequently spoke of their studio paintings as voyages of epistemological discovery, either into themselves or the world around them. But though artists might like to think of themselves as questing after the laws of nature, rather after the style of the physicist, that goal in most, but not all, cases is subsumed in considerations of technique and ways of registering experience. Formal considerations often assume much more importance than considerations of content. If they did not, there would be no difference between art and science.
In an art technique remains uppermost; in a science, the reverse prevails; content subsumes technique. In science it is what is displayed when the veil covering reality is lifted that is all important; in art it is the way that unveiling is conducted which is of more interest. Thus if art and science do make analogous epistemological incisions into the often inscrutable face of reality, for science the incision is enough in itself; for art it is the manner and style of incision that counts. With these differences between science and art in mind, it will now be possible to build a spectrum of knowledge.

4.6 COGNITION AND THE SPECTRUM OF KNOWLEDGE

Reality remains undivided until conquered by the classifications of knowledge. There are, arguably, no natural divisions in reality that would indicate one province of reality belongs to science, another to religion, and so on. Rather those divisions have been imposed on reality by man as he has progressively tried to make sense of it. Accordingly, man the cogniser may be regarded as a kind of 'prism' through whom the 'white light' of reality comes to be refracted. As it does so, that light is broken up into the colours that comprise the spectrum of knowledge. This section will concern itself with the range of that spectrum, and the 'chromatic' divisions of knowledge which exist in it.*

* The attempt to do so is not all that original. Philosophers both ancient and modern, have often tried to examine the whole gamut of knowledge and seek out its fundamental, non-reducible components. Bacon (1937, p.377), for instance, felt all "human learning" consisted of "history, poesy and philosophy". In fact his analysis of knowledge was quite typical of other early attempts. His is no more than the culmination of such attempts, which had begun in Classical philosophy, and had become something of an idée fixe with the early encyclopaedists and Medieval schoolmen. All of them
In trying to pinpoint the epistemological latitudes that philosophy occupies, Russell (1972, p.13) once suggested that its territory seemed to lie in the 'no man's land' between the dogma of theology on the one hand, and the definite knowledge of science on the other. In effect, Russell was indicating that the twin outposts of knowledge are religion and science, and that everything else of an epistemological kind, including philosophy, can be located somewhere between them. Behind this assertion, that religion and science constitute the two extremities of knowledge, is the notion that they both tend to exhibit opposite forms of epistemological behaviour. The definite knowledge of science, for instance, is demonstrable; it is empirically supportable. This is not so with the knowledge of religion. It requires an act in a laboratory to demonstrate a scientific truth; an act of faith would serve to demonstrate a religious one. Religion therefore tends to be the stuff of dogma and otherwise irrefutable beliefs; it tends to be begotten by revelation and divine inspiration, rather than, as is the case with science, by experience and observation. If knowledge, then, is warranted belief (see 3.5), science is the most warranted, religion the least.

tried to seek out the atomic components of epistemological activity. With the proliferation, in modern times, of many more types of knowledge, attempts to analyse the whole gamut of knowledge have become somewhat more complex, although they are still as earnestly pursued. In recent years, for instance, there has been a whole series of attempts to describe the various types of 'rooms' in what perhaps is no longer a 'house', but 'mansion' of intellect. The attempts of Phenix (1964), Tykociner (1964), Hirst (1968), Morris (1946, pp.123 et seq.) and Koestler (1964, p.332) are notable in this regard. Most of these attempts - with perhaps the exceptions of Morris' and Koestler's - have tended to accentuate the divisions inherent in knowledge. They have not tried to show any connecting 'doors' that might exist between the various 'rooms' of knowledge; or conceived of knowledge - as will be done in this section - as a spectrum ranging between two basic and antithetical epistemological styles.
All knowledge, then, tends to fall into camps that are either demonstrable or not. Science and religion are the respective paradigms of either camp in their most extreme manifestations. All the other forms of knowledge, according to whether they aspire to the condition of science on the one hand, or religion on the other, can be located somewhere on a continuum between them. Religion and science are, as it were, the 'red' and 'violet' of the knowledge spectrum; they represent the extreme "left" and "right" of epistemological behaviour (Bruner, 1974, p.31). They, so to speak, form the limits between which the compass of all knowledge is spread and ranged.

It is perhaps worth pondering what might lie beyond these limits. Are there some epistemological equivalents in the knowledge spectrum, for instance, of 'ultra violet' and 'infra-red' light? If so, what are they?

To go beyond religion, into the 'infra-red' parts of the knowledge spectrum, is presumably to enter a world which for its 'inhabitants' is transcendent and available only to divine and inexpressible 'afflatus'. It is a world whose experiencing perhaps provides the springboard for religious doctrine and knowledge, but whose experiencing is essentially private and spiritual. To the left of religious knowledge, then, is a cognised whose domain is essentially non-material, that is 'trans-organic', and available only to gnosis and divine illumination. It is that cognised which the great mystics, like Catherine of Siena or, in modern times, Jacques Maritain claimed to have experienced.

By contrast, the 'ultra violet' parts of the knowledge spectrum are thoroughly centred in the material and tangible world. For to the 'right' of science lies technology and a world to which knowledge is
applied. It represents the domain in which scientific theory is
given some material and objective form and it is manifested in tools
and the application of theory to the most concrete and tangible
problems encountered in reality. The 'ultra-violet' parts of the
spectrum, then, represent the domains where World Three knowledge
gets translated back into World One terms; it occurs at the cross-
roads between theory and practice.

Neither the 'ultra-violet' nor the 'infra-red' parts of the
epistemological spectrum, however, will be of much concern here.
Rather it will be the knowledge divisions that lie between the
extremes of religion and science, and which make up, so to speak, the
'primary' and 'complementary' colours of the knowledge spectrum that
this section will try and differentiate and position on the spectrum.
For if religion and science, as has been argued, constitute the basic
antinomies of knowledge, and everything else is simply a mollified
version of one or either of them, then it should be possible to draw
up a spectrum of knowledge on which the other disciplines can be
located, according to whether their epistemological proclivity lies
in the direction left of science or right of religion.

The capacity to carry this out is of course dependent upon whether
the primary colours of knowledge do display some basic proclivity towards
one or other of the antimonies just described. This is true, for
example, of the human sciences. Ever since the late Nineteenth Century,
when they began to emerge as disciplines in their own right, psychology
and sociology have tended to employ the methods encountered in the
laboratory to bear on the problems of the mind and of society. With
the incorporation of scientific methods, the human sciences gradually
broke the yoke that had tied them to philosophy. And it is of note, in this connection, that many of the first practitioners of psychology, for instance, were originally trained as natural scientists. Freud had been trained as a medical practitioner; Wundt a biologist; Mach a physicist. Throughout the Nineteenth Century, in fact, there had been cultivated the belief that a physics of human behaviour was not only desirable, but inevitable. This belief that the problems of mind and society could respond to the positivistic methods of science is very evident in the epistemology of Comte (1970, p.13) and Mill (Hearnshaw, 1972, p.225). The early practitioners of the human sciences, then, were convinced that importing the epistemological rigour of science would result in much more reliable theories about man than mere philosophical speculation. The method of the laboratory has been that to which, rightly or wrongly, sociology and psychology have, in the last hundred years or so, frequently aspired. They are disciplines, then, that are heading 'right' on the spectrum, not quite fully fledged sciences, but not yet totally without philosophical features. They are, as Hudson (1976, p.157) has said in connection with psychology, disciplines that "should stretch continuously ... from the creative and scholarly arts on the one hand, to the established sciences on the other"; they occupy a region, then, somewhere between the 'reasonableness' of philosophy and the empirical certainties of science.

In many respects, history is likewise continuously stretched between philosophy and the sciences. Moreover, it would appear to be only the English who have difficulty in recognizing the scientific status of history. For, "in every other European language the equivalent word to 'science' includes history without hesitation"
In Germany, for example, history would be regarded as *Wissenschaft* but the actual methodological predilections of history need not necessarily be concordant with it being a genuine science. Indeed, there is a good deal of debate about the epistemological status of history. Whilst there have been some, notably Hempel (1974) who would see history as having the potential to become a science, others have been much more sceptical. History is basically unlike science, it is argued, because it deals with unique events, it is often interpreted from a thoroughly subjective point of view and lacks the power to predict the outcome of events (Carr, 1974, p.62). The most it can do is to rescue some general significance in events that can never be experienced again. Whether that means principally peering into the minds and psychology of the "rational agents" supposedly responsible for the course of historical events, as the advocates of *verstehen* techniques suggest; or simply gathering generalizations together from the historical remnants left after the events themselves have 'passed away', as the "colligationists" insist, seems to be a matter for the methodological persuasions of the individual historian. For, unlike science, history does not appear to have a consensus methodology as its core, which all its practitioners tend to follow (Ziman, 1968, p.19). The methodological position of history, then, is much more fluid and less fixed than that of the human sciences. But to the extent that the generalizations historians compound, if they are to be considered valid, must have the corroborative support from the raw materials of history, history is scientific; that is, if documentation, archaeological evidence, chronologies - history's raw materials, its 'meter' readings - are to be considered legitimate grounds for empirical support. But unlike
science, historical events, the causes which generated them and the effects they give rise to, cannot be fully replicated in something like a historical 'laboratory', so that if there are laws in history, as Hempel (1974) has postulated, then their causal efficacy cannot be measured or assessed. For if science, at least in terms of Hempel's "deductive nomological" model of it, permits predictions about the future behaviour of the cognised to be made, then the nearest history can ever get to such clairvoyancy is retrospection. It remains a discipline, then, more concerned with seeing successfully into the past, than the future.

But not all historians have wanted to be scientists of the past. The more speculative history, that Marx and Hegel practised, inclined towards the left hand side of the knowledge spectrum and towards a synoptic and philosophical history which endeavoured to isolate some overall, hegemonic principle in the events of the past. History, for such historians, was partly deus ex machina. Its events and happenings were moulded by some all pervading "world spirit". It was the duty of the historian to observe the events of the past as if they represented the unfolding of the hegemonic principle. He was supposed to see the 'hands' of the "world spirit" at work. History, it was assumed, had some ultimate purpose to it, a telos, and the function of the historian was to decode that telos.

History's 'chromatic' wavelength on the knowledge spectrum tends to stretch, then, from philosophy on the one hand, to psychology on the other. But if a certain methodological ambivalence tends to make its exact placement rather difficult, then such problems are multiplied when it comes to the arts. Firstly, there is the general epistemological problem of deciding whether the arts are a form of knowledge at all.
If they do not make warranted truth claims - that being the most conventional way of defining knowledge - then there is no reason to include them on the knowledge spectrum. They would be World Three phenomena all right, but not part of that province of World Three occupied by knowledge and cognition. Yet some artists, as was noted in 4.5, do claim an epistemological status for their activities. They would probably concur with Lawrence (1963) and argue that there are domains of human experience which are closed to the method of science; that only the more intuitive and less rational methods of art can open the mind to an understanding of. But if the arts do deal in epistemological truths, prohibited to other forms of knowledge, there is the additional problem of the arts being something of a 'rag-bag' phenomenon. There is literature, music, painting and a host of subsidiary activities that all in their own way have had, or continue to have, the epithet 'art' applied to them. And on the surface at least all these activities are very dissimilar to one another. Therefore, given perhaps their highly idiosyncratic natures, is it possible to generalise from the condition and apparent objectives of, say, literature to the other art forms? After all, if the activities that comprise the arts are vastly dissimilar, it would seem unwise, lest it should dissemble their true appearance, to admit characteristics of any one or two of the arts that might be said to be equally true of them all. Music is a case in point. For whilst it is not improbable that literature does occasionally have insights into the nature of the human condition equivalent to those of the human sciences, this would apply, if at all, much less to music: for in Stravinsky's (1936, p.91) oft quoted words "music is by its very nature, essentially powerless to express anything at all". Even if the nature of a truth claim is
made as all accommodating as possible, it is difficult to quite see how it could legitimately embrace the expressions of music. Except on those rare occasions when music tries to be representational and onomatopoeic, and create aural pictures of the world, it is generally non-referential; its only subject matter is itself. It is a kind of emotional mathematics. For whatever music says it is either internal to itself, or about a world which exists beyond that of material fact and physical entities.

So that if music, and it is one of the major arts, does not live up to, in the conventional sense of the word, being knowledge, should its consideration for possible inclusion on the spectrum of knowledge be rejected? The problem is further compounded because there is undoubtedly a thing called 'musical knowledge' that composers and performers need in order to write and play music.

Perhaps a way of circumventing this problem is not to regard the arts as being in any way epistemologically equivalent at all but to regard them as having differences that can be arranged, as Reid (1969, p.87) has done, on a scale which has at one end of it those arts, like the novel, in which 'subject matter' looms largest, and at the other, those, like music, in which it looms least. From what was said in 4.4, it seems likely, in all events, that formal and technical considerations in the arts predominate over subject matter. This predominance is at its most extreme in music, where devotion to form and structure and its technical realization is almost an end in itself, and least in the novel where, whilst considerations of form are not always absent, they are there to a less marked degree. But even if, in the arts, there is a tendency for method considerations to take priority over those of content, content is present in them, and its presence does have
pronounced proclivities.

The arts have been spoken of as possessing the acumen to see more deeply into the affairs of men, and as lying somewhere between the enquiries of physical science and the left-hand domains of the knowledge spectrum, like religion and philosophy (Reid, 1961, p.98; Polanyi, 1962, p.199; Toulmin, 1972, p.396). They have also been spoken of as encompassing variously the concerns of psychology in that they sometimes seek to discover the mechanisms of human action, and often of overlapping upon the concerns of the theologian and philosopher (Getzels and Csikszentmihalyi, 1976, p.139). But if literature and poetry often make their province what Peters (1975a, p.99) has called the "concrete universals of life", it is also true that literature and poetry seek to plumb the depths of, and record what the French poet, Mallarmé, acknowledged to be, an Orphic order in the universe (Raymond, 1962, p.24). There are some poets, and Mallarmé was one, whose art tries to evoke the spiritual and gnostic side of man and reality. Its quality is deliberately visionary. It is also true that literature can sometimes serve the same end as history (Nathan, 1970). They might differ in their respective concern for exact verisimilitude, but literature, albeit fictionally, does, like history, attempt to recreate the past. Leopold Bloom was not a real Dubliner, but the Dublin that James Joyce created for Bloom to domicile in was as faithful a recreation of a Dublin on 10th June, 1904, as it was within Joyce's powers of research to recreate. In fact, the novel Ulysses is virtually a living museum in words, which, should Dublin suddenly vanish from the face of the earth, would enable, at least according to Joyce, the city to be rebuilt exactly as it stood on 'Bloomsday', 1904.
The arts, then, tend to be spread out over a number of epistemological domains, and can encompass in their concerns the philosophical, the psychological and the historical. On the spectrum of knowledge, they have a relatively 'broad wavelength' that can extend from the furthest left parts of the spectrum to the right.

Summary. Most of the conventional areas of knowledge can be located somewhere on a continuum which takes as its two end points a knowledge that can be demonstrated and refuted, and a knowledge for which it is impossible to do either of these two things. For whilst it is perhaps not quite wholly true to say that left-hand knowledge never proffers demonstrations of its validity, it tends to conveniently overlook and ignore counter-instances and refutations of that claimed validity (Agassi, 1975, p.221). Left-hand knowledge, then, tends to make a speciality of defying falsification; it is very resistant to refutation, and transcends the capacity to be scientifically tested. And since it tends to eschew the necessity of empirical support for its assertions, left-hand knowledge can take for its subject matter worlds which are not normally available to experience and observation in the conventional sense. It is almost as if another cognised, a transcendent cognised, a 'C\text{d}_4', must be invented to accommodate the world to which left-hand knowledge frequently claims it has the key to knowing.
One end of the knowledge spectrum (see Figure 4.1 above), then, is formed from those domains of epistemological activity which range over man's religious, metaphysical and essentially speculative concerns. Its concerns are the very antithesis of those which are dealt with by the knowledge found at the opposite end of the spectrum. For the latter are thoroughly rooted in the material world, a world that is open to the senses and available to experience and that can be demonstrated to exist in man's actual not mystical experiences. It is the world, then, that the physical sciences, above all, wrestle with, and try to make true statements about. And it is the essential feature of such statements that they remain refutable and falsifiable (Popper, 1974, p.41). That is the criterion which demarcates physics from metaphysics, speculative from empirical knowledge. All the other modes and divisions of knowledge can be located, as is shown in Figure 4.1, somewhere between them, for the reasons given in this section. Of course, the
spectrum can only present a most generalized picture of knowledge. Whilst, for example, it shows there is often considerable overlap between the domains of philosophy and religion, history and philosophy, the spectrum does not indicate that philosophy is sometimes concerned with the sorts of mental and social problems that psychology and sociology often investigate; or that the natural sciences often have a strong philosophical element in them. The spectrum, then, only shows the approximate relativity of the various forms of knowledge to one another. Nor are the divisions in that spectrum necessarily all that absolute. For whilst the wavelengths of the colours that comprise the optical spectrum can be said to remain fixed, the wavelength of each band of knowledge in the spectrum is forever fluctuating as the domain of its concerns either expands or contracts. This will become clearer in the next section, where the evolution of knowledge will be discussed in terms of the placements of its various forms on the spectrum.

4.7 THE SPECTRUM AND THE EVOLUTION OF KNOWLEDGE

The march forward of knowledge has been, up until now, the story of a gradual movement towards the right hand side of the knowledge spectrum. In the beginning it was myth that tended to tell the story of reality, now it is science (Popper, 1976, p.59). And instead of peopling the universe with gods and deities, and explaining its behaviour in terms of their actions, now man peoples it with atoms and molecules. The evolution of knowledge, according to Comte (1970, pp.1-2), passed through at least two stages before it developed into science. There was firstly the theological or fictitious stage which was the beginning of knowledge. During this stage, the activities of
the universe were ascribed to a series of supernatural agents; it was the stage of a mythical interpretation of reality. Immediately succeeding it came a stage of knowledge, the metaphysical or abstract stage, when the phenomena of reality were explained away in terms of an all pervasive "abstract force". It sought out some immanent cause - which was available to philosophical reasoning - that would explain the happenings of the universe. Typical of this approach to the world was Plato's; Plato held that beneath the world of sensation and perception was a world of ideas and forms. The most elevated form of philosophical reasoning, *dialectica*, could penetrate and understand this world. With the evolution of such metaphysical styles of knowledge there is a movement rightward from theological to philosophical knowledge. Commensurate with this move, there is usually an attempt to repress the epistemological significance of empirically derived notions. They do not gain their sovereignty until knowledge reaches its final state of evolution: the stage of science, or what Comte called the "positive stage". During that stage - which is the stage that knowledge furthest right on the spectrum has reached - the "actual laws of phenomena" start with experience and observation of the world. They have their incipience in what is sensorily available.

The emergence of the modern, autonomous disciplines of science has been identified with the period of Newton's *Principia* (the late Seventeenth Century). Bochner (1969) aptly calls this period the "age of eclosion". The epistemological fruit born during this period was sown in other fields of knowledge. The capacity of science to harvest so much more epistemological truth than previous modes of knowledge led to them becoming largely defunct. With the coming of science, all real epistemological power was transferred "to the nominally Lower House
of objectively demonstrable assertions" (Agassi, 1975, p.472; Polanyi, 1962, p.266). Moreover, this power has tended to spread outwards from physics to other areas of knowledge, such that it now encompasses large sections of the spectrum (see Figure 4.1). As the power of belief in religion, and of reason in philosophy, have given way to the experimental procedures of science, there has been a progressive encroachment upon the territories of knowledge that were once the prerogatives of philosophy and religion. As disciplines have discovered themselves, under the mentor of scientific method, they have tended to declare themselves independent of previous epistemological liaisons. This, it was noted in 2.8, is particularly marked in the case of a discipline like philosophy. After the advent of the Principia, the physical sciences were the first to break free from its methodological influence. With the coming of the autonomous discipline of psychology, the same thing has tended to happen to philosophy of mind; and many of the concerns which formerly belonged to it, have become embraced by psychology. In the same way, economics and political science have also tended to be led out of the 'arms' of philosophy. Thus, whilst Adam Smith, in the 'arms of philosophy' felt he could moralise about the condition of man and his political institutions, for Thorstein Veblen those same 'arms' had a deleterious effect. Whilst economics and political science were burdened with the normative questions that an allegiance to philosophy obligated them to raise, they were prevented from becoming fully objective sciences (Riesman, 1958, p.70).

As disciplines have sought to emulate the condition of science, there has been an appreciable exodus from philosophy. Its former domain has become somewhat diminished. The fastest growing regions
of the spectrum, then, are at its right-hand end.

But if philosophy and theology have been forced to retreat from the foreground of epistemological activity, they are still very much in evidence in its background. The insights of natural science, for instance, are often painted on a broad scenario that metaphysics provides. The superstructure of science has always tended to be built on a framework of "fundamental presuppositions, notions, terms, methodological judgments and decisions" (Holton, 1967, p.98). These have formed the themes around which scientific activity has been conducted. In Newton's case, this theme constituted the belief that at the heart of the universe was a God, who controlled all the forces and the observed order therein. However, in being committed to the absolute incorruptibility of that theme, Newton tended to restrict the compass of those questions he was willing to ask about the workings of the universe, lest their answers should presumably corrupt the theme.

In a rather different sense, it was a metaphysics that formed the backdrop from which Einstein cast his theory of relativity. For whilst it is true that the contradictions inherent in the Michelson-Morley experiment were something of a catalyst in the generation of that theory, it is also true that Einstein was led as much to the theory by those contradictions, as he was by the speculations about space and time in the philosophy of Hume and Mach (Toulmin, 1971, p.26).

It is possible, then, for a philosophical or religious stance to cohabit with one whose character is outwardly scientific and empirical. There would appear to remain vestiges of earlier epistemological states even in science. Indeed, it could be said that within the divisions of the sciences, the spectrum tends to recapitulate itself. Physics, for instance, has a speculative polarity where theories might be
conceptualised on a largely philosophical plane, and another polarity
where the articulation of theory begins with observation and experi-
ence. Certainly, in the human sciences this recapitulation of the
spectrum, from speculative philosophy through to empirical science,
is very much in evidence. Take, for instance, psychology: it ranges
essentially from the irrefutable, and therefore "metaphysical"
theories of psychoanalysis (Popper, 1969, p.34) - which have no
scientific status whatsoever - to behaviourism, which has represented
psychology's most concerted attempt to ape the methodology of science.
And it was noted in 4.6, that much the same sort of left- and right-
handedness of epistemological style prevails in history.

What is being observed, then, in the spectrum of knowledge is
something of a 'chinese box' effect. This effect becomes even more
pronounced when so-called 'second order' disciplines - those that seek
to describe or articulate the 'mechanics' of disciplines proper like
science and so on - are considered. Within them, spectrums within
spectrums tend to proliferate all over the place. Science is a good
example. For at the second order level, not only are well
established areas of philosophy, history and sociology of science to
be found, but within say something like sociology of science, are
practised left- and right-handed varieties, which tend to reflect the
spectral range of knowledge in general (see Figure 4.2 below).
One tendency that is evident in some forms of sociology of science is the tendency to formulate philosophical generalizations and all encompassing theories to explain the social dynamics and behaviour of scientists in scientific communities. The work of Merton (1972) would be strongly representative of this tendency. At the opposite extreme to the approach of Merton, would be that sort of sociology of science which seeks empirical evidence for those theories and generalizations (Sklair, 1973, p.109 et seq.). It tries to establish whether scientists, in actuality, hold the norms and values that Merton has prescribed for them; it attempts to go beyond left-handed abstract analysis, and discover some right-handed demonstrations of that analysis (Nelson, 1974, p.13).
Within each of the major divisions of knowledge, then, the epistemological spectrum tends to repeat itself, and goes on repeating itself even in second order disciplines. The displacement of philosophy as a way of understanding the behaviour of the cognised has not let to the relinquishment of the philosophic attitude in science. Science still requires a 'left-handed' attitude to answer certain queries. Indeed, as will be indicated in the next section, the need for this epistemological 'left-handedness' becomes more inescapable the further one moves away from the physical science domain of the spectrum. The reason is not that the knowledge involved is becoming progressively closer to philosophy, but rather that the knowledge is dealing with a cognised that fosters far more philosophical speculation about it than is perhaps needed to understand the sub-organic cognised \( C_{d_1} \), the domain of the physical sciences.

4.8 COGNITION AND COGNISED

In many respects, the capacity of the physical sciences to explain the behaviour of some (and 'some' is very much the operative word in this context) aspects of the universe is not so much a matter of the efficacy of scientific methodology as it is a matter of the nature and scope of the cognised that the physical sciences elect to investigate. For in moving from left to right along the spectrum, there is, with each division of knowledge, a progressive 'retrenchment' in the amount and diversity of cognised examined. Part of the explanatory success of physics and chemistry is that "so much of the wealth of natural phenomenon is excluded from their study" (Pantin, 1968, p.5). The compass of their concern is limited, and contains comparatively few
indeterminable variables. And it is because they censor so much of the complexity that exists in natural phenomena, that Pantin has called physics and chemistry "restricted sciences".

In moving from the physical to the life sciences the complexity of phenomena dealt with increases markedly. No longer are simple conglomerates of atoms the subject of investigation. Because their components are much broader and more variable in their behavioural patterns than those encountered in the sub-organic cognised, it becomes much harder to reduce the phenomena of living systems to laws and theories. The subject matter of biology, then, is an infinitely richer and more abundant source of variability than that encountered in the physical sciences. It therefore becomes harder, though not impossible, to make laws about the organic cognised.

In moving to those domains of knowledge, like history and sociology, that deal with the phenomena of the supra-organic cognised \( \left( \text{C}_d^3 \right) \) - the realm of man's cultural creations - the restrictions on the cognised become even fewer. The complexity of phenomena concerned with here tends correlatively to increase, whilst the capacity to make general laws about those phenomena is vitiated accordingly. Of course that vitiation has a lot to do with the considerable irregularity of the phenomena involved. Ordinarily, as has been noted (see 4.2), the explanatory success of knowledge is somewhat contingent on regular patterns of behaviour being observable in phenomena in general. If they displayed infinite variation, knowledge, of any sort, would become impossible (Pantin, 1968, p.32). One of the perennial difficulties encountered in history - which prevents it emulating physics - is that it tends to deal with events which are unique and grossly idiosyncratic. Therefore, it is impossible to expect of
history the 'clairvoyant' powers that it has been suggested (see 3.4) are characteristic of physics. For one thing, the cognised that history seeks to explain, embraces many more less determinable variables than physics (Belth, 1966, pp.158-159). To open an examination on the causes of a historical event is to open a veritable Pandora's box of unexplained forces and unpredictable consequences. In the same way, social explanation is also prey to innumerable factors that remain difficult to circumscribe in some epistemological formula or other. Society is not like a physical field of forces, controlled by a 'superordinate'. Rather it is built up out of a copious number of idiosyncratic actions on the part of individuals. A society is as much an exemplification of the accidental as it is of that which has been deliberated about and formulated. Society, then, like the historical event, is as much agitated into being by unpredictable forces, as it is by those which have been planned to occur (Watkins, 1973, pp.91-92,104). Thus it is more difficult to formulate laws in history and sociology than in physics. Therefore, what tend to be found in history are not laws, but interpretations. For, given that it is impossible to find some dispassionate law that will connect up the manifold elements of history in one way, and one way alone, it becomes possible for the historian to interpret those 'elements' from a multiple number of perspectives. Thus, what counts in history is often not the events, but the way the historian chooses to interpret them (Carr, 1974, pp.23-24).

In an equivalent way, psychology is also prone to interpreting the same mental and social events differently. This is evident in the fact that, by comparison with the physical sciences, psychology is rife with different schools of thought. There are behaviouristic
psychologists, for instance, on the one hand, and humanistic psychologists on the other, and both seek to deny the implications of each other's viewpoint on the nature of the mind and mental events. Therefore, in order not to misconstrue a psychological insight or pronouncement, it becomes important to know whether the psychologist making it is speaking as a behaviourist or as a humanist. Whilst such sectarianism is not wholly absent in the community of physicists - there are theoretical and experimental physicists, for instance - it never reaches the proportions of significance that are evident in the human sciences. This 'sectarianism' might, as Toulmin (1972, pp.391-392) asserts, reflect the fact that the human sciences are as yet very fledgling disciplines. They have not yet achieved the "theoretical compactness" of physics and biology, if indeed this could ever be possible, for it is also probably true, as is being asserted here, that the very unrestricted nature of man's behaviour makes it difficult to be theoretically compact about that behaviour which, even in vitro, often proves to be diffuse, variable, inaccessible and unpredictable.

It has been claimed (Bochenski, 1968, p.19), that a characteristic of Western scientific method is that it endeavours to exclude any emotional or subjective colouration that might be introduced into it by scientists. Science, thereby, succeeds because its practitioners are able to detach themselves entirely from the objects of their observation. And whilst there are some, like Polanyi and Grene (see 2.9), who would quarrel with this depersonalized picture of science, in terms of degree, from what has been said in this section, science remains much more objective and depersonalized than say history: which retains, by necessity, much more of it anthropomorphic dimension than does science. Indeed, in moving from history to science, it could be said that that
dimension becomes progressively more avoidable and less of a hindrance to the pursuit of objectivity. Thus, it is a matter of some importance to know whether a historian is speaking as a Marxist or a nationalist, since these positions will possibly taint the construction he places upon historical events. But with the physicist, the matter of his ideological persuasion has less import to the evaluation of his physics; for as a discipline, physics is mature enough, by and large, to protect itself from such colourations.

4.9 THE KNOWLEDGE TRIAD

That it is possible for a cogniser's predispositions to intrude upon, and thus 'finger-print' historical knowledge, indicates once again the interdependence that the elements in the knowledge process constantly have with one another. Of course, it is possible - as has been done in this chapter - to isolate those elements and examine them independently, as if they were free 'atoms' in the knowledge process; but, properly speaking, those atoms are not independent at all, but interdependent. One of the objectives of this section, then, will be to map that interdependence.

It was implied in Chapter Two that the knowledge process should be properly regarded as a 'triangular relationship'. The beginnings of that relationship occur in the kind of perceptual 'dialogue', and the associated 'biogrammars' used, which a cogniser engages in to become conscious of his surrounds (C). For, as was noted in 3.2, it seems that in order to make sense of his surrounds, the cogniser must somehow 'budget' his experience of his surrounds to the minimum. Unless he does so, he will be overwhelmed by the excess of perceptual
information to which he is potentially sensitive.

But the budgeting of 'stimulus reduction' can sometimes go too far, so that a cogniser can come to want fresh areas of perceptual stimulation (see 3.3). Unless all sorts of malign psychological effects are to ensue, he must fetch in from his surrounds new 'inputs' that will keep his perceptions alert and attentive. It is from under the auspices of this 'stimulus seeking', that knowledge eventually comes to emerge. But in effect, knowledge only represents one further mode in the budgeting of experience. For it has also been suggested that knowledge constitutes just one more manifestation of the urge to reduce experience to more manageable proportions. Knowledge, then, represents just one further 'précis' of experience.

However, it is a précis whose syntax and content can serve, in quite dramatic ways, to transform the cogniser's vision of the cognised. It can cause him to see 'hidden men' in the vast and disparate mosaic that is reality; and also to see Eskimoes where others, without his knowledge, would only see American Indians.

Knowledge, then, not only supplies a more spartan and laconic 'reading' of reality, but also enables 'words' to be read in reality which, in the ordinary course of experience, would go unrecognized. It has the power to raise to levels of significance aspects of the cognised that would normally escape attention. Knowledge is hewn ultimately from the cogniser's experience of the world, but when it is incorporated back into that experience, it serves to modify the way the world is regarded. There occurs, through the consciousness of a cogniser, a reciprocity between knowledge and the experience of the world. In fact, that reciprocity is the heart and the key to the knowledge process. The problem remains of how to represent that
reciprocity.

In fact, as analogues of that reciprocity, some of the models of linguistic meaning, and the diagrams that have been produced to pictorialize them, will do quite adequately. For it turns out that, just like knowledge, meaning is also, at least according to one body of linguistic opinion, a threefold process.* Analogously, the three components of the knowledge process can be represented as in Figure 4.3 below:

* Ogden and Richards' (1936, pp.10-11) model of meaning is representative. A lengthier and more detailed description of the possible analogues, together with other parallels drawn from semiology, that are pertinent to an understanding of the epistemological process, is given in Appendix I, Semiology and epistemology.
participate in the relationship. Thus, there is what will be called the 'a-dyad' sensitivity, or that accumulated experience arising from being exposed to knowledge \( (C_n) \). 'a-dyad' sensitivity is registered in the way the cogniser regards the world; it constitutes his ability to see Eskimoes in the cognised, where others, because of a rather different epistemological background, might see American Indians instead. The 'a-dyad' is the 'plane', then, along which "theory contamination" is ultimately manifested. However, that "contamination" does not arise \textit{ab ovo}. Rather it comes into existence as the cogniser assimilates from the cognition domain \( (C_n) \) the various ideas and theories about reality contained within the domain. That assimilation occurs along the 'b-dyad'. But almost independently of the cogniser, the knowledge that exists within the cognition domain, and which provides an "interpretative framework" (Polanyi, 1962, p.143) through which the cogniser gazes upon the world, forms a nexus with the cognised, especially where scientific knowledge is concerned. The knowledge, then, in the cognition domain tends to match the observed behaviour of reality; and in coming to assimilate that knowledge, the cogniser gradually comes to recognise that matching. He recognises that its 'c-dyad' validity accords with his own 'a-dyad' 'reading' of reality.

But assimilating knowledge does not just comprise assimilating a 'picture'. For in order to become aware of the accuracy with which knowledge represents reality, the cogniser must become aware of the way a knowledge has come to encode the behaviour of reality. For knowledge, like a painting, also has its conventions of perspective, light, shade and colour, which, so to speak, govern the way reality is depicted in knowledge. And if knowledge is to be seen properly, the
cogniser must, in addition to the knowledge itself, assimilate these conventions.*

However, the reciprocity that occurs between the elements of the knowledge process need not be one of complete and utter parity. The elements participating in the process do not always have the same degree of significance in the triad; indeed, as will become clearer in the next section, they can sometimes serve to override one another.

4.10 KNOWLEDGE AND THE KNOWLEDGE TRIAD

The cogniser's 'posture' towards the cognised can take one of three positions. Each of these positions accords a rather different status to the epistemological significance of the cognised and cognition. And as a result of this, the character of the reciprocity that exists between them and the cogniser is subtly different, and gives rise to rather different epistemological 'products'. This section, then, will consider the different styles of reciprocity, and the products they would appear to engender.

So far, it has only been indicated that the cognised is glanced at through the lenses that knowledge is able to supply. But of course it is quite possible to shut off the influence that might stem from knowledge, and respond purely intuitively to the cognised. Such a posture, then, would tend to eschew any obligation to trammel responses to the cognised within the conventions of knowledge. It would allow "fancy and imagination" complete reign, without any attempt to keep them in check within an epistemological framework. This, it has been

* These conventions will be examined in detail in 5.4.
argued (Margenau, 1972, p.3), tends in fact to be the procedure of the arts.

Whilst it is perhaps not wholly true that the artist has total freedom of expression - there often being the need to contain that expression within some artistic form or other - the rigour with which the "make believe" of art is subjected to epistemological test is certainly a lot less than that encountered in science (Pasmore, 1975, p.10). The validity of the 'c-dyad' has much less claim upon the concerns of art than it does science. Moreover, the aegis of objectivity that tends to guide the pursuit of scientific truth, and which represses subjective colouration in it, is a much less dominant feature in artistic activity. It is almost as if the subjectivity - that in science would be considered deviant epistemological behaviour - becomes the very thing which is celebrated in art. Certainly, there is very little attempt to exclude it. Yet it is also true, in spite of this absence of epistemological constraint, that art does offer penetrating and valid insights into the nature of the cognised (see 4.3). Subjectivity might be autocratic in its domain, but this does not prevent some of the expressions of art having a certain amount of objective validity. It is perhaps only that those expressions remain essentially inexplicable or otherwise unanswerable to reason or fact. The conventional route which leads to scientific truth, and whose itinerary can be demonstrated and pointed out, is often not followed in art. The normal processes of reason, rationality and logic that characterize most forms of knowledge in the cognition domain, are often suspended in the case of art. Rather, art represents a manifestation of that "intuitional wit" which the Seventeenth Century Spanish physician, Juan Haarte, spoke of, and by which means, without art or
study, surprising and unprecedented knowledge about the world are arrived at (Chomsky, 1972, p.9). And it might be, as Bergson (1944, pp.167 et seq.) pointed out, that this "intuitional wit" or what he preferred to call "instinct", is displaced out of existence by the onset of reason and "intelligence". Creative insight of the artistic kind, then, could well be fettered by the kinds of rationality that exist in the cognition domain. The efflorescences of artistic thought that come from creative insight might stop flowering altogether if the cogniser allows the cognition domain to influence unduly his outlook on the cognised. It might only be by suppressing the influence of the cognition domain that artistic activity flourishes.

If art has tended to work by the repression of cognition, and its constraints, there is at least one body of influential philosophical belief - rationalism - that opposes any ascriptions of epistemological significance to the cognised. For the doctrine of rationalism has tended to hold that there is a variety of ubiquitous and absolute truth, which, transcending the differences of time and place, becomes available to pure reason rather than science. The truths of mathematics and logic are supposedly available in this way. They can be proved without essential reference to empirical findings; there is no need to resort to "observational statements" to support them (Hempel, 1966, p.1). The cognised (the real world) can be discarded without manifestly affecting the capacity to pursue mathematical truths. For the empirical constructs that form the foundation of natural science tend to be absent in mathematics and logic. They can stand up on their own without the cognised. In fact, both mathematics and logic are rather expansions of themselves than of the cognised. Once created, as systems they tend to release themselves from the real world, and
concern themselves only with the abstract "structures and forms" and relations that lie amongst them. Mathematics and logic tend to create the objects of their own discourse, and then keep within the confines of that discourse (Lange, 1964, p.50; Polanyi, 1962, pp.184-6). As disciplines, then, they tend to talk with themselves, rather than with the world. In this sense they are in direct contradistinction to the empirical sciences. But like them, the sciences are also repressive. For, as has been noted (see 4.8), the sciences attempt to rid themselves of any subjective colouration that might be introduced by a cogniser. The ultimate judge of scientific truth, then, is not personal feeling or reason, but reality. It supplies the standard against which the truths of scientific knowledge are measured. For in the sciences, it is important that there should be a demonstrable correlation between knowledge and the world as it is experienced. Where the two can be shown to be incommensurate, knowledge will be considered to be absent. The story of scientific knowledge, then, is a matter of improving the match that exists between cognition and the cognised. That the match can at all be ameliorated is because science, alone amongst the various forms of knowledge, offers the possibility of having its truths overthrown by more perspicacious and accurate 'readings' of experience. For the cognised can not only supply support for the validity of cognition, but it can also harbour evidence that can be used to testify against that validity.

With the knowledge triad, then, three different types of reciprocity would appear to prevail. The first tends to reject the cognition domain, and respond to the cognised in a private and self-expressive way. Out of that reciprocity would appear to spring the products of art. The second type of reciprocity is in a sense no reciprocity at
all. It tries to repress the cognised altogether and discover the 'necessary truths' that pervade thinking and rationality; it aims, so to speak, for a cognition without a cognised. The third type of reciprocity tries to establish a compatible rapport between the cognition and the cognised. It seeks in the cognised some formulae that will enable the behaviour of the cognised to be explained. Scientific knowledge is generated from this third type of reciprocity. Scientific knowledge, however, is subject to modification. The validity of the 'c-dyad' is by no means absolute or immutable. The fact that it is not so introduces another behavioural trait of the knowledge triad.

4.11 CONSONANCE AND DISSONANCE IN THE TRIAD

Whilst scientific knowledge possesses epistemological characteristics that are to some extent peculiar to itself, and which are not quite so keenly adhered to in some other parts of knowledge, its general tendency to establish an objective correlation between itself and an aspect of reality appears to remain a perennial theme of knowledge in general. What distinguishes scientific knowledge, above all, is that it tries to formulate a knowledge that fits the observed patterns and behaviour of reality. Other forms of knowledge, as was noted in 4.10, either try to overlook any epistemological obligations they might have to reality, or in aiming to establish a correlation of sorts between themselves and reality, do not bother too much with the objectivity of that correlation. For scientific knowledge, however, that objectivity is all important. The observations of reality always act as a first criterion against which to measure the epistemological
authenticity of scientific knowledge. Where there are any irresolvable discrepancies between the observations of reality and the postulated behaviour that knowledge indicates that it should be following, there will not be scientific knowledge, only what Polanyi (1962, p. 123) has called a "logical" or "heuristic gap". The progress of scientific knowledge, then, can be regarded as the gradual reduction of that gap - the gap between cognition ($C_n$) and cognised ($C_d$).

Expressing these general epistemological characteristics of scientific knowledge in terms of the triad, it can be said that scientific cognition strives to make an integration of cogniser experience that most nearly corresponds to the observed facts about the cognised. It aims to establish what will be called a state of epistemological 'consonance' between the knowledge ($C_n$) and reality ($C_d$) radicals of the triad, the 'c-dyad'. The establishment of that 'consonance' in effect, amounts to narrowing the "heuristic gap".

In quantitative terms, this consonance could be expressed as numerically lying somewhere on a continuum of values between 0 and 1, where '0' corresponds to an absolute and conclusive refutation of the $C_n$ involved, and '1' its absolute confirmation. The nearer the value $C_n$ approaches 1, the more plausible the scientific explanation involved. The gap between itself ($C_n$) and the cognised ($C_d$) is minimal and exhibits considerable consonance. But since a scientific proposition can never fully be verified - since an infinite number of examples of its verification can never be observed - the value of $C_n$ is always and ultimately asymptotic to 1. The more confirming instances that are observed, the closer the value of $C_n$ approaches 1. Similarly, at the refutation 'end' of the continuum, the value of falsified or unverifiable $C_n$ knowledge is asymptotic to zero. After
all, just as it takes an infinite number of examples to confirm the irrefutable truth of a scientific proposition, by inference, it should take an equal number to finally falsify it. It can be said, then, that the value of $C_n$ lies on a scale somewhere between 0 and 1, or:

$$0 < C_n < 1$$

Thus the value of $C_n$ formed from the proposition "griffins once existed" - to use a favourite example of Ryle's (1970) - can be regarded as tending very close to zero; and presumably will continue to maintain that tendency until some paleontological evidence is uncovered in the cognised that would corroborate the proposition. The probability of that happening on present trends in paleontological evidence is, however, increasingly remote, thereby serving only to depress the value of $C_n$ still further. That being so, whilst it cannot be said with absolute certainty that 'griffins never existed', it does seem more probable that their existence is a product of man's fantasy rather than of his scientific enquiries.

But though a scientific proposition might initially possess a $C_n$ value very close to 1, it does not necessarily follow that this value is fixed once and for all. Scientific propositions and the theories embodying them, as has been noted, are periodically overthrown when empirical evidence gathered from the cognised shows their continued tenability to be open to question. When that overthrow occurs, and a scientific theory is refuted, the value of $C_n$ reverts to zero, and a "heuristic gap" opens up between it and the cognised. Indeed, it is their capacity for refutation which is the most salient feature of scientific theories. Any knowledge which does not offer the opportunity of empirical falsification is not, properly speaking, scientific knowledge; it belongs instead to that realm of irrefutable knowledge,
which is metaphysics (Popper, 1969).

With the possibility that scientific theories are frequently subject to refutation and overhaul, it would appear that the 'c-dyad' is not permanently in a condition of consonance. When, for instance, a theory is being overturned, thus opening up a "heuristic gap" between the cognition and the cognised, consonance is displaced. What occurs in its stead will be called a state of epistemological 'dissonance', implying simply that the harmony which once prevailed between the cognition and cognised radicals of the triad has been temporarily upset. In fact, dissonance would appear to be as necessary to the functioning of scientific knowledge as consonance. For if consonance was the permanent condition of the 'c-dyad', then, in Popperian terms, the knowledge involved would presumably be closed to the possibility of refutation, and therefore be unscientific. It would be of the sort "griffins once existed".

Scientific knowledge undergoes progressive refinement as it alternates between the states of consonance and dissonance. For the displacement of the dissonance generally means that the degree of correlation between $C_n$ and $C_d$ over the replaced $C_n$ has also been increased.

If he states it in rather different terms, Kuhn (1973) makes a similar kind of assertion about the progress of scientific knowledge when he argues that that progress pendulates between phases of so-called "revolutionary" and "normal" science. During the former, the credibility of a scientific theory (or "paradigm" in Kühn's terminology), is thrown into serious doubt; whilst during normal science, that paradigm's credibility undergoes further stringent test, and in being so tested, is gradually articulated in those parts of the
cognised to which it seems to have applicability (Kuhn, 1973, p.23).

In the nomenclature of this section, then, the practise of normal science serves to reinforce the consonance that has already been found to prevail between a scientific theory and some aspect of the cognised. It makes for greater asymptosy in the value of $C_n$ knowledge; for, in adding further corroboration to the validity of the paradigm, the 'c-dyad' value of the $C_n$ draws closer to unity. Normal science, then, sustains and augments the harmony that already exists between the cognised and cognition radicals of the triad.

By contrast with the reinforcing activities of normal science, during phases of "revolutionary science" "anomalies" are discovered in the articulation of a paradigm. These anomalies serve to weaken the accord which previously existed between the cognition and the cognised radicals of the triad. In effect, they serve to defy the legislation of the paradigm; they represent examples of recalcitrant behaviour in the cognised, which a paradigm is unable to predict or manage. The perturbation of Mercury was an example of such recalcitrant behaviour (see 2.5). When considered solely within the framework of the Newtonian paradigm that perturbation was completely anomalous. The existing rules established by the paradigm failed in this case. It was an instance of the paradigm going "bad" on the scientific community (Masterman, 1972, pp.82-83). With the accumulation of such recalcitrant behaviour, the tenability of the paradigm eventually collapses altogether. And a heuristic gap of unbridgeable proportions opens up between the cognition and the cognised. A state of dissonance, in effect, prevails between them which persists until a replacement paradigm is formulated that is able to accommodate the anomalies evoked by the dysfunctional paradigm. In fact, it is when that modulatory
paradigm - one that restores harmony to the 'c-dyad' - is formulated, that a "scientific revolution" is born.

But before the "change of intellectual clothes" (Toulmin, 1972, p.101), that a scientific revolution demands, occurs, there is firstly the problem of identifying, then resolving the dissonance that is sensed to be apparent along the 'c-dyad'. That of course has nothing to do with the 'c-dyad' itself, but rather the sort of beliefs and interpretations that a cogniser bring to bear on that 'c-dyad'. It might sound trite to say it, but unless there is a cogniser in the triad, the consonance or otherwise of the 'c-dyad' will go, so to speak, unheard. For it is only the cogniser who is finally able to judge whether the 'dyad' between $C_n$ and $C_d$ is harmonic or discordant, and it is also only he who possesses the capacity for modulating that dissonance.

But how is that dissonance registered? And once registered, is there some psychological mechanism that might explain why the cogniser should remain particularly disposed to regulating it? Does for instance the state of epistemological dissonance cause such intolerable levels of psychological discomfort that cognisers are driven to extreme lengths of tenacity and resourcefulness to be rid of it?

Knowledge, it was argued in 3.4, can be regarded as a kind of conceptual gestalt. It represents a more integrated and cohesive - if more abstract - form of experience. And in likening knowledge to gestalts, it was also argued that the gestalts of knowledge also share with those of perception the structural qualities of simplicity, elegance, bonne forme, unity and so on, if anything to a more marked degree than those of perception. When dissonance occurs, however, the structural cohesiveness that knowledge tends normally to display
becomes disrupted and fragmented. The capacity of a paradigm to amalgamate disparate elements of the cognised becomes increasingly reduced. This happened in the case of Newtonian mechanics with Mercury's perturbation. Mercury's behaviour remained outside the compass of the Newtonian gestalt. Yet it should not have done so. In effect, the failure of the mechanics to deal with Mercury was tantamount to *pregnanz* being lost from the gestalt. It is at stages like this, then, that a scientist apprehends dissonance, and has to begin living in a world that "is out of joint" (Kuhn, 1973, p.79). The need to recover 'c-dyad' harmony, to put the world back into epistemological joint, therefore, acts as the psychological motivation to a cogniser activity.

It was also noted in 3.4 that gestalts in which *pregnanz* or closure is absent - which are not in fact true gestalts - tend to be a source of psychological discomfort. It is possible, for instance, to demonstrate the heightened states of tension and emotional arousal that accompany feelings of structural disunity in a perceptual situation. The mind, then, feels distinct unease if it has to confront situations where unity and cohesion are absent. They are a source of considerable tension for the mind; and it is of note that there would appear to be strong drives to reduce such tension. It is of equal note, that when such tension is reduced, and a gestalt is produced to combat the feeling of disunity, the mind achieves an overriding sense of relief and satisfaction, of pleasure and gratification (Kreitler, Kreitler, 1972, pp.12-13).

If parallels, then, can be drawn between the perceptual and the epistemological circumstances, it seems probable that when a piece of knowledge loses its *pregnanz*, it too is a source of 'mental disturbance'
and discomfort, which does not cease until a new gestalt is uncovered. Certainly, if recovering that *pregnanz* is seen to be like solving a problem, then, according to Wertheimer (1945), there are undoubted similarities. For he noted that when a problem is encountered in the environment it triggers a mental process that only ceases when the solution to the problem has been found. Wertheimer, in fact, sees a problem as a structurally incomplete situation. It is a gestalt from which the link of *pregnanz* is missing. The solution to a problem, then, supplies that missing link. But what that missing link really amounts to is a new gestalt of knowledge that is better able to incorporate those elements which a previous gestalt, as it were, 'locked out' of its compass. It was in this sense that Newtonian mechanics locked out of its compass the perturbation of Mercury, which in due course led to a structurally incomplete situation. Initially, as was noted in 2.5, the first attempts to fill the "heuristic gap" were centred on explaining the perturbation in terms of the Newtonian gestalt. But whilst all sorts of ingenious explanations were invented to accommodate the perturbation in that gestalt, none was ultimately satisfactory. There was always some dissonance inherent in those explanations that upset the attainment of structural completeness and the solution of Mercury's problem. That was because the problem of Mercury's perturbation could never be solved within the Newtonian gestalt; it required a different gestalt altogether to explain it. There had to be a completely new organization and "reconstruction" of the fundamentals involved, one which would alter altogether some of the extant generalizations governing the behaviour of those fundamentals (Kühn, 1973, p.85). That organization was, of course, forthcoming with the advent of the theory of relativity, for within the gestalt
of relativity it proved possible to accommodate the problem of Mercury's perturbation, and thereby modulate the dissonance it had caused.

To explain Mercury, then, required a fundamentally new way of looking at the universe. Since the advent of Newtonian mechanics, scientists had grown used to seeing everything in the universe in its terms. Because of the considerable causal efficacy of that mechanics, scientists had developed a faith in them to the degree that they had almost come to believe that they were inviolable (Born, 1962, p.101; Capek, 1964, p.xiii; Einstein, 1951, p.21). Scientists had become so habituated to assuming that the universe only ever obeyed the rules of Newtonian mechanics, that it had become virtually impossible for them to break the habit. They were rather like those subjects on whom Postman and Bruner (Kuhn, 1973, p.52) conducted their anomalous playing card experiments. In an analogous way, as Kuhn points out, just as those subjects had not been able to perceive that what they were seeing was not a 'red heart' but a 'red spade', because of their habitual familiarity with playing cards, so scientists could only ever see the universe as a 'red heart'. So that when a 'red spade' in the form of Mercury's perturbation, came along, it took them some time to see it as such. Their preconceptions had to be jerked out of old habits. One set of 'seeing as' theories had to be substituted for another. In fact, they had to undergo a complete "gestalt switch". To use an analogy cited earlier: they had to see Eskimoes where previously they had only seen American Indians.

To overcome a dissonance and cross a heuristic gap, then, it might first be necessary for a cogniser to rid himself of some theory that is "contaminating" his view of the world. This was necessary in the case of Mercury. However, this is but one possible variety of
modulation that may occur in the triad; a number of others will be examined in the next section.

4.12 VARIETIES OF MODULATION: SOME EXAMPLES

With Mercury's perturbation, the paradigm of Newtonian mechanics had tended to reach the limits of its extensibility. Henceforth, objections, doubts and suspicions began to gather which were eventually to undermine the paradigm's supposed inviolability. Dissonance in the paradigm, then, tended to erupt slowly as counter-instances in the cognised were revealed which proved to be beyond the power of the paradigm to accommodate. The incipient collapse of one paradigm, then, tended to provide the circumstances from which another was born. Since it is doubt and objection that are the prelude to dissonance, the modulation which subsequently brings about that consonance to the 'c-dyad' which is required when a paradigm is overthrown will be called 'aporetic' modulation. Not all new knowledge, however, is born by devouring an extant paradigm and carrying our aporetic modulation. This section in fact will concern itself with other and less drastic ways of bringing knowledge into the world; it will also show how these ways can be accommodated within the framework of the triad.

Most scientific activity - that which Kuhn describes as normal science - in fact is concerned with merely seeking confirming instances that will reinforce the tenability of a paradigm. Calculating another physical constant for a chemical compound or element would fall into this category of epistemological activity. The methods of calculating that constant have been established and have been well authenticated. The researcher does not have to invent any radically new methodological
procedures, or break any new theoretical territory to engage in normal science. He merely follows an attested set of procedures that are normally used. Yet though his practices might be routine, the researcher is modulating a dissonance of a kind. If a physical constant for a particular chemical compound remains unknown, then there is a "heuristic gap" between that unknown and the cognition domain; and that gap—though it might be relatively easy to cross—constitutes a dissonance. Because the modulation of such dissonance tends to supply further evidence demonstrating the incontrovertible nature of a paradigm, such modulations will be called 'apodictic' modulations. Unlike aporetic modulations, they tend to supply further grounds to support rather than refute the empirical credibility of a paradigm; they tend further to augment its consonance.

But it is not always necessary that there should be some paradigm or theory to sponsor and guide the gathering of knowledge; for sometimes that paradigm does not exist; it has first to be fabricated. That is sometimes affected by the patient and painstaking accumulation of facts from the cognised, and then hoping that some overall order or generality can be discerned in those facts. The classical expositions of this mode of knowledge gathering are Darwin's theories about hereditary (Grene, 1974, p. 191; Harré, 1974, p. 37). But whilst "fact collecting" was an important ingredient in the creation of those theories, on its own it did not bring them about. That needed an act of "scientific imagination" that was able to produce a "conceptual gestalt" that could encompass and give a whole to the sum of all the accumulated facts.

Since knowledge gathered in this way tends initially to follow the principles of Baconian induction, the modulation which finally brings
such knowledge about will be called an 'inductive' modulation. What it attempts to do is envisage a comprehensive theory that will explain all the facts that have been collected about a certain phenomenon in the cognised. It is a matter, then, in inductive modulation, of the facts coming first, and the theories later. This will become more evident in the following example.

In 2.5, some brief references were made, in another context, about how it was the Norwegian explorer, Nansen, came to discover the existence of an Arctic Ocean. The route to its discovery, in fact, fell into four main stages, beginning with a set of inductive observations. These concerned driftwood found off the coast of Greenland, in the Denmark Strait. It is perhaps important to note at this juncture, since it bears on certain issues to be raised in Chapter Six, why Nansen's attention should have been aroused to the driftwood (a) at all, and (b) in a way quite different from the Eskimoes, who saw such driftwood only in functional terms - it being a source of wood for their throwing sticks! For Nansen's interest in the driftwood was of a different epistemological order altogether. It was not situated in the 'ultra-violet' domains of the knowledge spectrum (see 4.5), like that of the Eskimoes, but rather in those domains occupied by geography and botany. The reason for these grossly different reactions to the driftwood - to build on the thesis developed in Chapter Two - is related to the rather different 'epistemological' emphases in the respective backgrounds of Nansen and the Greenland Eskimoes. Trained as a botanist, Nansen would have been more than ordinarily sensitive to the various specimens of the floral world he encountered, especially where those specimens proved on initial sighting to be so topographically incongruous. For in being able to
identify the driftwood as belonging to larch and fir, Nansen soon realised that of all the places bounded by ice those trees were only found in Northern Siberia, a place very remote from the Denmark Strait where he had found the driftwood. Since such wood does not normally "travel" of its own volition, and continental land masses could be regarded as relatively fixed in their positions, Nansen presumed there must be something wrong with current theories about the nature of the Arctic land mass: that is, that it was simply an extension of Franz Josef Land. For the observed fact that pieces of driftwood were being regularly transported from Northern Siberia to the Denmark Strait was dissonant with the notion that the Arctic was "one continuous track of land" (Nansen, 1897, p.15). And since Nansen could be certain of his dendrological facts, and since there was also some evidence that the mud compacted into the ice seemed also to be of Siberian origin, he was forced to conclude that perhaps the Arctic was not a fixed land mass at all, but one continuous ocean in which:

"a current flows at some point between the Pole and Franz Josef Land from the Siberian Arctic Sea to the east coast of Greenland" (Nansen, 1897, p.24).

It was on that current, and the ice floes that conveyed it, that the (Siberian) driftwood travelled. At least, if that current existed - and Nansen still had to prove that it did - it would serve to modulate the dissonance between the C^\text{\textsubscript{n}} knowledge that the Arctic is a land mass, and certain inductively gained evidence retrieved from the Arctic cognised (C^\text{\textsubscript{d'_1}}), that seemed to contradict that fact. As a postulate, then, the hypothesis that there was an Arctic current appeared to re-establish the consonance that Nansen felt was absent along the 'c-dyad'. But in order to verify his hypothesis, so to speak, to
'sound out' its consonance, he had to demonstrate the existence of Arctic drift. This Nansen subsequently did in embarking on a three year voyage from Spitzbergen to Greenland, on the very ice floes upon which his driftwood has travelled in the first place. That was the proof finally required to render the 'c-dyad' harmonic again.

In a sense, Nansen's discovery of Arctic drift was both an inductive and an aporetic modulation. For whilst the evidence he gathered from the cognised led to a new theory about Arctic geography, in doing so it also challenged an existing theory about it. To that extent, the theory was aporetically induced. But it is not always the case, as it was with Nansen, that the empirical facts come first, and the theory which will accommodate those facts, second. Sometimes, as happens in situation of what will be called 'retroductive' modulation, the theory comes first, and the facts which will support that theory, second. It was in this way that Kepler worked out the orbit of Mars (Peirce, 1931, p.31). He started out with a 'law' - that Mars proceeded around the sun in circular orbit - and then tested that law against the evidence. He worked from the cognition radical of the triad to the cognised, instead of the other way about, as happens in the case of inductive modulation. Eventually, Kepler was forced by the evidence to reject the 'law' and enjoined, apparently with great reluctance, to accept that the orbit of Mars was elliptical. Thus, Kepler was able to work out and predict the positions of the planet as it journeyed around the sun. If these predictions corresponded with the positions of Mars as they were observed, then his new law was consonant with the cognised.

The need for retroduction modulation, in fact, tends to become much more of an imperative where the cognised being dealt with is difficult
to examine and observe, even with the aid of "sense expanders". Obviously with a premium on the number of satisfactory observations which can be made, inductive modulation in such circumstances becomes a difficult way to generate knowledge. It becomes easier to formulate a hypothesis about what the cognised might be like, and to see whether in fact observation bears it out. This certainly tends to be the procedure of much epistemological activity in the field of "elementary particle physics". Thus, the neutrino, for instance, was initially a hypothetical construct conceived to account for the apparent lack of conservation of energy in beta particle disintegrations. In order to do this, it was hypothesized that the neutrino would also have to possess certain designatable properties (Hanson, 1969b, p.124). But, of course, until such a particle was observed with the properties accorded to the neutrino, the 'c-dyad' concerned with it would remain an unresolved dissonance; and retroductive modulation would remain incomplete.

Retroductive modulation, however, is not always restricted to understanding the phenomena of the sub-organic cognised \((C_{d1})\). The Swiss pioneer of semiotics, Saussure, brought much the same methodological technique to bear on the problem of understanding the phonemic character of certain archaic languages, phenomena of the supra-organic cognised \((C_{d3})\). What Saussure addressed himself to in particular was the nature of the "vowel alternation" that must have occurred in the link language that existed between Sanskrit and ancient Greek. The trouble was, at the time of Saussure's speculations, that link language was not available for its phonemic features to be examined and analysed. Retroductive modulation was therefore forced upon Saussure. Sanskrit and its descendent, ancient Greek, did
exist and therefore could be analysed. And by inspecting their phonemic features, Saussure postulated that within the link language there would be one phoneme which had the property that it "could stand alone to form a syllable, like a vowel, but it could also combine with another vowel, like a consonant" (Culler, 1976, p.66). Until the language containing that phoneme was discovered, however, the dissonance or consonance of Saussure's postulate remained undetermined. In fact, some fifty years after Saussure's initial speculations about it, a language, Hittite, was found that contained a cuneiform that operated, phonetically, exactly as Saussure predicted. Then, and only then, was the retroductive modulation finally complete, and a consonance between cognition and the cognised attained.

Where the derivation of scientific knowledge is concerned, the resolution of dissonance in the triad, whether managed by aporetic, apodictic, retroductive or inductive modes of modulation, ultimately centres around securing the sort of empirical evidence from the cognised that will support the tenability of the knowledge involved. It is a matter of improving the balance between the cognition and cognised radicals of the triad. In fact it is by improving that balance that scientific knowledge tends to progress. But in other disciplines (see 4.9), the pursuit of knowledge tends to be less dependent upon creating a balanced equation between $C_n$ and $C_d$. Indeed, there is sometimes an attempt to repress the pursuit of that equation altogether. So without the cognised to monitor the epistemological efficacy or otherwise of knowledge contained within these disciplines, how does modulation and progress occur within them? That will be examined in the next section.
4.13 NON-EMPIRICAL MODULATION

In moving from the left- to the right-hand ends of the knowledge spectrum (see 4.6), it has been observed that there is a progressive increase in the degree of testability to which the knowledge involved can be submitted. Thus, that knowledge on the extreme right of the spectrum demands that its truths offer the possibility of demonstration in the cognised; whereas that to the extreme left - because it frequently deals with metaphysical realms, realms beyond the world of experience - cannot be demonstrated or refuted on empirical grounds at all. But of course, and it is somewhat of a paradox, the principal varieties of extreme left-hand knowledge - religion and mythological knowledge - frequently claim to offer explanations about the nature and condition of the empirical cognised. Myths about the origins of man and the universe, whilst they might defy the precepts and rules of Western logic and science, however, make perfect sense within the framework of the culture that upholds them. They only appear dissonant when an alien set of epistemological criteria, say those of right-handed science, are applied to them. Otherwise, as was noted in the case of the Azande (see 2.2), given the set of premises and propositions that govern mythological thinking in the culture, they appear as consonant with the facts of reality as Einstein's theory of relativity does to a modern scientifically literate culture. Yet it is frequently a property of left-hand knowledge that it remains unresponsive to its epistemological failings. Rather than modify the knowledge itself - as tends to happen in the right-hand sectors of the spectrum - when anomalies are unearthed in the left-hand knowledge, a series of "secondary elaborations" are formulated that will excuse these
anomalies (Horton, 1974, p.162). The central tenets of left-hand knowledge tend to be protected from findings that would threaten to overthrow them. A taboo tends to be placed on those modes of knowledge and that kind of evidence which are incompatible with the orthodoxies of left-hand knowledge. It is as though the rhythm of consonance and dissonance, that normally generates scientific knowledge, is suspended when it comes to left-hand knowledge; and that dissonance when it happens, poses no outward threat to the knowledge itself. Epistemological activity, then, within the ambit of left-hand knowledge tends to be mainly concerned with conserving the epistemological status quo; and modulation within it, with circumventing and proffering explanations that will parry and counter threats to that conservation.

When it comes to the arts a rather different set of imperatives are responsible for generating modulation. Whether art in fact is a vehicle for knowledge and truth is a matter of debate, although it was asserted in 4.6 that certain forms of art do propound quasi-epistemological propositions - albeit non-testable propositions (Kuhn, 1974b, p.245). But having said that, art's epistemological activities are also diverse and various. It does not appear to take any single domain in the cognised as properly its own, but, as was also noted in 4.6, art tends to embrace in its dominion religious, psychological, social and historical concerns. And although growth and development are discernible in the arts, it is not that linear and sequential growth that, comparatively speaking, tends to be encountered in science (Crane, 1972, pp.26-28). Thus, whilst it is impossible to envisage Leverrier's astronomy without Newton's physics, George Eliot's novels are not necessarily constructed on the insights into social and
psychological behaviour that are available in Jane Austen's novels. Nor does art seem to involve the kind of knowledge that strips the patina from reality and offers visions of it not previously glimpsed or known about. The epistemological differences between Shakespeare and Ibsen are not of the same order that divide the science of Newton and Einstein. For art rarely penetrates new frontiers of epistemological awareness. Art is rather a continuous variation on a limited set of themes; it has a concentric rather than sequential pattern to it; it is constantly returning to perennial subjects, like the nature of tragedy and so on (Bell, 1966, p.140). Whereas science moves forward conquering unexplored regions, revealing the new 'inhabitants' that dwell there, art tends to revolve on its axis, exploring the same themes it has always explored.

But yet art does change, very visibly so, and in ways that are just as revolutionary as anything found in the sciences. There is a world of difference between a painting by Giotto and one by Ingres, and more so between the paintings of Leonardo and Picasso. So is it possible, as Dryden (1969) postulated in 1669, that just as "natural causes" have become better known since the time of Aristotle, that poetry and painting and the other arts have also driven closer to perfection? But if art's content and subject matter do not change, what does it mean to attain that perfection?

Because pre-Twentieth Century Western art tended to hanker after realism, its progress could be explained in quasi-empirical terms. Representational painting of the sort Giotto and Ingres executed was, after all, only an iconic way of making an equation between the cognition and the cognised radicals of the triad. The summit of perfection in painting therefore, as Vasari indicated in the Fifteenth
Century, would be attained with the summit of realism and the exact reproduction of nature (Gablik, 1976, p.155). It is possible, then, to see the development of painting as simply the attainment of this end. Certainly, this has been the approach of Gombrich to the problem of explaining the history of painting. Conscious of Popper's theories of scientific development (Gombrich, 1960; Magee, 1972, p.228), Gombrich sees the pursuit of likeness and verity in painting as a progress story of "error elimination" and "false hypotheses" about how that likeness can be more effectively achieved. Development in painting, then, like that of science, has had, until quite recently, the persistent objective of augmenting the harmony between cognition and cognised. It has aimed to make it more consonant. But whilst Gombrich does offer a way of accommodating the newer developments into his theory of artistic development, the major weakness in his approach is that it fails to explain in a convincing way, the course art takes, after it is diverted from realism, and goes abstract. Other ways, notably Gablik's (1976), have tried resurrecting a kind of "culture epoch" theory to explain this most recent direction in art's course. Gablik, in fact, sees the history of painting as recapitulating the stages of Piagetian cognitive development. With the coming of abstraction, the history of painting has done no more than move into its "formal operations" phase! But whatever the reason for painting, and art in general, for taking the various courses it has, plainly, since art does not always emulate the sciences, there must be other reasons for generating revolutions in it, that, moreover, would tend to spring from rather different sources than those that cause paradigm collapse in the sciences. For if one of the reasons for paradigm collapse in the sciences is the breakdown in the marriage between C_n
and $C_d$, except when art is decidedly empirical - and that tends to be so only in the case of some eras of painting and literature - there must be some other stimulus for change in it. If that stimulus can be found, then, some clue about how changes occur in the arts might be forthcoming.

The ability to respond to art in a profound and meaningful way, just like that required in science, it was noted (see 2.4), is somewhat dependent on "theory contamination". Without an appropriate set of theories to augment the perception of art, much of the meaning, symbolism and expression inherent in it will never be discerned. To see a painting in all its aesthetic 'colours' needs as practised an eye as does the radiologist interpreting an X-ray plate; and what is true of painting is equally true of reading a poem or listening to a piece of music. Unless the observer of art possesses theories then the experience of art will be superficial and impoverished. But, paradoxically, it is possible to become over-imbued with theory about art. One can have such a comprehensive appreciation of an art, that there is nothing new to see in it; art, in such circumstances, can have no more surprises. It is a bit like the situation with the playing card experiments discussed earlier. And in such a situation, art, as Koestler (1964, p.336) has pointed out, soon "loses its emotive impact, its transcendental appeal and aesthetic impact". It becomes stagnant and its expressive power becomes blunted. Art becomes a "superior entertainment", not a powerful and moving expression of the human condition. In Adorno's (1973,pp.33-34) view, this is what happened to music in the late Nineteenth Century. Certain harmonies were exploited to a degree that their musical possibilities became emasculated. They became "impotent clichés" that served only to send
the sensibility to sleep. No real intelligence or imagination was required to appreciate them.

The way out of this creative cul-de-sac is to confront the world with an art form which is a revolutionary departure from orthodoxy. This proves to be the only way in which the art world can be awakened from its complacency and be made to look at art with a fresh and intelligent gaze (Koestler, 1964, p.33). In art, then, consonance for any period leads to aesthetic ease and repose, and that is ultimately anathema to the vigour of art. If art is not to sink into an expressionless torpor, it needs periodic shocks and reforms. The forms in which art presents itself need to be renovated and overhauled. It is the recognition of this need which is the equivalent to the dissonant state encountered in science. And when these renovatory forms have been conceived, an artistic dissonance is modulated. Thus, in music, as if to repudiate the over exploitation of tonality in the Nineteenth Century, one finds composers like Schoenberg and Webern who were keen to expand the "limited number of tonal combinations" and embrace all the notes of the chromatic scale. What is seen in their music is the dethroning of tonality and the renouncement of key modulation, the dominant principles of the Romantic symphony and sonata. In their stead came the "emancipation of dissonance" (Schoenberg, 1951, p.137), and that offered a range of musical possibilities not previously explored in the history of music.

What serves to generate change in art, then, is not so much a refutation of \( C_n \) by \( C_d \), but rather modifications in the method for generating \( C_n \). The shifts that occur in artistic development are modal rather than, in the strict Kuhnian sense of the word, paradigmatic. It is not so much that the 'knowledge' in art is discovered to be
anomalous or falsifiable, but that the methods for creating that knowledge prove, so to speak, anomalous and falsifiable. If, in fact, science and art were at all analogous in this respect, then in science too there would be periodic and wholesale disillusionment with the scientific method, and scientists would become suddenly committed to a method that acquitted their epistemological interest more powerfully and effectively. But in science, of course, it is the matter of knowledge which is subject to review and modification, not the manner of generating it.

These observations about the probable forces engendering change in the arts and the sciences respectively, in fact accord with what ultimately differentiates an art from a science. For in 4.5 it was indicated that, in an art, technique is uppermost to epistemological content, whereas in a science the reverse situation tends to prevail. Thus it would be expected that in art more attention would be given to the framework in which epistemological content is presented, rather than the content itself. And this tends to be so, for the majority of major changes in art tend to be those affecting the method rather than the matter of art. That is where the mass of modulation occurs. Now whether these methods, these frameworks which guide artistic activity, are technically paradigms or not, is another matter. Kuhn (1969) has his reservations; some of his disciples much less so. Crane (1972, pp.134-138) for instance, sees the "discovery of perspective, Igor Stravinsky's bitonality, James Joyce's experiments with words", as paradigms that, just as their equivalents in science, serve to orientate the outlook and practises of the artistic community as a whole. But certainly science and art do have in common the fact that their respective developments pass through phases of revolution, wherein a
paradigm is overthrown and replaced, and phases of normality, when a paradigm is simply applied as a matter of course. Where art and science differ somewhat is in the matter of what causes the paradigm to be communally revoked. For artists seem to find fault with their paradigms out of a different sense of revisionist critique than that of scientists. Artists tend to quarrel with the methods dictating the practises of their discipline, as artists should! Scientists, on the other hand, quarrel with the content of their discipline. Methodology, because it is of more paramount concern, is more ephemeral in art than it is in science, and therefore more subject to change.

4.14 SOME CONCLUSIONS WHICH ANTICIPATE CHAPTER FIVE

This chapter has shown that the phenomenon of knowledge is properly speaking a conjunction between itself, the knower and his relation to something called reality. A model of this relationship in the triad has been developed. But as far as this study is concerned, the triad is only the very beginning of the epistemological story. It has been implied, for instance, that in order to perceive dissonance in the triad, the cogniser must initially have a commitment to the knowledge area involved. But how and under what conditions does a cogniser attain that commitment? For plainly not all cognisers who may have some measure of that commitment are either capable or qualified enough to perceive that, in fact, a paradigm is anomalous or dissonant, let alone modulate it. That perception tends to be the privilege of those cognisers who are at the "research frontier" of a disciplinary community. In the final half of this study, it will be
argued, that in disciplinary communities different types of cogniser can be identified, of whom only a few are trained to recognise and modulate dissonances. The other members of the community tend to have other, but no less essential, responsibilities in such communities. What the remaining two chapters of this study will attempt to do, then, is describe and typify these responsibilities and show how they, like other aspects of the phenomenon of knowledge, can be accommodated within the 'arms' of the knowledge triad.
CHAPTER FIVE

THE DISCIPLINARY CONTINUUM AND ADMITTANCE INTO DISCIPLINARY COMMUNITIES

"Learning is but an adjunct to ourself
And where we are our learning likewise is".

(Love's Labour Lost, Act IV, Sc.iii)
5.1 INTRODUCTION

Whilst it has been indicated that the knowledge triad produces an authentic portrait of the epistemological enterprise, as far as accommodating the social profile of knowledge is concerned, it is singularly lacking. This could be acceptable if that profile was at all an inconsequential aspect of knowledge, whose features were only peripherally attached to the functioning of knowledge. But that is not so. Of course, the social dimension of knowledge need not form the principal focus of epistemological attention. Indeed, it can be neglected altogether. It is often contended, for instance, that true knowledge can be divorced from the social context in which it is formed, and that therefore investigation into that context, as far as understanding the logical and conceptual features of knowledge is concerned, is quite otiose. But whilst what remains an essentially Platonist view of knowledge is venerated in some quarters and still serves to vindicate approaches to knowledge that seal it off from social and human considerations, newer ways of examining knowledge tend to regard a wholly de-anthropomorphised and 'de-socialised' account of knowledge as a mythical abstraction that has no foundation in the actuality of knowledge.

If not exactly suspended, then, the ethic of a Platonist approach to knowledge is treated with a degree of healthy circumspection. This is because obedience to its principles tends to disguise what are functionally inescapable facts about the condition of knowledge. Firstly, there are those facts which emerge from the consequences of what is, in the history of epistemology, essentially
the Humean ethic: that there is "no knowledge without knowers". It was the application of that ethic - with its obligation to seek out those facets of knowledge which are influenced by man's psychology - that principally gave birth to the triad. But embodied in the Humean ethic is another inescapable fact about knowledge: that it is pre-eminently a social activity (Ziman, 1968, p.8; Storer, 1966, p.75). Paradoxically, it is precisely to prevent degeneracy into the distortions of anthropomorphism and to uphold the tenor of its objectivity, that the whole phenomenon of knowledge is contracted to having the social dimension that the Platonist would have epistemology deny. For in order to achieve the Platonic ideal of a knowledge untainted by human prejudice, there must be somewhere within its framework a normative order of some kind that will permit the effects of subjectivity and speciousness to be isolated. That normative order, as will be shown in Chapter Six, exists principally in the social arena of knowledge. It is possible, then, to speak, as Merton (1972, p.67) does, of knowledge being a rational or conceptual system which is constrained by a social envelope of consensual standards. These standards form the 'moral code' of a knowledge community, and it is how each respective community and its members come to submit themselves to that code that will represent one of the main themes of this, and the next chapter.

At the end of Chapter Four, it was indicated that advancing the frontier of knowledge represented, in terms of the triad, modulation of 'c-dyad' dissonance. But in order to perceive that dissonance, the cogniser must first have acquired an epistemological sensitivity capable of alerting him to any discord that there might be between established knowledge and the behaviour of the cognised. That sensitivity, it has been argued, arises as the cumulative effect of being exposed to know-
ledge. For knowledge serves to transform a cogniser's outlook and amplify aspects of the cognised which normally lie outside the compass of ordinary sensitivity. Or if they do not, then their epistemological significance remains unregistered. There are, however, more elements to epistemological sensitivity than there are in a transformed vision of the world, for knowledge itself represents more than just a prescription for looking. There is, for instance, what has just been referred to as the 'moral code' of knowledge, to which the various transmutations of looking must be answerable if they are not to be considered deviant. That code, then, serves to trammel a cogniser's conduct, and make it conform to patterns that are considered acceptable in the knowledge community as a whole. Then there are the various publicly accredited ways of transmuting the experience of looking into knowledge. They also constitute a major zone in the complexion of epistemological sensitivity which must be mastered if the cogniser is to develop the capacity to modulate dissonance and create new knowledge.

It can be said, then, that what Ayer (1972, p.33) has called the "accredited routes to knowledge" take in, as part of their itinerary, (a) a perceptual sensitivity, (b) a communally defined 'moral code' and (c) a repertory of epistemological knacks for processing experience. And whilst, in this study, it has repeatedly been stated that the route to acquiring these elements of an epistemological sensitivity travels via education, the description of the 'journey' involved has, at best, only been cursory. It remains another of the objectives of this chapter, then, to compensate for this by supplying a detailed account of the sorts of 'obstacles' and 'landmarks' the cogniser encounters in education as he progressively makes
his way to the research frontier of knowledge.

5.2 THE STYLES OF EPISTEMOLOGICAL SENSITIVITY

Whilst it will be argued that disciplinary communities require new knowledge, and, therefore cognisers to produce that knowledge, not all cognisers need be in the business of modulating dissonance in order to serve in those communities. Similarly, it is possible for cognisers to exist outside of disciplinary communities altogether, and still be profoundly sensitive to knowledge. Thus, the cogniser whose responsibility revolves around gathering new knowledge, and who requires for the purpose an 'acquisitive sensitivity', represents only one type of cogniser. Another cogniser on whom the existence of the disciplinary community depends is the type who possesses the 'educative sensitivity' required for transmitting knowledge and all its associated features. Teachers, who in the main possess this sensitivity, then, are alert to the problems of communicating, rather than acquiring knowledge. They have been trained and equipped with the means of transferring knowledge from one generation of cognisers to the next. But teachers not only transfer knowledge to those who will subsequently become bona fide members of disciplinary communities, they also cultivate in some cognisers a purely 'appreciative' sensitivity towards knowledge.

There is, then, an element of duplicity in education's subservience to the knowledge ideal. Firstly, there is the functional obligation to manage the training of those cognisers who will eventually give service in the various disciplinary communities. In the past,
this training tended, in a rather laissez-faire manner, to occur outside the framework of educational institutions.* Today, however, it is difficult to secure admittance into disciplinary communities, and gain recognition therein, without the credentials that educational institutions award. That being the case, since the numbers who experience education are great, and the numbers who eventually become professionally employed in the "knowledge industries" are comparatively small, it could well be argued that perhaps education should re-examine its epistemological 'idol', and select one that accords much more with the needs of the majority. But if education's instrumental end of serving the needs of knowledge communities disproportionately favours the minority, that argument is often countered by imparting benefits to knowledge that can be taken advantage of by the majority. And it is at this juncture that education's functional idolisation of knowledge fuses with certain melioristic ends that attach to knowledge the power to develop understanding and reason in all, and not just the minority. Since these things are held to be desirable in themselves, in that what makes man essentially man is the pursuit of rationality and truth, education's allegiance to knowledge is doubly reinforced. Thus, the assumption that it is knowledge which has the capacity to make man

* Although the natural sciences have been extant for several centuries, it is only in the last hundred years or so that they have achieved some measure of academic representation in universities and schools. Whilst the early universities, like Bologna and Paris (but not Oxford and Leipzig), did of course have their chairs of science, in the case of Bologna since the Fifteenth Century, they were never considered to be as academically respectable as other disciplines. In fact it was not until the mid-Nineteenth Century that the educational networks and bureaucracies that now form the context in which the training and practise of scientific researchers occurs, were established. That first occurred in Germany. There, models of scientific education were developed, which, having a previously unknown educational effectiveness, soon became the pattern for universities outside Germany to follow (Ben-David, 1971).
a more reasonable creature has often been used to vindicate an education which takes knowledge as its centre of gravity.*

But aside from all the existential benefits that are said to accrue from acquiring knowledge, its dominant presence in education is often defended on Arnoldian grounds: that knowledge represents one of those excellencies of our culture to which people ought to be introduced. The principal purpose of education, according to this view, is to foster, lest it be silenced, a "conversation" with the various achievements of human civilization (Oakeshott, 1967, p.199; 1973, p.170). That is because in order to participate in that conversation, the cogniser must first master its syntax and grammar. This mastery does not arise in a vacuum, but requires implantation. Education has evolved to carry out that implantation over all parts of the knowledge spectrum. For it is true of both the arts and the sciences, at even the level of 'appreciative sensitivity', that substantial training and epistemological background are required if their significance is to be fully registered. In connection with science, this, it has been noted, has often been pointed out by Hanson (1969a, 1969b). It seems an educated vision is absolutely essential if the full repercussions of scientific theories and laws are to be appreciated. And what is true of their appreciation, as was noted in 2.6, appears to be equally true of paintings, poems and pieces of music. A set of educated preconceptions and expectations is a vital part of deciphering an artist's

* This is the stance taken particularly by R.S. Peters and his followers, who have made a virtual cult of reason and its development. Quite legitimately, it has been asked (Watt, 1976), however, whether there are not more sides to a man's psyche than reason; and that if education takes as its sole centre of gravity only those forms of knowledge in which reason resides, might not these aspects of the psyche be inhibited from developing to their full potential?
'cryptograms'. Unless they are present in the cogniser, that is all art will remain, an unrecognisable cryptogram. Thus, the concept of an aesthetic tabula rasa, devoid of preliminary predispositions to art, is a contradiction in terms; for art is only ever appreciated via the mechanics of an educated vision.

It would seem, then, that if education does serve the knowledge ideal on the functional grounds that no other institution in society currently manages the training of personnel for the disciplinary communities, then that function can also be justified on normative grounds; that a broad general education in the major areas of knowledge is in any case good for humanity. Knowledge not only makes scholars, but is the key to becoming a better person as well (Frye, 1967, p.75; Langford, 1973, p.14). This, combined with the fact that much the same kind of initial epistemological background is required to appreciate knowledge as is needed to communicate or acquire it, would suggest that education's current allegiance to knowledge is no more than the 'killing of two epistemological birds with the same institutional stone'. Education, then, serves the dual function (a) of preparing cognisers to do service in disciplinary communities as, amongst other roles, teachers and researchers and (b) of transforming the mental outlook of others, who, although they will not serve in such communities, will have the capacity to appreciate knowledge long after they have left school and university. Of these two functions, this chapter will essentially be concerned with the first, and how it is that disciplinary communities come to recruit cognisers to their service.
5.3 THE DISCIPLINES AND THE NATURE OF ORDERLY EPISTEMOLOGICAL CONDUCT

So far, the transformative effects of knowledge on cognisers have been considered primarily from the perspective of the kinds of perceptual ramifications they have on the outlook of cognisers. It has been suggested, for instance, that knowledge serves to amplify the power of the cogniser's senses, allowing him to perceive aspects of reality that otherwise would remain unperceived. But this amplification does not involve any artificial modification of the mind's powers; for the transformation in outlook that knowledge engenders merely channels what comes naturally to the mind anyway. It directs to epistemological quarters what the mind normally does in its informal encounters with 'reality'. And just as certain kinds of language and topography serve to exaggerate perceptual sensitivity in directions that others do not, so certain knowledge amasses in the cogniser awarenesses and expectations about the behaviour of reality that those lacking that knowledge are denied. Knowledge, then, exploits that capacity of man to construct from his experience of reality a reliable set of predictions about the world and its behaviour. In such terms, knowledge is no more than a sophisticated manifestation of what was described earlier as one of the fundamental necessities of animal life, the "propriorceptive act".

But as was also noted earlier (see 5.1), knowledge is more than just a mode of looking. It might serve to transform outlook; left at that, however, that is all it remains; an outlook. For knowledge also consists of a repertoire of procedures for integrating that outlook. Knowledge, in fact, arises from what is done to the outlook, it is
not synonymous with it. Reorientation of attention, then, on its own, would only allow the cogniser to perceive knowledge, not formulate it. That only comes about when what is perceived is converted into terms that can be accommodated by the various epistemological procedures for dealing with experience. Bringing about that conversion involves conceptual rather than perceptual aspects of knowledge.

Admittance into a disciplinary community involves transformation on both epistemological planes: the perceptual and the conceptual. Knowledge, then, not only promotes a mode of looking, but a set of methodologies that will enable that looking to be converted into knowledge.

Before embarking on any knowledge training the cogniser lacks any of the requisite sensitivity needed to become a member of a disciplinary community. He will have an 'a-dyad' outlook on the world, but it will be one that is neither circumscribed nor specialised enough to be compatible with that outlook of a disciplinary community. But as a cogniser undergoes training, his epistemological sensitivity gradually comes to conform with that of the community as a whole.

The notion that epistemological training serves to trammel cognitive behaviour is implicit in the etymology and current usage of the word 'discipline', as are other pertinent notions about knowledge activity. To these, Hirst and Peters (1970, p.125), have drawn particular attention. The notion, for instance, that a 'discipline' imposes cognitive constraints evokes analogies with the behavioural connotations in the infinitive case of the word 'discipline'. For 'to discipline' is to bring to order or to achieve some measure of control within the parameters of a defined set of constraints. This entails the introduction of a degree of order that otherwise would be absent.
Discipline, then, in the behavioural rather than the epistemological sense, carries with it associations that link the establishment and maintenance of order to rules and regulations, designed to delimit behaviour. Co-incidentally, this is not an inappropriate description of knowledge, for it also comprises a set of rules and prescriptions, which allow both experience to be organised and epistemological conduct to be controlled.* The epistemological and behavioural senses of the word 'discipline', then, are close allies.

There is another sense, this time springing from its etymology, in which the word 'discipline' is apposite. The notion that a discipline is essentially "a body of subject matter that is teachable" (Walton, 1963, p.5), with the accent on "teachable", is reinforced by the fact that discipline shares a root with the Latin word discipulus, meaning pupil or student. What this tends to emphasise is that the intelligent, 'law abiding' behaviour that is a mark of the epistemologically disciplined cogniser, does not arise of its own accord, but emerges out of the slow accretion of knowledge. Moreover, those experiences - and this is where the etymology of discipline shows its appositeness - are carefully managed by teachers, who ensure that a student - the discipulus - not only acquires the substantive content of a discipline, but also those rules and regulations that are a feature of its normative structure.

Admittance to a disciplinary community, then, is carefully controlled. The passage from discipulus to 'disciplinarian' - achieved

* It is also interesting to note in this connection that 'discipline' shares similarities in its connotations with the archaic sense of the word 'art'. The medieval philosopher, John of Salisbury (McGarry, 1955, p.36) pointed this out when he noted that 'art' stems from the Greek word 'artant', meaning to delimit by rules and precepts.
when the former can dispense with his teacher (Peters, 1963, p.18) and practise a discipline autonomously - is full of sanctioning procedures, designed to ensure that the student acquires an epistemological outlook that is compatible with the disciplinary community at large. This passage makes for epistemological conformity, rather than deviancy.

Two things, then, have emerged from this discussion of the word 'discipline'. Firstly, there is the notion that a discipline comprises a set of prescriptions which legitimate certain sorts of epistemological behaviour, and legislate against others. Secondly, there is the notion, implicit in the word's etymology, that that behaviour is transferred principally in the student-teacher relationship. What has still to be described are (a) the sorts of rules which characterise epistemological behaviour and (b) the nature of the passage, and the sanctions therein, that mark the transition from discipulus to disciplinarian.

5.4 THE TRANSFORMATIONAL GRAMMAR OF KNOWLEDGE

The epistemological structure of a discipline is framed from a collection of specific facts, theories and laws that arise from the application of a repertoire of methodologies needed to make sense of the 'raw material' of experience. These methodologies of knowledge remain antecedent to the production of its substantive content. Thus, in terms of a basic epistemological distinction made by Ryle (1970, p.28), it is possible to "know that" Boyle's law states that the pressure of a fixed mass of gas at constant temperature is inversely proportional to its volume, but it is another matter "knowing how" to
formulate that law. In disciplines, then, there are "facts" which constitute the discipline's substantive content, and also "knacks" by which that content comes to be extracted from experience; and it is the latter which permit the formulation of things like Boyle's law.

Another way of looking at the epistemological structure of a discipline is to draw an analogy between it and language. Using language, for instance, it is possible to articulate a large number of statements about the world. In order, to make sense, however, those statements must observe the rules and regulations that govern the construction of sentences and the use of words in a particular language. In fact, as Wittgenstein (1972, p.7e) pointed out, there are clear analogies between using language and playing a game. They both depend, to a degree, on following a code of rules; and in as much as knowledge is also constrained by sets of rules, it too can be regarded as sharing features with games. For to obtain results from a 'knowledge game', the players in it, just as in any other game - sporting or language- must also agree to abide by the rules that govern epistemological play. And so, just as cricket is not cricket if it is played to the rules of football, so neither is history history when played to the rules of chemistry. Games, then demand conformity to, not contravention of the rules that preside over what is acceptable and non-acceptable play. Deviancy is not permitted, and sanctions and penalties are imposed on those players who constantly break the rules; for to do so is to sabotage the progress of the game.

The game metaphor, as it applies to knowledge, suggests that the transition from discipulus to disciplinarian, in part, amounts to learning the rules of the knowledge game that govern a discipline. As will
become clearer (see 5.7), it is the function of the teacher - and he, after all, manages that transition - to ensure that the discipulus displays both a willingness and an ability to play the 'knowledge game'; or if he displays a recidivistic defiance of the game's rules, his admittance into the disciplinary community is to be prevented. Part of the transforming process of a disciplinary system, then, is devoted to modifying any recalcitrant behaviour that might be exhibited by student cognisers.

But there is yet another characteristic of games, for which analogies also can be found in epistemological contexts. It is that games do not have one overriding characteristic common to them all, but rather that they share certain "family resemblances" which form a complicated network of similarities, sometimes overall, sometimes only in detail (Wittgenstein, 1972, p.67). For instance, it has often been posited that the epistemological structure of a discipline, and the knowledge game it often forms a panoply for, displays a great deal of systemic unity. It is a structure that appears to strive after a holistic rather than a discrete organization of its parts. Indeed, according to Kant (1969, p.471), Cicero (1967, Book I, x1,186-189) and Hugh of St Victor (Taylor, 1961, p.82), the family similarity of disciplines is that they all communicate a unity to things which are normally disconnected and sundered. They supply the means - identified by Kant as the "architectonic" - of welding into some solid, coherent epistemological framework things which are ordinarily discrepant with one another and in a "rhapsodic" state, to use Kant's happy word. Disciplines, then, provide the basis for encapsulating and accommodating components of the epistemological process that otherwise would exist only in a condition of separateness from one another; and,
because of this separateness and discreteness, could not, on their own, constitute autonomous disciplines. Thus, as Hugh argued, "invention" and "judgement" did not exist as independent disciplines, in their own right, but instead were subsumed in the discipline of "argumentative logic".

Some considerable degree of corporate unity, then, is a distinguishing feature of disciplines. It is of note, in this connection, that an observation frequently made about burgeoning disciplines is that unity is an attribute which is often foreign to them. They lack the sort of "architectonic" which would communicate a coalescence to their parts and diminish any lack of unity in them. Thus, Morris (1946, p.188) noted in the 1940's that whilst the relatively new discipline of Semiotics had developed a "language to talk about signs", it was not sufficiently evolved to unify that talk and make laws about sign phenomena. It was a discipline still in what Huxley (Holyroyd, 1972, p.48) called the "natural history" phase of its development. As such, its epistemological development had not reached the level of more mature disciplines, like the physical sciences; for unlike them, Semiotics did not possess the 'grammar' which permitted generalizations and predictions to be made about the cognised. It was a discipline, then, which although it had a lexicon to annotate the cognised, could not form sentences from that lexicon.

It is for much the same reason that "art history" has also been seen as a discipline that has yet to get beyond the "natural history" phase. As a discipline, it has perfected the art of giving names and addresses to what Berenson called "homeless paintings", but, according to Rosenberg (Walker and Walker, 1975, p.87), any "formal analysis" that goes beyond 'lexicography' is absent. Like Semiotics in 1946, art
history is a discipline still in search of an architectonic.

Thus one "family resemblance" that has, in the past, been attributed to disciplines, namely unity, does not appear to be all that pervasive. This is particularly true where new and 'immature' disciplines are concerned. What appears to be more pervasive, in that it is also found in 'immature' disciplines, is that they all appear to have as their foundation a basic vocabulary of fundamental concepts and terms upon whose existence the discipline is wholly contingent. Hirst (1968, pp.128-129) who, along with a number of other writers (Gowin, 1970; Schwab, 1971; Toulmin, 1972; King and Brownell, 1966) has attempted to identify the fundamental features of a discipline, suggests, for instance, that concepts like gravity and acceleration in the sciences, God in religious knowledge, number, integral and matrix in mathematics, are peculiar to these respective "public forms of knowledge". They constitute the constellation of basic presuppositions upon which the discipline's existence rests. When a new discipline is being brought into existence, it is these presuppositions that are conceived first; for it is they which supply the means of classifying and ordering that cognised with which the discipline will be vitally concerned. Whilst it remains essentially preoccupied with 'baptising' the cognised, the discipline will remain in a pre-synthesis condition. Once it advances beyond that stage, however, and tries to make generalizations about the cognised, the discipline will often proliferate sub-specialities concerned with taxonomy and the gathering of raw data. The taxonomical sciences in biology are a case in point, as are the various "auxiliary sciences" of history, like archaeology, epigraphy and chronology, which supply the historian with facts he will try and integrate (Carr, 1974, p.11).
But neither names nor facts speak for themselves. Part of the art of the historian is in some measure ventriloquial; he puts his words into the mouth of facts (Carr, 1974, p.11). He forms 'sentences' from the raw facts that are presented to him by the auxiliary sciences of history, and with these sentences he hopes to explain how it is certain historical events came about. The physicist or, for that matter, any other disciplinarian, employs much the same sort of strategy; initially they ask the question why and answer it by making plausible connections between the raw facts about the cognised they have at their disposal. In fact, this proclivity to synthesize, to unify, to "form networks of possible relationships", or to establish what amounts to conceptual and logical connections between the basic vocabulary of the discipline, represents a second feature of "public forms of knowledge" (Hirst, 1968, p.129). This is what Hugh (vide supra) obviously had in mind when he suggested that argumentative logic was an independent discipline because it formed a canopy for discrete logical activities like judgement and invention. In the same way such encapsulations are observable in physics. For instance, the laws of motion establish a network of relationships between fundamental concepts like mass, space and time. Nor is this syncretic property of discipline necessarily restricted to those areas of knowledge at the right-hand end of the spectrum (see 4.6). For instance, in religious knowledge there are strong conceptual connections between the notion of original sin and redemption; and in music too there are similar sorts of syncretic connections. As Cicero (1967, Book I, x1,186-189) pointed out, the phenomena of "rhythm, sounds and measures" are all interconnected.

Another feature attributed to the public forms of knowledge is that they have distinctive ways of testing their epistemological
statements against experience (Hirst, 1968, p.129). This was noted when the knowledge spectrum was discussed (see 4.6). It was observed for example that in progressing from the left- to the right-hand ends of the knowledge spectrum the demand increases for empirical validation. Whilst this is not a criterion wholly absent from left-hand knowledge,* the more common means of corroboration is via an act of faith or divine revelation.

Then there are the half-way-house disciplines which are increasingly trying to ape the physical sciences, but which, because of the subject matter they take as their cognised, namely man, often find it difficult to produce empirical pronouncements that quite match the epistemological efficacy of genuine scientific statements (see 4.8). It seems they are left with an unavoidable philosophical strand which serves to redress their unscientific character.

But there are more criteria for checking the legitimacy of knowledge than merely, as in science, checking such knowledge against the observed behaviour of reality. It is a fundamental part of the logic of scientific knowledge to establish a symmetrical relationship between the two. There are other constraints, however, on scientific knowledge apart from this, and which are also designed to prevent the production of deviant knowledge. There is, in addition to the logic of a

* Since the Seventeenth Century, when scientific knowledge began unveiling an uncanny and bespoke order in the universe, religion has tended to draw comfort from what was a very convenient extrapolation: that only a divine, omnipotent being could be the architect of such order. Not that scientists were totally immune to this proposal themselves. Newton, who did so much to launch modern science into being, was committed to believing that science should support not negate the tenets of religion. In fact Holton (1967, p.94) has noted how this inmixing of left-hand metaphysic with right-hand knowledge was instrumental, in Newton's case, in inhibiting certain insights he might otherwise have had. (See also 4.7).
particular area of knowledge, what could be called its 'moral code'. All disciplinarians and other members of a knowledge community must observe this code in their conduct with knowledge. Of course in some disciplines this moral code is more pervasive and restrictive than in others. Science is again a case in point, for its moral code can be very delimiting on epistemological behaviour. But however limiting, this code and the norms which it embraces, again serves to order conduct and reduce the possibility of exercising absolute epistemological freedom.

There is, then, within a disciplinary community like science, not only a consensus methodology, which scientists more or less employ to process their experiences of reality, but also a set of standards which it is assumed scientists will observe in their treatment and evaluation of scientific knowledge. There is a set of what Merton (1972, pp.66-8) has called "institutional imperatives" which, in their advancement of "certified knowledge", men of science are bound to observe and expected not to contravene. Loyalty to these overriding principles leads to the maintenance of scientific standards, and the prevention of deviant knowledge entering the repository of certified knowledge. And whilst at times these standards - "universalism, communism, disinterestedness, organised skepticism" (Merton, 1972) have sometimes been flouted, as in the Velikovsky affair for instance (Polanyi, 1967, p.74; Mulkay, 1969, p.131); and whilst there is also a certain amount of evidence to suggest that scientists, in actuality, do not adhere as rigorously to the Mertonian norms as the theory would impute (Sklair, 1973, pp.151-152) the general notion that science obligates its practitioners to follow a certain code of practice would suggest that the acquisition of scientific outlook is partly synonymous with the acquisition
of a set of acceptable behavioural patterns. Whether this is true to the same degree of other disciplines - that there are within them equivalent Mertonian norms to be acquired - is debatable. What seems more certain is that the general values of science do exist in other disciplines, but in a mollified and less rigorous form, and most significantly, to a less pervasive degree. The human sciences, for instance, are very prone to sectarianism. There is not a compact body of values which all human scientists appear to accept and submit themselves to; instead, values vary from sect to sect, faction to faction, according to the general epistemological policy that each sect or faction chooses to uphold (Toulmin, 1972, pp.391-392).

But it would be wrong to infer that because a discipline's logical and normative structures have been articulated and made explicit, that would-be disciplinarians - the discipuli - simply assimilate such and are able to practise the discipline without more ado! That is not the case at all. For one thing, although a Merton or a Hirst might have described various principles operant in each of the major disciplines, discipuli are not compelled to study them overtly as a preparation for admittance into disciplinary communities. That is because the actual genesis of scientific knowledge does not always follow the path accorded to it by logic. A background in philosophy or sociology of science, then, need not necessarily ameliorate the practice of actual scientific research (Scheffler, 1973, p.35; Medawar, 1970, p.9). This raises the question, then, of how it is the discipulus secures, if they are not spelt out to him overtly, the logic and standards of disciplinary practice. But before investigating that question, it needs to be asked whether there are not more things to a discipline than that which its logical and normative structure serves
to encapsulate. And if there are, might this justify why merely spelling out overtly the canons and norms of disciplinary practise does not alone constitute the required background for advancing the frontiers of knowledge?

In discussing the processes of taxonomical identification, Pantin (1969, p.109) differentiated the style of procedure adopted in the field from that used in the laboratory. He noted how the taxonomy of worms in the latter case tended to follow the routine, logical course, as spelt out in taxonomy handbooks, of classifying the internal anatomy of the worms against some paradigm species, in this case Rhyncodemus bilineatus. Yet in the field, Pantin was able to achieve much the same classification by a process he called "spontaneous illation". The worms were instantly recognisable as Rhyncodemus bilineatus, without any need to analyse the intricacies of their anatomy. Pantin attributed this capacity of his to the accumulated result of a long series of biological experiences, "unconscious as well as conscious". It was not solely due to the techniques and procedures learnt from taxonomy handbooks.

Pantin's experience, then, would suggest that indeed there are more sides to knowledge than those substantive, logical and normative features which have been delineated thus far. Indeed, the tenor of Pantin's remarks would indicate that there might be some epistemological features of knowledge which transcend explication and defy verbalization altogether. In this he is certainly supported by Oakeshott (1967, p.7) and, in particular, by Polanyi (1962, 1969) whose whole subjectivist epistemology rests upon a basic dichotomy between a dimension of knowledge which can be rendered "explicit" and another which remains "tacit" and beyond the realm of specifiable formulation.
Polanyi suggests this is particularly evident in areas of human activity in which "skilful knowing" is much in evidence. An admittedly trivial example, but one which Polanyi (1962, p.49) is fond of citing, is cycling.

The laws which bicycles obey when in motion, and the sort of centrifugal forces that must be overcome if balance is to be maintained, can be explicitly formulated; the physics required is known. But the capacity to ride a bicycle is far from being contingent upon knowing the physical laws which govern its motion. Rather, the "knack" of cycling relies on a complex set of psychomotor co-ordinations, which although they cumulatively obey the laws of physics, are individually mastered without reference to those laws. There is, then, to cycling, a tacit dimension which is unspecifiable and inarticulatable, and which can only be acquired through the trials and errors of experience.

Now, cycling is quite an unsophisticated activity and can be mastered very quickly provided one is willing to suffer a few spills and falls. Moreover, it is an activity that is autodidactically masterable. In that sense, it is rather different from the epistemological abilities being discussed in this study in that they result (a) from the gradual accretion of manifold but controlled disciplinary experiences and (b) from the interaction between a discipulus and master disciplinarian. They are not acquired spontaneously or autodidactically, as is the case with cycling. But even so, there are still tacit dimensions to them which transcend textual formulation. Pantin's taxonomical illations are a case in point: and Polanyi (Polanyi and Prosch, 1975, pp.31-32) himself has stressed the importance, for instance, of the tacit element in the surgeon's skill. That skill is formed, not from the "diligent reading of textbooks", but through the training of the
eyes, ears and sense of touch, to which the more practical context of medicine is patrimony. It is only in the arena of doing, then, that the tacit element in skilful knowing can be acquired; and although there are epistemological activities in which such skills and knacks are not uppermost * - where such things as observational acumen are less important - it would seem that to every science there is also an art, in the sense discussed in 4.5, which comprises a set of techniques, whose mastery is ameliorated through experience and practice. Some of that art, it has been mooted (Polanyi, 1962, p.53, Hirst, 1968, p.129), can only be "learnt from a master at his job". Solitary study of the symbolic expressions of knowledge does not yield aspects of a discipline which can only be acquired through relating to a master disciplinarian. The tacit dimensions of knowledge are to a degree like this. Since they transcend formulation, they can only be acquired through the discipulus experiencing them in the hands of disciplinarians who have considerable and proven mastery of them. Through seeing and experiencing the tacit dimension of knowledge in direct operation, the discipulus/apprentice "unconsciously picks up the rules of the art, including those which are explicitly unknown to the master himself" (Polanyi, 1962, p.53).

* Very theoretical sciences, like mathematics, which do not gather their data directly from the empirical world, presumably require from their executants less perceptual sensitivity. It is therefore less important for a mathematician than a biologist to be trained to look, at least in the usual sense of the word. But this does not preclude the possibility of there being tacit dimensions to disciplines like mathematics. It has been noted of mathematics, for instance, that for every significant theory there are an infinite number of trivial ones. Part of the mathematician's feeling for his subject, and that is tacitly generated, comprises being able to distinguish what is genuinely interesting mathematics from the welter of "altogether trivial statements and operations" (Polanyi, 1962, p.188).
It is possible, then, to acquire the substantive elements of a science from books. But if the discipulus cogniser wishes to acquire the art which supports the execution of that science, he must 'apprentice' himself to a community of disciplinarians practising the discipline's art. But more than just that, if a disciplinary art and the total epistemological sensitivity it gives rise to, is to be perpetuated there must always be a new generation of cognisers willing to submit themselves to the authority of master disciplinarians. Of course it sometimes happens that there is not a new generation of willing cognisers. In this case, a kind of 'generation gap' occurs in which a disciplinary art fails to get passed on and is eventually lost. The rupture proves so profound and irrevocable that the art cannot be recreated with quite the same degree of finesse and virtuosity. For instance, since the appropriate tacit skills have been lost, it seems virtually impossible to replicate violins which have quite the same timbre as a Stradivarius or a Guarnieri. The tradition which created such violins came to an end when the last violin-making members of the Stradivarius and Guarnieri families died out. With more public forms of knowledge, which have a great deal more explicitness about them, inter-generational transmission is arguably much less of a crucial factor in the perpetuation of a discipline. If disciplines, like violins, have certain je ne sais quoi aspects to them, as it seems likely they do, then it would be expected that apprenticeship to rather different master disciplinarians would cause in their apprentice discipuli rather different styles of skilful knowing and epistemological sensitivity. And to the extent that those discipuli who also tend to perpetuate the trail of distinctions their teachers have
already achieved, there is a certain amount of evidence to suggest that the more masterly the disciplinarian, the more masterly his discipulus offspring are likely to be. Thus, the epistemological genealogy of most Nobel laureates usually includes other Nobel laureates in its background (Cole and Cole, 1973, p.232). Some laureates have been particularly fecund in this regard. Between them, for instance, Leibig and von Baeyer could have counted somewhere in the region of forty six Nobel Laureates as their former students (Jevons, 1969, p.35). But the significance of the je ne sais quoi factor in a discipline is never intense enough such that once its influence is terminated, a school of skilful knowing is irrevocably lost, and that the discipline, as a consequence, suffers irreparable harm. That is because that factor is not the crucial element, as it is in the case of making a Guarnieri, in the creation of new knowledge. It might be an ingredient in the process of its creation, but it is never the sole one.

Summary. This section has described the epistemological structure of a discipline. It has been suggested that that structure is formed from two layers, one of whose epistemological features can be adequately described and made explicit, whilst the other cannot. It has also been indicated that successful disciplinary practice is a product of conflating the two layers of the fabric; and that the latter part of the structure, the tacit dimension, emerges not from the cumulative experience of the discipline's explicit manifestations — as they are set out in textbooks — but from the context of actually practising the discipline. One of the functions, then, of education is to supply the context and framework for the tacit dimensions of a knowledge to be acquired. That such a context might prove expedite is in part due to the fact that a modicum of disciplinary
tacitness can be conveyed through a student/teacher rapport. But more than just conveying the je ne sais quoi elements of knowledge, education also supplies the context in which the explicit elements of knowledge can be acquired. By allowing the discipulus to experience an "arsenal of exemplars", in which the normative and logical features of knowledge are concretely displayed, he eventually comes to dwell inside a "disciplinary matrix" (Kuhn, 1974c, p.462). There is, then, a two-fold advantage in conducting the initiation of the discipulus via exemplars, rather than those epistemological features which philosophers and sociologists have abstracted from knowledge. For the exemplar, when articulated in the educational context, permits the discipulus to simultaneously acquire some of the explicit and the tacit dimensions of knowledge. But as will become clearer in 5.5, education also serves to act as a kind of 'quality control' of the discipulus cogniser. Admittance to a disciplinary community turns out to be a process of rigorous selection, in which the strongest measures are taken to ensure that the discipulus cogniser not only secures an epistemological sensitivity appropriate to the discipline involved, but also displays the capacity to work within that discipline's values and standards. That capacity, then, will be displayed in his ability to master the arsenal of exemplars he confronts in the context of his education.

Part of the function of education, then, is to carry out personnel selection for disciplinary communities, and to bring about a level of epistemological conformity compatible with the standards and values subscribed to by the various disciplinary communities. How education does so, will constitute the theme of the next section.
Disciplinary systems exist in order to perpetuate themselves and the knowledge which they accommodate. Part of their function is deployed, then, in educating the kinds of cognisers who can either acquire new knowledge or communicate it to others, or both. For without the recruitment of appropriately trained cognisers, to occupy the positions of disciplinary responsibility, when the current generation occupying them dies off, the discipline will also die off, at least as an active knowledge 'gatherer'. That is because it will not secure the appropriate level of personnel input to maintain its social fabric. And this does occasionally happen, admittedly mainly in sub-disciplinary fields. "Invariant theory" mathematics suffered just such a fate. Its exponents failed to recruit students who had a strong commitment to the field, and thus its epistemological development was arrested (Fisher, 1967). But above and beyond mere commitment, the students recruited to a disciplinary system, if they are to make a contribution to knowledge development within it, must be thoroughly acquainted with the areas which have been developed, and more importantly, those which remain to be developed. Students must be familiar with what counts as the orbit of certainty in a given discipline, and be prepared to move beyond it. That moving beyond, into new territories of epistemological awareness, however, tends to follow the same basic methodological routes and observes the same basic standards which have always prevailed in a discipline. New knowledge, then, as was imputed at the beginning of 5.4, is a matter of forming new sentences from the grammar and syntax that is universally accepted and applied in a disciplinary community. Therefore in order to create that knowledge, the cogniser must first
not only have a familiarity with the sentences which have already been formed in a discipline, but also with the grammar and syntax that are usually used to form those sentences. It is a matter of treading old, before breaking new ground; that treading, however, must be seen to accord with the 'gait' that is normally used in the discipline. The cogniser, then, must first prove himself capable of upholding the traditional disciplinary standards, before his own contributions to knowledge will be considered and recognised. That is because the advancement of knowledge, as Kuhn (1963, p.343) has pointed out, consists of making iconoclastic statements within the framework of a rhetoric that is traditionally used in a discipline. It is a matter of being simultaneously a radical and a conservative, and of allowing the constraints that come from being the former to check and chasten any epistemological informality that is generated by being the latter.

In these terms, education can be seen to serve a dual function. The role of initiation into the public forms of knowledge that is often accorded to it, then, amounts to ensuring (a) that those cognisers wishing to gain entrance into disciplinary communities are equipped with the standards and ordinances that normally prevail there, and (b) that, having been thus equipped, the cognisers exhibit the ability to observe those standards and ordinances in dealing with the discipline's knowledge. Education, then, is very much in the business of bringing about epistemological conformity. It is charged with the responsibility of standardizing cognisers, of rendering, to borrow two concepts developed by Piaget (1932) in connection with moral development, their "heteronomous" epistemological behaviour "autonomous". But apart from just 'normalizing' the cogniser - and it has been suggested that that process occurs more or less continuously as the substantive content of
a discipline is transmitted - the context of education facilitates the transmission of certain tacit values (see 5.4).

Education, therefore, can be regarded as the itinerary a cogniser must follow if he is to be permitted to reach the research frontier of a discipline. It is an itinerary which not only allows the cogniser to see and experience the principal 'landmarks' in a discipline's history, but also in the process of doing so, allows him to acquire those values and epistemological methods which he will find necessary to advance the frontiers of knowledge. Education prepares the cogniser for his 'expedition' into the unknown regions of knowledge by making him trek the old routes to knowledge. By doing so, it inculcates the set of values which are commensurate with a discipline (Cole and Cole, 1973, p.86). But what of the educational route itself? Are there some general characteristics of it, which not only apply to all disciplinary communities, but which also transcend the institutional variations of localised educational systems?

In considering these two problems, it is of note that it is only during the last hundred years or so that education has taken over the "management of knowledge" (Davies, 1972, p.124) as its principal function. Of course in the preceding centuries education was always associated with knowledge, but it is only since the Nineteenth Century that the Academy has become the setting in which the advancement of knowledge is largely conducted. Thus whilst the Academy was always a mecca of scholarship, it is only recently that that activity has been considered enough in itself. Previously there had always been that obligation to justify the existence of the Academy, and the activities that went on therein, in terms of some extrinsic goal or
other. That goal was for the most part ecclesiastical; the Academy was regarded as a kind of secular seminary; it was a kind of 'professional school', responsible for training the "classical sinecurists" who ran the church (Dore, 1976, p.19). And that responsibility continued right up until the Seventeenth Century and even into the universities that were founded in the New World; for when Harvard was founded, part of its charter stressed the need to ensure the church was not administered by an "illiterate ministry" (Millet, 1962, p.37). In fact the full secularization of universities - together with the concommitant substitution of epistemological for ecclesiastical goals - does not really commence until the Nineteenth Century, and then at first only in Germany. But once established there, and initially only in the science faculties, the idea of a university surviving upon faith becomes increasingly anachronistic. It is replaced with the notion that the principal function of the university and the Academy is to conserve, transmit and advance knowledge (Millet, 1962, p.40, Watson, 1973, p.133).

It is noticeable that, co-incidental with this change of function, there also arose in education, bureaucracies specifically designed to train personnel who could deal with and produce knowledge. It was not that bureaucracies did not exist to do so before education adapted itself for the purpose, but that those which existed were relatively diffuse, undefined and unstructured. Knowledge was a kind of cottage industry that, though capable of producing results and highly significant epistemological "commodities", lacked overall direction and organization (Coser, 1965, p.252). Thus, even without the bureaucratic framework education has given it, science could, as far as the advancement of knowledge was concerned, be an enormously fruitful dis-
cipline.* It was just that those advances tended to occur largely outside of the Academy and in largely non-educational settings. Moreover, particularly in the Seventeenth and Eighteenth Centuries, they were largely carried out by amateurs and dilettantes. The phenomenon of a professional scientist, whilst not unknown, was not in any way common. It is of note, for example, that of the original members of the Royal Society only a bare one-third devoted themselves in the main to science. Science, was for many of its first practitioners, an indulgence, a hobby, a pastime rather than a full-time occupation. Not that within this atmosphere of scientific amateurism there were not institutions to protect the standards of scientific research and to permit the dissemination of scientific ideas. The existence of

* Whether this has served to accelerate the growth of knowledge is a matter of speculation. Weber, for instance, noted that all forms of bureaucratization have a damaging affect on the individuals participating in them. They cumulatively act to alienate their participants. Rather than foster an individual's capacity to contribute and initiate, it was Weber's belief that bureaucracies did no more than "dry up the well springs" of creativity (Coser, 1965, p.252). If this were true then the bureaucratization of knowledge should be registerable in a deceleration of its growth; and that, on recent evidence, is profoundly not the case. But, then, any of this very evident growth in knowledge needs to be compared with the equally evident growth in numbers of those presently serving in knowledge bureaucracies. If the two do not correlate - and they frequently do not (vide infra) - then it could well be argued that knowledge bureaucracies, whilst not exactly arresting the growth of knowledge, do not catalyse it to a great extent either. A better way of approaching the issue is to examine it historically, to see whether diffuse, non-bureaucratic organizations of knowledge did not retard its growth. Here the evidence is more strikingly on the side of bureaucratization. For instance, whilst there were impressive scientific achievements in ancient Mesopotamia, Greece and China, the overall growth and progress of science in these places was largely stunted and always ended up ceasing altogether. According to Ben-David (1971, p.22), this cessation was in part due to the fact that the social frameworks needed to disseminate new knowledge and train new scientists did not exist.
institutions like the Royal Society and, in France, the Académie des Sciences were in many respects the first steps towards the progressive bureaucratization of science. What education did, then, was simply rationalize the prototypes of an institutional framework that had already developed, particularly in the science disciplines, and apply them overall to other disciplines. It made aspects of the "invisible college", that cojoined certain activities in science, visible. This was particularly true of the training of scientists, which, as has been noted, only became a fully institutionalised affair in the Nineteenth Century. Since then the phenomenon of the detached scientist working outside of the Academy has become a thing largely of the past.* A modern day Mendel would not have to work his life out in an obscure monastery; he would be attached to a prestigious university department (Cole and Cole, 1973, p.213). He would not have had to suffer the penalty of retrospective recognition because the modern methods of distributing knowledge would have ensured that his work on genetics was correctly reviewed and evaluated. The advantages that have accrued to science, as a result of its bureaucratization, then, include things like the more effective training of scientists and the more efficient transmission of new knowledge and research.

The method of enculturation that has prevailed for the last hundred years or so in the scientific disciplines has tended, because of its apparent success there, to become the pattern which the other disciplines have followed. Not only have they adopted comparable

* This is not to forget, of course, that industry and Government employ very many research scientists. The differences, especially in the matter of the purposes of their respective researches, between the industrial and government scientist and the scientist working in the Academy will be examined in Chapter 6.
methods of training, but the modes by which knowledge is disseminated in the disciplines are analogous. Thus even the creative arts, longtime thought to be alien in the Academy, are increasingly being hosted there. It is the university, then, that has, in the Twentieth Century, become Prince Esterhazy to the arts. And with their colonization by the Academy, it could be said that cultural advances occur almost exclusively within the atmosphere of the campus setting.

Nor are the numbers involved in the knowledge industry particularly small. In the sciences alone, for instance, it has been calculated that there are something like one million practising scientists today (Cole and Cole, 1973, p.40). Add to this the numbers involved in their initial education, and to that number those involved in the administrative and technical services needed to support active scientific research; then repeat that survey across the whole of the spectrum of knowledge, and the figures involved start to form significant percentages of a nation's population, which indeed they do. In the USSR, for instance, something like $2\frac{1}{2}$% of the population is involved in some form of higher education (Watson, 1973, p.129), and doubtless comparable figures could be produced for other nations in the developed world.

The knowledge industry, then, is very 'big business'. Like any other big industry or organization it has certain personnel needs if it is to run itself efficiently. Part of the function of education, it has been argued (see 5.3), is to supply these needs. Not only then is education very much concerned with managing knowledge, it is also very much responsible for selecting those who will get into knowledge management. Thus a great deal of the business in any disciplinary community is simply concerned with quality control. On the one hand, there
is that control exercised to ensure that new knowledge conforms to the epistemological standards which normally prevail in a discipline. These controls were discussed in 5.4 and the way they are applied will be examined more thoroughly in Chapter Six. On the other hand, there are those controls which are exclusively concerned with ensuring that a disciplinary community secures the personnel, of requisite calibre, which it needs for its continued survival. It is with these latter controls, and how they are generally exercised, that the remainder of this and the next section will be concerned.

Education's unbounded loyalty to the knowledge ideal has already been mentioned. The major focus of that interest in knowledge comes to bear in the arrangement and construction of the curriculum, or "the course that is run in education". Therefore defining the curriculum is virtually synonymous with defining education itself (Barrow, 1976, pp. 17-18). Progressive educationalists are inclined to emphasize this, and supply very open-ended definitions of the curriculum. Amongst progressives, therefore, it is not uncommon to hear the curriculum defined as the totality of experiences a student has in school. Thus, walking down a corridor is as much a part of the course that is run in education as studying D.H. Lawrence's Sons and Lovers. Both desultory and determined experiences can comprise the curriculum. Unfortunately such open-ended definitions of the curriculum pay little or no deference to the fact that some curriculum experiences have considerably more educational import than others. Without doubt, for instance, Lawrence does more for the student than corridor walking. In terms of ascribing educational significance to the experiences of the curriculum, it is necessary, unfashionable though it might be, to suggest that the curriculum serves to promote, above all else, the knowledge ideal.
Anything else is very much subsidiary to the realisation of that ideal.

What this entails is that the curriculum principally exists to distribute knowledge experiences, and by virtue of this entailment, to bring about admission of students into disciplinary communities. The arrangement of education can be regarded as a kind of 'disciplinary continuum', along which knowledge experiences are variously distributed. As students progress along that continuum, and are subjected to planned disciplinary experiences, they slowly acquire a loyalty to a specific discipline. Complementing that loyalty is a set of values and methodological principles that the student will need in order to practise a discipline.

But admission to a disciplinary community is not ipso facto a product of experiencing disciplinary knowledge and displaying a loyalty to the values which characterize it; for that admission is only secured after the student has satisfied the 'community' that he is capable of practising the discipline in accordance with its standards. The disciplinary continuum, then, is also marked by procedures for checking that students are acquiring the values that are associated with a discipline. If they are not, then their further advancement along the continuum will be discouraged or prohibited. Getting into a disciplinary community, then, is very much a matter of the survival of the intellectually fittest. At seemingly pertinent stages along the continuum, therefore, there are procedures for measuring that fitness. The problem, then, is to generalize these characteristics and to assemble some model that will accommodate the procedures used in disciplinary selection and also explain how it is that knowledge comes to be distributed to the would-be members of a disciplinary community.
5.6 DISCIPLINARY CONTINUUM: PERSONNEL ASCENT

In very general terms, it can be said that passage along the disciplinary continuum serves to transform the cogniser's outlook on the world. The through-put processes inherent in the continuum exert to create what has been previously called an 'epistemological sensitivity'. Further, that sensitivity represents something of a consensus view of the world, as it is defined by the disciplinary community at large; and its acquisition represents the culmination of a cogniser's disciplinary development. That development can be seen to consist of three major and distinct phases:

(i) a pre-paedeutic phase, which corresponds to the cognitive state of the cogniser before his passage along the disciplinary continuum commences. It is the state of non-epistemological awareness and non-epistemic seeing;

(ii) a propaedeutic phase during which the cogniser's outlook slowly undergoes transformation, according to the type and range of disciplinary experiences he encounters during his education; and

(iii) a meta-paedeutic phase during which the cogniser, having mastered the methods and practices of a particular discipline, has the capacity to gather new knowledge for it.

Of these three phases, it is the intermediary one, the second, during which the cogniser acquires an epistemological sensitivity; and it is therefore that phase which the disciplinary continuum serves to describe.

Since it is principally within the context of education that an epistemological sensitivity is acquired, the pattern of a cogniser's disciplinary development tends to reflect the institutional structure of education. That structure generally has four major sectors to it;
and even though national systems of education do vary in detail, especially in the matter of when disciplinary specialization commences, most would appear to conform to this overall tetradic structure. Thus, most educational systems can be compartmentalized into primary, secondary, tertiary and what, for the purposes of the continuum, will be labelled 'quaternary' sectors of education. Whilst the age at which the transition from one sector to another does vary between educational systems, as a general rule primary education takes place between the ages of 5 and 11, secondary 11 and 18, tertiary 18 and 22, quaternary 22 and 26.* The time span of the disciplinary continuum, then, is approximately twenty one years in duration. But though all children are compelled to experience a modicum of primary and secondary education, and thereby to embark on the disciplinary continuum, only very small percentages of them become contributing members of disciplinary communities. The attrition rate on the disciplinary continuum is in fact quite considerable, although its magnitude is far greater in some systems than others. In this respect, the system of education in the United States would appear to be most lenient of all, permitting, as it does, something like 50% of an age group to enjoy some form of higher education (Grant, 1973). By comparison with European systems of higher education, that of the United States is positively generous and all accepting (Grant, 1973, p.32). For

* The initial years of schooling are generally fixed by government legislation, so no variation is possible there. It is noticeable, however, that the age at which tertiary and quaternary education occurs is increasingly fluid. The phenomenon of the mature age student, studying for his first degree, is not exceptional these days. Some universities even insist, as a 'matriculation' requirement, that their would-be alumni have spent a minimum of a year in the outside world doing orthodox work. Griffiths' University, Queensland, is one such university.
example, in West Germany only some 10% of school leavers gain admission to higher education. What is more, in the German system, which still retains a form of selective secondary education, that gate begins to close at the age of ten, when all Grundschule students sit for an examination which will determine whether they will go to the Gymnasium or not. Since the Gymnasium represents the principal 'nursery' for university, failure to be admitted into it at that age virtually denies the student the possibility of a tertiary education.

Before systems of comprehensive secondary education became firmly established, much the same sort of system of early selection prevailed in Britain and France. In Britain, for instance, selection for the equivalent of the Gymnasium, the grammar school, occurred at the age of eleven, again by means of a public examination. In France, a similar examination, conducted at ten rather than eleven, served to demarcate those suitable for an education at the more academically inclined lycée from the rest. The advent of comprehensivization* in these two systems effectively postponed 'university' selection until eighteen, thus serving to accommodate the student whose academic talents only bloomed in late adolescence. The mechanism of attrition that functioned at the transition from primary to secondary education served to exclude such students from further progress along the disciplinary continuum. Instead, those mechanisms now operate just before the transition is made from the secondary to the tertiary sectors of education (Halls, * It has been observed that the academic egalitarianism of the comprehensive school is largely an illusion. Such schools are in fact academically stratified and can be regarded as only accommodating under the one roof the partitioned systems of education they served to displace (Ford, 1969, p.9). On the other hand, the comprehensive school does permit a fluidity that enables the 'late developer' to graduate to an academic stream.
1976, pp.203-220; Bell, Fowler and Little, 1973). At that stage, those students who have survived a school's selective mechanisms, and who desire to continue their education, must sit for a set of public examinations which enable the matriculation requirements for university to be acquired. Most systems of secondary education, whether they be comprehensive or selective, have such an examination. The West German system has its Abitur, the British, its 'A' levels, and the French, its baccalauréat; and even in the United States, usually the exception when it comes to the matter of educational selection, a number of states (e.g. New York State) have retained a public examination for those who wish to be admitted to the more academically prestigious universities.

The attrition rate in these examinations can be considerable. Until quite recently, for example, it was something like forty per cent in the baccalauréat (Yarmolinsky, 1960, p.171). On the other hand, it is sometimes convenient to have a high attrition rate. If there are only a limited number of university places available, it is sometimes necessary to inflate matriculation requirements, if only to cause attrition. This to some extent happened in Britain, where the nominal two 'A' levels required for matriculation, was a minimum requirement only. Because of the competition for places in tertiary education, universities could often choose from students who possessed as many as four high passes in 'A' level subjects. When demand outstrips the availability of places, entrance requirements tend to be elevated just as when the number of available places exceeds demand there is a corresponding relaxation in entrance requirements. This process of "certificate devaluation", as Dore (1976, p.6) has called it, has tended to prevail throughout the world in the 1970's.
It is in the tertiary sector of education that personnel selection for disciplinary communities begins in real earnest. Thus, the attrition may actually increase within the tertiary sector rather than decrease. Admittedly, most of that attrition rate is due to personal factors, rather than just plain academic failing. General indifference to university life and anxiety brought on by the pressure of academic work are, for instance, proven causes of students leaving university prematurely. In Britain, for example, the "mortality rate" of students in the science and technology faculties of universities is particularly high (Miller, 1970, p.12). In technical colleges, the situation is even worse. Up to half the initial student intake fail to complete the courses they enrolled for.

In universities, at least, it does not seem that high intellectual attainment necessarily correlates with academic success. Often it is the ablest students who quit from university, and they do so for personal rather than academic reasons. Thus for whatever reason, the "mortality rate" in the tertiary sectors of education can account for up to 30 and 40% of the intake students never graduating. Again this figure can vary from one system of education to another. It tends to reach the 30 or 40% mark in countries like the United States, Canada and Australia, whereas in Britain, perhaps because of its more rigorous matriculation procedures in the late 1960's, it was as low as 14% (Miller, 1970, pp.10-11).*

* On the other hand, the author recognizes that there might be other factors, often of a transitory rather than a long term nature, which might vary these circumstances. The economic recession in the Western world during the 1970's, for example, and the consequent tendency of governments to reduce levels of public spending on education places new demands on tertiary education to preserve its absolute numbers of students. A secondary result of this is that the attrition rate is reduced; greater percentages of incoming
The ordeals of disciplinary initiation do not cease with graduation. If the cogniser wants to progress further and secure an "academic berth" in a knowledge community, there is an obligation to obtain a higher degree, and for that the cogniser must progress into the quaternary phase of education (Wilson, 1964, p.48). And just as, at the other turnover points along the disciplinary continuum, progression is decided on contest, so also is the progression from tertiary to quaternary sectors of education.

The possession of a first degree does not automatically grant admission to higher degree work. The academic 'weeding out' process, then, continues even into the last sector of propaedeutic education. Only the 'best' students are admitted into it, the epithet 'best' generally entailing that such students possess a first degree classed at honours level.

Whilst the disciplinary continuum ostensibly exists to transform cognisers in accordance with the principles of public forms of knowledge, a contemporaneous aspect of that function is that it selects out those cognisers who have capacity and talent enough to be admitted into disciplinary communities. Whether it is finally efficacious at this - and there is considerable evidence (vide infra) to suggest that it is not - that selection is generally based on some formal, public examination, designed to predicate a cogniser's capacity to graduate and succeed in the next stage of the continuum. These examinations generally occur at the nodes between one phase of education and another, and serve to test the adequacy of a cogniser to pursue initiation any

students actually obtain degrees and diplomas; the purchasing power of these credentials tends to be reduced; and it may be doubted that the degrees and diplomas have the same academic merit as they did when the attrition rate was higher.
Further. In this way, a disciplinary community recruits the cognisers it needs. The continuum, and the capacity a cogniser has to maintain mobility along it, then, is very much a proving ground for the cogniser. Proof of his capacity to do so, is available in the number and quality of 'tokens' he has managed to accumulate on the way. For it is a characteristic of institutionalized education that it awards tokens to those who display the ability to master a discipline at a particular academic stage. Moreover, these tokens are recognized outside the disciplinary continuum and the "groves of Academia", and can be used to secure employment in general. Thus education is not only a 'credentialing' agency for the knowledge industry, but also for the world at large.

In a very real sense, the epithet 'initiation', which has been given to the processes occurring along the disciplinary continuum, is apposite. Firstly, the ordeals which the student cognisers undergo whilst waiting to be admitted into a disciplinary community, whilst they may not be as exacting as some forms of religious initiation, are very much of the testing kind. They are designed to sort out, so to speak, the 'intellectual' men from the boys! Secondly, there are undoubtedly rituals and ceremonies which accompany the business of initiation into public forms of knowledge. The whole ritual of the graduation ceremony, and the diluted version of the same thing which occurs on speech and prize giving nights in schools - which are designed to reward and highlight the acquisition of certain academic credentials - are not so remote from the rituals of a religious initiation ceremony. Lastly, there is the notion implicit in the concept of initiation that through it the cogniser becomes aware of what Bernstein (1974, p.374) has called the "sacred" aspects of
knowledge. Initiation into a discipline, which Bernstein sees in a very disparaging light, has all the hallmarks of becoming privy to the secrets of some sort of epistemological 'mystery cult'. It is a very private world, which only the cognoscenti and the initiate can fully appreciate. In essence, the hierarchy of a disciplinary community protects its hieratic order, by only releasing its deepest secrets to a few, chosen and highly selected acolytes.

In the worst possible of lights, the disciplinary continuum could be said only to make a token gesture to egalitarianism. In that same rather sepulchral light, it could be said that education is, in effect, practising what amounts to a rather cerebral form of 'eugenics'. It is in the business of breeding a 'master race' of cognisers who can manage the disciplinary communities in the most effectual and intellectually capable way possible. Indeed, a cynic could be forgiven for thinking that education is principally subservient to the 'great god episteme' by virtue of it wishing to perpetuate itself. After all, whilst the tokens education awards can be used to obtain work outside disciplinary communities, it is there that they have principal import and worth.

Thus, it can be said as a generalization, that one of the primary functions of the continuum is to produce cognisers capable of keeping the continuum itself functioning. The continuum, then, not only acts as a means of personnel ascent – and for many that ascent simply takes them off the continuum – it is also, for those who survive the distance, a mode of personnel descent back down along the continuum; although, this time, they return with a rather different set of roles and responsibilities. Thus the academy not only supplies an institutional context in which the advancement and conservation of knowledge can be conducted, it is also a context in which knowledge is transmitted as
well. But what is important to note is that those cognisers doing the transmitting are also responsible for the conservation and advancement of knowledge. Such cognisers, then, having reached the epistemological limits of the disciplinary continuum are expected, so to speak, to retrace their footsteps back down the continuum, one or two phases, and communicate their disciplinary expertise to the up and coming body of student cognisers. This is equally true of those other cognisers who wish to remain in a disciplinary community, but whose academic talents have not taken them much beyond the tertiary phase of education. Having reached that level of disciplinary mastery which falls short of actually gathering new knowledge, such cognisers are generally fed back into the earliest phases of the disciplinary continuum in order to teach, an activity for which they are generally expected to do some preliminary training. Because their role pre-eminently is to teach, it is not incumbent upon them, as it is with the teachers in the tertiary sectors of education, to do research.

The role of the teacher in relation to his student, and the cognitive benefits that are supposed to accrue from it, will be examined in more detail in Chapter Six. What is of interest at this juncture is to describe the sorts of forces that prevail to determine (a) the teacher's placement on the continuum and (b) the types of students that that placement will entitle him to teach. And since what determines these things is very much related to the bureaucratic organization of education, is there some way of achieving this description which reflects that organization? In fact there turns out to be a relatively easy way of codifying this relationship.

The continuum, it has been argued, can be divided up into four major sectors of education. The question now being raised, then, is
what sort of epistemological qualifications are required to teach in each of these particular sectors of education? This can be initially settled by considering the institutional level to which disciplinary training is expected to be carried before teaching is allowed in specified sectors of the continuum. For instance, it has already been indicated that teachers in the tertiary and quaternary sectors of education ($t_3^C_r$ and $t_4^C_r$, where $t$ denotes teacher and the subscript numerals, three and four, the sectors of education in which they teach, i.e. in this case, the tertiary and quaternary sectors respectively) are, if not already in possession of a higher degree, at least working towards one. This latter qualification is even more importunate in the case of the teacher in the quaternary sector ($t_4^C_r$) who, after all, is supposedly training students to gather knowledge for themselves and therefore should have considerable research experience. It is often not simply a matter of a doctorate, but that the teacher involved has a research reputation in the disciplinary community at large. The higher that reputation, the more post-graduate students the teacher is likely to attract.* It is a case, then, of the cogniser's capacities, having been extended well beyond the propaedeutic phase of the continuum, being able to communicate his experience of acquiring knowledge to the students ($s_4^C_r$, where $s$ denotes student) who come to him for supervision in their particular research project.

From these observations, it can be said, as a general rule, that

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* J.D. Bernal's work on the X-ray crystallography of proteins and nucleic acids acquired him such a reputation that he was sought after by graduate students the world over. One was Francis Crick, who, on inquiring if he could work with Bernal as one of his students, was given the curt reply by his secretary, "Don't you realise that people from all over the world want to come and work under the Professor?" (Olby, 1972, p.233).
where the tertiary and quaternary sectors of education are concerned, it is anticipated that the teachers involved will be one institutional phase in front of their students. Equally, this rule would appear to prevail in the earlier two phases of the disciplinary continuum. That it does so enables the relationship between the institutional level of training reached as a student and the sector of education that that training qualifies the student to teach in to be conveniently represented on the following diagram:

\[ \text{Diagram showing the relationship between institutional levels and sectors of education.} \]

It can be seen from this diagram, that teachers in the secondary sector of education, whilst they are not expected to have completed a research degree, are expected to have a first degree with an appropriate 'major' in the discipline they anticipate to teach. In other words, although it is not incumbent on secondary teachers to have been quaternary students \( (s^4_r) \), it is required that they should have been tertiary students \( (s^3_r) \). As an additional prerequisite, it has become policy in recent years that such teachers have also completed a minimum of one year's teacher training. This latter element is particularly emphasised in the preparation of primary teachers \( (t^1_r) \). With them, as the diagram implies, disciplinary development is not expected to extend much beyond that received in the upper 'reaches' of the secondary school. Proportionately speaking, the emphasis of their training lies in the direction of the methods and knacks of teaching, rather than in the direction of the subject matter that they teach.
Another general rule of the continuum is that as the level of disciplinary training rises there is a corresponding decrease in the level of teacher training expected. Thus, teachers in the tertiary and quaternary sectors of education – who have most disciplinary expertise – are not obligated to pursue any teacher training whatsoever. It is more important that they exhibit prowess in scholarship than teaching (Miller, 1970, p.150). In other words, in moving from the primary to the quaternary sectors of the continuum there is a complete reversal of what could be called 'pedagogic priorities'.

There are of course reasons for this being quite justifiable. Firstly, there is the fact that the primary teacher does not deal with a homogeneous group of students, all equally able and intellectually capable. Not only this, but the students he deals with are mostly in a state of incipient cognitive development. Both these factors entail that a major responsibility of the teacher revolves around tailoring knowledge to meet the special cognitive needs of his students. As Peters (1970, p.256) has pointed out, such a teacher needs not only to be an authority on some subject, but also an authority on the ways of teaching it. And whilst the teacher working in the latter sectors of the continuum should also consider the way he is communicating his discipline, the fact that he is dealing, for the most part, with a cognitively more homogeneous corpus of students means that his problems in that quarter are manifestly simpler and less exigent. But the major difference between the teachers working at opposite ends of the disciplinary continuum is in the degree of their respective knowledge expertise. As has already been intimated, this gets progressively more pronounced in moving from the primary to the quaternary sectors of the continuum. This in turn reflects the disciplinary attrition
which occurs as the student passes from one sector of the continuum to another; for although the student, when he embarks on the continuum, is given the opportunity to experience a wide range of disciplines and subjects, if he survives to the end of it, that range has been narrowed down to one discipline, and often one specialty within that discipline. And of course mounting specialization for the student entails greater and greater specialization on the part of his teachers.

The age at which disciplinary specialization commences tends to vary, like everything else on the continuum, with the system of education being considered. But in no system has it yet commenced in the primary school; for there, between the ages of five and ten, students are given an adequate grounding in the "survivor skills", together with an epistemological baptism, whose scope tends to embrace the overall character of the knowledge spectrum. Students, in the primary school, then, are introduced to some science, history and geography, and are encouraged to express themselves in music, drama and painting. They are exposed to a broad array of disciplinary experiences which are explored in none but superficial depth. The training of primary teachers, and the wide range of disciplinary expertise that is expected of them, tends to reflect this. They are very much the 'Jacks and Jills' of all epistemological trades and the 'masters and mistresses' of none of them.

With the transfer from primary to secondary education, the same broad array of disciplines is studied, although this time in much more depth. Not only is this reflected in the greater disciplinary expertise of secondary teachers (vide supra), but it is also apparent in the fact that instead of one teacher communicating the whole spectrum of knowledge - as tends to happen in the primary school - that spectrum
is compartmentalized, and each teacher tends to teach one or two sections of it only. Moreover, there begins in the secondary school, particularly in the English system, a gradual attrition of the number of disciplines studied, such that by the time education in that sector is completed, the student can be studying as few as three disciplines. An added feature of this specialization, is that these disciplines often do not represent a selection of disciplines drawn from the spectrum as a whole, but rather from one particular quarter of it. Thus by the time students reach the English sixth form, their epistemological proclivity towards the arts, humanities or science sections of the spectrum has generally been settled.

This is said to have both advantages and disadvantages. It has been pointed out, for instance, that early specialization in the sciences cultivates an ebullience for research, and that this is its chief merit (Jevons, 1969, pp.100-101). On the other hand, it has been argued that there is a need to retain a broad general education right up until the completion of secondary education, and this the English system does not cater for. In this respect, the style of secondary education encountered in Scotland and on the continent, particularly in Germany and France, in which little or no disciplinary attrition occurs, is perhaps preferable. If anything, as Elvin (1977, p.35) has indicated, the nine or ten subjects that are often studied in the baccalaureate and Abitur is a little too extreme in the direction of non-specialization, whereas what is really required is a balance between over and under specialization.

Disciplinary attrition, once commenced in the secondary school, remains a marked feature of the rest of the propaedeutic part of the continuum. Thus, the closer a cogniser gets to entering a
disciplinary community, the greater a particular discipline comes to dominate his curriculum. Instead of studying a multiplicity of disciplines, he studies just the one. At the beginning of his education, the cogniser is expected, as it were, to study the whole galaxy of knowledge. Upon emerging from secondary education, that same cogniser is usually concentrating upon a particular constellation in that galaxy, say the sciences or the arts. In moving to university, there is a further concentration of interest, and the cogniser is expected to study just one particular star in that constellation. He will do so with teachers whose field of interest does not, as is the case with secondary teachers, cover the whole of the star, but only a particular aspect of it.

In the tertiary sector of education, then, there is not only attrition of disciplines, but also often attrition within a particular discipline; and this tendency continues into the final, quaternary phase of the continuum. For there, students, along with their teachers, specialize and research into a sub-field of a particular discipline. Attenuation of disciplinary interest reaches a degree of specialism such that it has been calculated (Polanyi, 1962, p.216) that any single scientist is probably only competent enough to judge about one hundredth of the total output of research in science.
Summary. The disciplinary continuum - of which Figure 5.1 above is a schematic representation - is an attempt to describe the 'life history' of a student cogniser. It shows where that history begins and ends, as well as the points at which major cognitive metamorphoses might occur. The continuum can be regarded as showing the route by which a disciplinary community usually secures its personnel. It has been noted, that the community rejects many more cognisers than it accepts. The attrition rate on the continuum is quite considerable. But whilst there are still others who do collect the appropriate tokens and progress a great distance along the continuum, only a very few of these are admitted to the meta-paedeutic phase of the continuum. Those who do not make it quite there, and who choose to remain in the knowledge industry, are usually 're-cycled' back down the continuum as teachers in the earlier phases of the continuum. The continuum, then, is
characterised by both an upward and downward mobility of cognisers, the degree of that mobility being determined by contest. At the same time as longitudinal promotion occurs there is a lateral attenuation of disciplinary experience. This reaches its peak in the research for a higher degree.

The notion that a disciplinary community needs a regular input of cogniser personnel in order to survive and to maintain its social equilibrium, suggests the possibility that perhaps some of the concepts of System Theory, briefly touched on in 2.10 and 3.2, could be used to explain and describe some of those dynamics of disciplinary communities which have been identified in this section. Before pursuing that possibility, however, it might first be useful to outline in more detail the principles of System Theory and some of the concepts that are regularly used therein.

5.7 SYSTEM THEORY AND DISCIPLINARY COMMUNITIES I

Whilst the impetus that originally led to the emergence of "General System Theory" (G.S.T.) as an autonomous area of knowledge came from the life sciences - out of the need to isolate features that would more readily demarcate living from non-living systems - the territory of General System Theory now tends to incorporate not only biological, but technological and cultural systems as well (Bertalanffy, 1967, p.64). In the sense that living systems also share characteristics in common with the latter, and thereby are not the unique entities they were originally supposed to be, G.S.T. now tends to concentrate its systemic divisions about systems which are "open" and those which are "closed", with living systems and their
"isomorphs" falling into the former category. Thus, it has been suggested (Bertalanffy, 1971, p.207; Katz and Kahn, 1966, pp.99-104) that the organization and structure of society display "open system" characteristics which have analogous parallels in the behaviour of living systems. If this is a valid proposition, then, since it has been asserted that a disciplinary community is a social organization facilitating the communication and acquisition of knowledge, the community should exhibit the features that are characteristic of open systems in general. Showing that in fact a disciplinary community can be regarded as an open system together with all the ramifications that this has for its social structure, remains the objective of this and the next section (5.8).

A system is generally defined as an amalgam of elements in some kind of interaction with one another (Bertalanffy, 1971, p.85). The particular property of an open, as opposed to a closed system, is that it has the capacity to disobey — temporarily at least — the Second Law of Thermodynamics. Whereas the remainder of the matter in the universe is subject to prosecution by this law, it is in the nature of an open system to defy it, and instead of inexorably degenerating into chaos and "entropy", as the law says it should, the system is capable of maintaining itself in a "steady state" condition. This is because the system has the capacity to assimilate from its surrounds the requisite energy needed to secure stability and order, and to stave off degradation into entropy. Closed systems lack this capacity. They cannot participate in the sort of exchange with their surrounds — since they are sealed off from them — that would furbish the system with the requisite energy needed to inhibit the formation of entropy. In the closed system, then, a steady state condition cannot be achieved,
because the system cannot expedite the energy importation required. Its only destiny in 'life' is to produce more and more "positive entropy", and that leads to maximum disorder between the parts of the system (Bertalanffy, 1971, p.38).

Schroedinger (1967, p.219) once remarked that the most obvious feature of life was that it was able to "feed off negentropy". In the sense that all living systems are open systems, and that by virtue of their ability to interact with their surrounds, they can preserve their systemic unity, his statement is true. But to reserve, as Schroedinger does, that privilege to living systems alone is wrong. Thunderstorms, steam engines, self-winding watches are also capable of doing so (Pantin, 1969, p.37; Popper, 1976, p.137). They too, just like living systems, have the capacity to keep themselves "wound up" and in a state of homeostasis. They too can contravene the workings of the Second Law of Thermodynamics.

But if the system, of whatever variety - mechanical, social or biological - was suddenly starved of an importable energy, or lost the ability to execute an ingestive rapport with its surrounds, it would also be deprived of the capacity to produce the requisite energy needed to regulate a level of order and stability in the system. A prolonged deprivation, and it of course does happen, would mean the system would eventually lose the ability to preserve its unity. In such circumstances, it would quickly revert to the condition of a closed system. Manufacture of 'negentropy', then, is the way an open system protects itself from closing down.

The operative word is of course 'manufacture'. For although the system might retain the capacity to ingest energy from its surrounds, unless it is able to transform what is ingested and turn it into terms
that the system can utilize, the function of ingestion is redundant. Somewhere within the system, then, there must be operant certain "through-put" processes (Katz and Kahn, 1966, pp.93-94) which permit the input to be appropriately transformed. But before that transformation can commence, the system must first determine the levels of input required. For this purpose, open systems generally have incorporated into them feedback circuits capable of registering loss of homeostasis and level of input required to restore it (Thornton, 1972, p.165). The feedback circuit, then, is the medium by which a system conducts a 'dialogue' with its surrounds, and through which a system is able to secure the adjustments needed to sustain homeostasis. It is the means by which the internal mechanisms of a system make contact with the outside world.

But assuming the system can secure the requisite energy and input needed to maintain homeostasis, the way of achieving that goal can take a variety of paths and means. This flexibility of systems to secure the same end multifariously embraces the principle that, in G.S.T., is known as "equifinality" (Bertalanffy, 1971, p.46; Katz and Kahn, 1966, p.100). It is a principle that will be seen to be particularly apposite in connection with disciplinary systems. Similarly apposite are the principles of "compartmentalization" and "redundancy". Whilst these principles were originally formulated in connection with the selective permeability of cellular membranes, as principles they have an applicability that can be readily extended to the "macro-cultural structures of man" (Thornton, 1972, pp.180-181). Input, then, by this process of compartmentalization comes to be distributed to those parts of the system which require that input to sustain homeostasis. And in order to ensure that the requisite distribution occurs, a
"redundancy" factor is built into the system, such that if one route to the upkeep of homeostasis fails, another can be taken. The system has something in reserve, as it were, to countervail the effects of malfunctioning. This ensures that the work a system must 'get done' to maintain its steady state actually gets done.

It has already been noted that some G.S.T. concepts which have been attributed to living systems can be applied to social organizations. Of course such organizations usually lack the localised holism of living systems. Indeed, the boundary of the organization can sometimes span the globe and there might be a very fluid distribution of members within it. But even discounting the topographical discursiveness of the organization, it usually possesses a structural unity that serves to ensure a coalescence of its various discrete parts. This unity represents a way of introducing maximum order into the social organization, and therefore in itself represents a defiance of the Second Law (Angrist and Hepler, 1973, p.189).

It has been suggested that in order to preserve this unity, an open system needs a regular flow of input. In a disciplinary community, this comprises a regular supply of personnel or cognisers who have the requisite sensitivities needed to operate within the epistemological parameters of the discipline. Unless those cognisers are forthcoming, the social connections within the community, which largely facilitate the transmission and creation of new knowledge, will become ruptured and the system will inexorably degenerate into entropy. But more than just the rupture of unity, the termination of cogniser supply also means that when the generation of cognisers currently occupying positions of important epistemological responsibility in the community "die off", there will be no one to replace them. Since there will be
no cognisers to manage the affairs of the discipline, the advancement of knowledge will cease. No personnel input, then, means no output knowledge; and since disciplinary communities primarily exist for that purpose, the community will eventually close down. Entropy will develop within the system.

But it has also been argued that input on its own cannot sustain homeostasis. Before that can happen, the system must somehow transform that input into forms which the system can utilise. Thus in order for a disciplinary community to sustain its social structure, and in order for that community to execute that function which the social structure supports—namely, the advancement of knowledge—the input cogniser group must first acquire the repertoire of skills and epistemological sensitivities which the disciplinary system, so to speak, 'feeds off'. But if the output of a disciplinary system is knowledge, and the epistemological sensitivity needed to produce it is an 'acquisitive' one (see 5.2), it has also been noted that that sensitivity is educated into existence; it is not born spontaneously, but only follows from a long, sustained period of training and apprenticeship. That apprenticeship, which is equivalent to transforming the cogniser input, occurs on what was called in 5.6 the 'disciplinary continuum'. The various transformative processes contained on that continuum amount to the through-put work that the system must do to secure an output of knowledge from the input cognisers. However there are other likenesses between an open system and a disciplinary community besides this, and they will be explored in the next section.
It was noted in 5.7 that disciplinary communities, like any other social organization, could be regarded as possessing the properties of an 'open system'; for like any other system, a disciplinary community requires an 'input' of energy to sustain itself in a condition of homeostasis. Without that requisite input energy, to keep it 'wound up', the disciplinary community would simply, like any other system, degenerate into entropy and chaos. The disciplinary continuum, then, can be regarded as attending to the 'energy' requirements of knowledge communities; for passage along it, it was suggested in 5.7, results in the student cogniser acquiring the skills and abilities needed to serve in a knowledge community. The continuum, as it were, transforms the student 'input' and produces, as an 'output', a cogniser acceptable to the disciplinary community at large. Those who are not, those who do not acquire the right 'tokens', to press on along the continuum, are either encouraged to think about joining other disciplinary communities, or discouraged altogether from working in any section of the knowledge industry. There is, then, a distribution of energy input: some of it goes out of the knowledge system altogether. The remainder stays, to be distributed within the system itself. Thus, according to the level of disciplinary training he has received, the cogniser can be appointed to a variety of positions on the continuum. This might also be dependent on the personnel needs of the disciplinary system; for it is possible for the 'continuum' to produce a glut of cognisers who cannot be readily assimilated into the disciplinary community, but who must seek positions elsewhere, either lower down the continuum, or outside of it altogether. It does seem however that over-production
of cognisers, because of the scarcity of positions in the community and the increased competition for reward, can lead to increased epistemological innovation in disciplinary communities (Mulkay and Turner, 1971, p.47). Recognition being harder to attain, cognisers are forced to diversify their field of interest and to be that much more original in their knowledge contribution to a disciplinary community.

On the other hand, it is equally possible for the continuum to under-produce, especially in the area of particular kinds of cognisers. And it occasionally happens that forces outside the disciplinary system itself will insist that this paucity be rectified. A recent case of this was the United States Government's concerted attempt to improve the quality of scientific education by making it rival and excel that of the USSR. A precedence for this government interference in education, in very similar circumstances, is to be found in the United Kingdom, after the First World War. The excellence and the superiority of the German "war machine", just like the capacity of the Russians to launch a 'Sputnik', was attributed to the quality of the scientific and technical education available in Germany. After the war was over, the United Kingdom duly tried to emulate the excellence of that education (Landes, 1972, p.76).

The manner of producing cognisers does not have to be all that similar. As has been indicated, in discussing national variants of the continuum, there are many ways of achieving the same cogniser end. Thus specialization does not have to, and rarely does in fact, begin contemporaneously; rather the age at which it begins tends to slide up and down the continuum, according to the system of education being considered. Then there is the related question of 'nostrification'. Between different systems of education, university degrees are often
not of comparable academic value and significance. It all depends upon the particular academic goals established by different education systems for their tertiary institutions. Generally speaking, however, major systems of education tend towards the attainment of equivalent degrees of epistemological sensitivity. In comparative international terms, then, the continuum has some measure of 'equifinality': there are many ways of attaining the same end.

Just as there are different institutional networks for achieving the same cogniser result, so within those networks there are alternative routes for achieving that result, such that if one fails another can take over. There are, as it were, equifinalities within the overall equifinality. This amounts to there being an element of redundancy built into the system. Thus, comprehensive secondary education is far more redundant than a selective system because it can accommodate the late developer whose academic talents are not revealed, say, at ten years of age. Similarly, a system that delays the need to specialize in a particular discipline as far along the continuum as is possible, is accommodating to those student cognisers whose loyalty to a particular part of the knowledge spectrum might change the more that part is studied. A system that allows a student to change loyalties three-quarters of the way along the continuum is obviously more redundant than one which does not. It is of note that in the English system, notorious for its encouragement of early specialization, one or two universities, Keele and Sussex for instance, mount first year courses that are sufficiently broadly based in their curriculum as to countervail any of the effects of premature specialization. Such courses give the student the opportunity to realign his loyalty if
he so desires. Such safeguards serve to increase the level of redundancy inherent in the system.

Another characteristic of open systems, described in 5.7, is compartmentalization. In connection with disciplinary systems, this characteristic is revealed in their tendency to distribute the input energy, in this case cogniser personnel, to that part of the system where their talents and abilities can be most readily utilized and exploited. Hence, within the various phases of the continuum the cogniser's ability is continually evaluated and tested, in an effort to ascertain to what phase of the continuum the cogniser's forte might be best suited.

Although it is much less easy these days, it is still possible to by-pass the bureaucratic network - designed for the purpose - and secure admittance into a disciplinary community. The continuum need not necessarily be the sole route into it; it is just that, with the tokens it supplies, it is easier to achieve admission via that network than it is via non-publicly-accredited routes. Einstein is a case in point. He left university with a poor first degree and did most of his 'quaternary research' in a non-academic setting, a Swiss patent office (Ziman, 1968, pp.64-65). Another, although for rather different reasons, is Francis Crick, who, together with James Watson, helped to crack the structural code of DNA. What is interesting about both of these research workers is that neither was initially trained in the field in which they eventually 'made their names'. Crick was a physicist, who worked in the area of hydrodynamics before embarking on molecular biology. His knowledge about the latter in fact came largely through self-tuition rather than a conventional education in biology and chemistry (Olby, 1972). Thus although he did not possess the tokens...
appropriate to research in molecular biology, Crick was not prevented from making a highly significant contribution to that field. It is possible, then, to avoid the disciplinary continuum and still eventually become a member of a disciplinary community.

5.9 CONCLUSIONS

This chapter has tried (a) to specify in more concrete terms what is meant by epistemological sensitivity and (b) to describe the institutional route by which that sensitivity is generally acquired. Description of the latter was achieved by assembling a model of the institutional process of knowledge initiation. That model has been called the 'disciplinary continuum'. It was argued that the continuum is an 'open system' and that therefore it should display the features of open systems. It was shown that it did. But the disciplinary continuum not only produces cogniser personnel as its output, it also produces knowledge. Indeed, if a discipline is to remain intellectually alive, then it must advance the frontiers of knowledge. If it does not, then it will become defunct. Thus, some of the cogniser personnel produced by the continuum must prove themselves to be capable of advancing the frontiers of knowledge by doing just that. The cogniser output produced by the continuum must itself produce knowledge output.

The way that knowledge is produced, evaluated and disseminated by a disciplinary community evokes issues not so far discussed in this study. The way knowledge is produced, evaluated and disseminated also involves a whole new 'breed' of cognisers of rather different sensitivity from that of the teacher and the student discussed in this chapter. The next chapter, then, will examine the meta-paedeutic
phase of the continuum and suggest how it is that knowledge comes to be circulated in disciplinary communities. It will also develop a typology of these communities, and show how it is that each of the roles described can in fact be represented on the knowledge triad formulated in Chapter Four.
CHAPTER SIX

THE PRODUCTION AND DISTRIBUTION OF KNOWLEDGE

"Tout, au monde, existe pour aboutir a un livre"

(Mallarmé, Quant au Livre)
Whilst the proposition that a corpus of knowledge can exist independently of a community of knowers is not wholly strange to some varieties of epistemology (see 5.1), it is a proposition whose chief strength is imaginary rather than factual. Pursuance of its absolute verity, for instance, would involve neglecting all the assertions and observations of preceding chapters, as well as those to be made subsequently in this chapter. It is also somewhat ironic that much of the strength of the proposition rests on the existence of a community of knowers to begin with. For, as was noted in 5.5, such communities serve to ensure that knowledge is purged of subjectivity and the sort of values that might otherwise sabotage its objectivity. The proposition, then, has its functional roots in a world of persons that the concept of a wholly non-subjective account of knowledge would serve to deny.

Much as though the logician of knowledge might try to banish the possibility that knowledge has its provenance in people, that possibility is really a hypothetical abstraction born of a liaison with a Platonic ideal and not of the empirical facts about knowledge. A great deal of this study, then, has been concerned with confuting the viability of a Platonic epistemology. Chapters Four and Five, for instance, with their accounts of how it is that personal and social factors insinuate characteristics into knowledge, vindicated the position that there are strong and unavoidable humanistic streaks in knowledge. But those streaks, it needs emphasizing, are never uncontrolled or untrammelled. The parameters of what is acceptable epistemological behaviour are well defined, and one of the reasons for knowledge having a social dimension to it, is to make sure that the
humanistic streaks in knowledge do not 'get out of hand' and disgrace the limits of acceptable epistemological behaviour in a disciplinary community.* Knowledge, then, is in part socialised to impose a check on those personalities who would deviate from the communally accepted norms that govern and pervade the workings of a disciplinary community. The progressive institutionalization and bureaucratization of knowledge - described in Chapter Five - are responses to the needs to uphold disciplinary standards and to filter out would-be defectors from those standards. The existence of education, playing as it does a major role in selecting suitable cognisers to serve in disciplinary communities, is testimony to the normative expectations that are prevalent in epistemological behaviour. Thus the disciplinary continuum (see 5.6), which was an attempt to map the institutional route ** a cogniser must follow to gain admittance into a knowledge community, in effect amounted to plotting the major stages of disciplinary socialization.

It is through education that a disciplinary community comes to propagate its values to successive generations of cognisers. It is the discipline's answer to DNA! And in this connection, it was noted in 5.5 how the most succinct way of propagating these values was via

* Buckley (1972, p.189) makes the pertinent remark that, "... knowledge is not positively and finally given merely through information input to sensory apparatus, but rather is actively constructed and reconstructed through continual interchange between the individual and his physical and social environment".

** Whilst the admittance to disciplinary communities tends to take place these days exclusively via institutions of education, this does not prohibit the possibility that that admittance could take place by other means (see also 5.8); or that the way these institutions have evolved to conduct disciplinary initiations are in any way absolute.
the knowledge that openly manifests them. Since the one is the extension of the other, the distribution of a discipline's normative values can occur concurrently with the distribution of its substantive content. But the purpose behind that propagation is never merely distributive or conservative. For disciplinary systems, the business of propagating themselves is only a means to more overriding epistemological ends. There is, for instance, the general meliorative end: that contact with knowledge and pursuit of the truth it embraces enhances the reasoning capacity of men and women in general, not just cognisers. That end, as was noted in 5.2, is frequently advanced to justify knowledge occupying a pre-eminent role in the educational process. It is the argument used to defend the 'liberal education' tradition. Fortunately, it is also a rather convenient end, for it permits education a degree of ambidexterity in its practices. On the one hand, for instance, it means that educational systems, without loss to their effectiveness, can dedicate themselves to educating men and women via knowledge, whilst on the other, carrying out the initiation of a few of them into disciplinary communities via some of that same knowledge. But although disciplinary systems - and the medium by which they carry out that function, education - exist to manage the distribution of knowledge, that function is really subsumed under a greater epistemological goal: which is to manage the production of new knowledge.

The 'life blood' of a discipline, then, is the acquisition and creation of new knowledge. All the members of a disciplinary community are really dedicated, either directly or indirectly, to the realisation of that goal. Anything else, such as the problem of circulating new knowledge to the disciplinary community at large, is
really subsidiary. Production comes first, the problems of distribution second. However, it is around both these functions that the bureaucracy of knowledge happens to be concentrated and organized. Not all members of a disciplinary community, for instance, are involved, per se, with gathering new knowledge. As in all bureaucracies - that is why they exist - there is within that of knowledge some measure of distribution of tasks and responsibilities. Specialized competencies are, for example, required to gather rather than to distribute knowledge, which in its turn requires specific skills and training. The identification of cognisers with the requisite competencies is in the main executed by meritocratic selection; for the ruling class of a disciplinary community is above all things a meritocracy; and part of the function of a disciplinary continuum is to generate that meritocracy into being.

If disciplinary communities have taken on the properties of bureaucracies - with roles and responsibilities being delegated to cognisers of a particular level of competency and ability - it should be possible to draw up a typological classification of such communities. A rudimentary classification, for instance, can be centred on the cogniser's relation to the commodity of the community - knowledge. In very simple terms, all cognisers are either concerned with producing or distributing knowledge; and, as will be seen, all other roles that accrue to the cogniser are functional variations on this basic classification. Teachers, for example, are primarily distributors, whereas those cognisers working at the frontier of the discipline, near to the edge of nescience, are producers. This most primitive of typologies can be extended to accommodate other styles of knowledge production and distribution. Distribution, for instance, can be as well written as taught, thus evoking another type of cogniser; and then there are
those cognisers who take on the task of acting as the 'conscience' of the discipline by criticising its means and methods of productivity. Neither should the purely entrepreneurial roles, which are less concerned with production of knowledge and more with the organization of the disciplinary community, be overlooked. They are important to the functioning of a disciplinary community, for they act to direct its operations and generally oversee the production and distribution of knowledge. And lastly there is, of course, the role of the student who is the recipient of distributed knowledge.

From these observations, a provisional typology of a knowledge bureaucracy can be assembled. The typology would consist of categories of cognisers who are capable of executing the following epistemological functions:

(a) the dissemination and distribution of knowledge through teaching or writing;
(b) the creation and production of new knowledge that will either add to or refine the extant corpus of knowledge within a discipline;
(c) the critical evaluation of new knowledge, such that any deviations from the publicly accredited routes to knowledge can be identified;
(d) the assimilation of an appropriate body of knowledge and the values it upholds.

In addition, there is the meta-epistemological function which involves administering the institutions which have evolved to produce and distribute knowledge. It is a function that requires the cogniser to deal not so much with the matter of knowledge as with the institutions that handle knowledge. And since organizational problems affect all parts of a disciplinary bureaucracy, this sort of cogniser is
likely to be found there too. But that is not necessarily true of the other categories of cognisers, for the ambit of their responsibilities tends to be restricted to particular sectors of the knowledge community. Thus, in terms of the divisions of the disciplinary continuum (see 5.6), cogniser roles 'a' and 'd' tend to figure most prominently in the propaedeutic phase, whereas those of 'b' and 'c' are more prominent in the metapropaedeutic phase.

Yet another way of composing a typology of cognisers can be achieved by relating the tasks and responsibilities just outlined to the model of the knowledge triad 'constructed' in 4.9. This has the advantage that in portraying those tasks and responsibilities on the triad, it highlights what is epistemologically involved in executing them. To some extent this approach to analysing a cogniser's role has been prefigured in Chapter Four, where it was employed to elucidate the mechanics of producing new knowledge. It was noted, for instance, (see 4.11), that in order to generate new knowledge, the cogniser is often involved in modulating an observed dissonance between the cognition and the cognised radicals of the triad. It will remain, then, one of the objectives of Chapter Six to apply a similar analysis to the evaluation, distribution and assimilation of knowledge, and to ascertain if these also can be represented within the framework of the triad. But before that will be possible, the triad will have to be modified in one important respect.

6.2 TRIAD INTO TETRAD

Since no prescripti.on was made about the matter, it could be assumed that the radical (C_r) assigned to the cogniser in 4.3 could
refer equally to plural or singular 'varieties' of knowers. The triad was similarly culpable in this regard. But then there seemed no virtue or pertinent epistemological insight to be gained from forcing such a distinction, so the radical was left, as it stood, to impute cognisers both in particular and in general. With the suggestion, however, that knowledge possesses a social dimension - or, in other words, cognisers in the plural - there might now be some point in modifying the triad to incorporate this dimension. After all, aside from the fact that the whole commerce of knowledge is conducted in a communally governed framework (see 5.5), there are certain features necessary to that commerce which only arise from very intense and intimate cogniser contacts. And at present the triad has no way of accommodating these contacts, or of describing the epistemological exchanges that might occur in them. The notion, then, of a singular cogniser operating in a social vacuum is one that is foreign to the concept of knowledge. Even on a very fundamental and elementary level, the human relationship is a vital cogniser nexus from which the operations of knowledge cannot escape. This is, for instance, born out by the necessity of the teacher/student relationship, whose existence the triad, as it presently stands, tends to disguise. For instance, from examining the triad it could be surmised that the process of knowledge assimilation occurs in a social vacuum, without any real need for teachers to mediate in the process. The exchange between the cognition and cogniser radicals of the triad can be entirely managed by the student cogniser. He does not need direct and intimate contact with other more expert and competent cognisers to facilitate the acquisition of epistemological skills and facts. And to some extent the existence of the 'autodidact' - the self-taught man - who manages to acquire a
level of epistemological competence quite in excess of his formal educational experiences, moreover in 'solitary confinement', would tend to bear this out. But before acceding to the implications that flow on from the phenomenon of the 'autodidact' and the concept of the self-educated man, the phenomenon really needs to be more thoroughly examined. When that is done it soon becomes apparent that the 'auto' in 'autodidact' is not so auto after all; for whilst the autodidact might claim to have had no direct physical contact with teachers, in the orthodox sense, he will have had contact with 'teachers' of sorts through the books and writings that he will presumably have read to have obtained self-tuition. The word 'self', then, in the participial adjective 'self-taught' is really a misnomer. Admittedly, the autodidact does not have the benefits — and there are several, as was suggested in 5.5 — of 'person to person' teaching, but he does have the benefit of a teacher. His teacher, however, unlike that of the usual student, is cast in the role of an author and not a pedagogue.

The moral to be drawn from the 'autodidact' is that even in the attempt to deny the sociality of knowledge, it is implied. However much the cogniser might try to incarcerate himself from the community that knowledge represents, he is indubitably, even if only by proxy, involved with it. There is, then, to all knowledge a civic coefficient, whose value is determined by the level of personal involvement a cogniser has with a knowledge community. With the autodidact the value of that coefficient is relatively low; with the cogniser, working at the frontier of his discipline, certain factors (vide infra) make it imperative that it be much higher. It is a matter of any engagement with knowledge bringing the cogniser into contact with other peoples' minds, both living and dead. For as the French Eighteenth
Century philosopher, Fontonelle, put it: "an educated mind is, as it were, composed of all the minds of preceding generations" (Gablik, 1976, p.35).

A cogniser travels to knowledge through the auspices of a discipline's social dimension. At present, the triad does not portray this part of the cogniser's itinerary. It only indicates that, principal amongst the cogniser's epistemological relationships, are those he has with knowledge (cognition, $C_n$) and reality (cognised, $C_d$). What is now being suggested is that in fact the cogniser's epistemological outlook is also compounded from another relationship: that which he has with other cognisers. There is involved in the knowledge process, then, a 'plane of conviviality', along which the cogniser establishes a rapport with past and present members of a knowledge community. And it is to accommodate this plane, and the ramifications that flow on from its existence, that one more vertex will be added to the triad, thus transforming it into a 'tetrad':

Figure 6.1

- THE KNOWLEDGE TETRAD -

![Diagram of the Knowledge Tetrad]

- COGNISED ($C_d$)
- COGNITION ($C_n$)
- COGNISER ($yC_r$)
- COGNISER ($xC_r$)

Plane of Conviviality
The principal advantage of the tetrad compared with the triad is that it makes it possible to incorporate those inter-cogniser rapports which are a vital part of the commerce of knowledge. Those rapports come in a variety of styles and types. Their style is likely to be determined, however, by the kind of cognisers involved. For instance, if the prescript 'y' in the expression $yC^r$ denotes a student, then the inter-cogniser rapports involved are likely to be an assimilative style and to be conducted largely with teachers $(tC^r)$. But as the student $(sC^r)$ progresses along the disciplinary continuum, the pedagogic bias of that rapport tends to weaken and change. Indeed, if the student progresses to the metapaedeutic phase of the continuum he will become involved with a different set and caste of role cognisers altogether.

The tetrad, incorporating as it does the social dimension of knowledge, enables a more comprehensive and authentic picture of the epistemological process to be framed. It will permit, for instance, the representation of the kinds of rapport and exchanges which occur between cognisers in their dealings with knowledge; and as these are a vital adjunct to the knowledge process, a model which accommodates them is obviously more plausible and veristic than one which does not. It is to the modified model of the triad, then, because of its greater flexibility and better schematic representation of knowledge, that much of the subsequent discussion of role cognisers will resort when it seems enlightening to reproduce these roles diagrammatically. That discussion will commence with an examination of the role of student cogniser.
6.3 STUDENT COGNISER (sC*)

The embryo of cogniser development is found in the student; but how that embryo develops depends on a number of factors, not all of them epistemological. Cognisers, for instance, are made not born; and their making occurs as they proceed along the disciplinary continuum. It is there that knowledge instigates its impressions upon the cogniser, effectually drawing his attention to quarters of the world that would normally lie below the threshold of his awareness. Before that happens, the cognition vertex of the triad and all the verities about the world it acts as a vendor for, is virtually absent from the cogniser's percipience of the world. The cogniser, of course, still perceives the world, but without the benefit of knowledge. He is a prisoner in his own consciousness and the constructions it chooses to place upon the world; for whilst he remains a 'captive' in the pre-paedeutic phase of the continuum (see 5.6), he is estranged from the public domain of knowledge. It is only when he embarks on the continuum - and enters the first phase of knowledge initiation - that the 'secrets' of the cognition domain are revealed to the cogniser, and he becomes aware of a publicly authenticated 'reality' that is epistemological rather than perceptual. It is at that stage, then, and only then, that the cognition vertex of the triad penetrates the consciousness of the cogniser; and as it increasingly does so, the cogniser becomes much less the slave of his own egocentric interpretations of the world, and more the willing participant in a communal interpretation of it. And as that participation becomes more intense, the consonance between the cognition and cognised - which is the condition of established knowledge - gradually gives way to
dissonance. For, as the cogniser becomes epistemologically aware, he begins to sense discrepancies between some of the knowledge he has assimilated and the observed behaviour of reality. But that only occurs when the cogniser begins to emerge from the chrysalis of cognitive metamorphosis that is the continuum. And, in any case, before that happens, the cogniser is subjected to a whole plethora of transformations that serve to determine what sort of dissonance he, as a 'mature' cogniser, will eventually come to modulate.

Whilst it may be assumed that the cogniser's mind, before it 'sets foot' on the continuum, is a virtual tabula rasa that is susceptible equally to any epistemological influence whatsoever, there are factors - perhaps psychological, perhaps pedagogic - which cause the cogniser to develop a stronger orientation to some parts of the knowledge spectrum than others. It has been noted that, as his education proceeds, the cogniser gradually learns to look at the world through the 'eyes' of knowledge, rather than his own. But the dominion of knowledge, as discussion of the epistemological spectrum (see 4.6) revealed, is wide ranging and diverse. It is 'polyommatus' - many eyed - and so the question is inevitably raised, what are the major factors that influence the cogniser choosing one 'eye' of the knowledge spectrum rather than another? Some of these factors are obviously pedagogic, and these will be dealt with more thoroughly in 6.4, when the role of the teacher cogniser (tC_r) will be examined. There is evidence (Griff, 1970, p.147), for example, which indicates that, of all influences, the "public school experience" of art is a major factor in the recruitment of students to artistic communities. Conversely, it has been pointed out that a major factor in the decline in the recruitment of students to scientific communities is the poor quality of science teaching in
the secondary sector of education (Zinberg, 1974, p.242). That that should be particularly worrying is due to the fact that most scientists decide upon a commitment to science as a career between the ages of thirteen and fifteen.

It would appear that education's role in fostering disciplinary loyalty only serves to cement and give outer-direction to disciplinary tendencies that are incipient in the cogniser from a very early age, indeed from the earliest age possible! For example, there is a strong correlation between "primogeniture" and being either a successful artistic or scientific cogniser (Getzels and Csikszentmihalyi, 1976, p.164; Hudson, 1975, p.121). Newton and Einstein were both 'first borns' in their families; not that that means much in itself, except that it might have generated that degree of emotional independence and isolation which is a marked personality trait of the scientist (Gardner, 1973, p.319; Cotgrove and Box, 1970, pp.50-51). Indeed, scientists would appear to find the company of the natural and physical world much more to their liking than that of people; and whilst it would be difficult to characterize scientists as out and out misanthropes, it is of note that they often transfer the scientific mode to their dealings with people. Scientists, for example, quite often expect to trammel their human relationships in the same cordon of order and determinism that marks their dealings with the physical universe. They employ the methods of empiricism not only in the laboratory, but in their lives as well.

These autobiographical ramifications however do not necessarily stem from just studying science, for there is some evidence to suggest that they are already incipient in the cogniser before he ever reaches the continuum and begins a formal scientific education. Most potential
scientists, for instance, spend relatively isolated and lonely childhoods, exiled from the pursuits and interests of their contemporaries. They would appear to be socially inept and gauche from the first. It is as though these precocious Ishmaels of culture prefer to sublimate their problems with people in unravelling the riddles of the physical world; for from an early age scientists are very materialist in instinct. A strong interest in the physical world and a delight in discovering new knowledge are often dominant passions in the childhood of the scientist (Hudson, 1975, p.137; Miller, 1970, p.82). This was certainly the case with Max Planck, who, in recalling the origins of his scientific mentality, noted how it was stirred into life by the realisation that the laws of reason echoed the sequences of sensory impressions received from the world. From the moment, which was in early childhood, that he saw the connection between the two, Planck came to regard the pursuit of scientific reason as the "most sublime pursuit in life" (Planck, 1950, p.13). But it is not just scientists who reveal their talents at a very early age. It would appear to be equally true of very gifted artists. It is said that Picasso could draw before he could talk, and that at four Bartok could play from memory forty songs (Storr, 1972, pp.170-171). Education, then, sometimes merely serves to reinforce an epistemological 'life style' that the pre-paedeutic cogniser is beginning to lead anyway. The roots of disciplinary allegiance, at least in a number of well known individual cases, often seem to lie much deeper than the service education can perform. It only capitalizes on what at a profound psychic level has been determined anyway. The intellectual is an outgrowth of the deeply personal, and it is as much inner as outer directed.
The type of thinking that science elicits is that which Hudson (1966, p.102) has characterized as "convergent". It tends to attend to the impersonal aspects of culture and is inclined to take flight from the expression of human emotions. It is the kind of thought that finds the security of authority, order and absoluteness much more acceptable than the vagaries of irrationality and extreme subjectivity. On the other hand, "divergers" - Hudson's opposite category of thinkers - do not find themselves retreating from the domain of affectivity and are in fact quite at home in it. Indeed, they are inclined to loathe the exactitude and manifest determinism of convergent thought (Hudson, 1970, p.16).* Thus, whereas convergers are inclined to develop an interest in the right-hand end of the knowledge spectrum, divergers feel more naturally inclined to its left-hand sectors. Their appetite for knowledge is more readily satisfied by art rather than science.

In terms of cogniser development, it would appear that a loyalty to the arts or science ends of the knowledge spectrum emerges at particular phases of a child's general psychological development. It has already been noted, for instance, that an enthusiasm for science and things of the material world is evident in scientists often well before the onset of adolescence. The scientist usually has a strong commitment to his discipline when others are still vocationally very

* These are unlikely to be mutually exclusive categories of thought. Indeed, it could be argued that there are elements of divergency in convergency thought, and vice versa, as Elliot has to some extent pointed out (Elliot, 1971, p.122). The writing of a poem - which would presumably be, in Hudson's terms, a divergent activity - is a case in point. What could be a more convergent activity than searching for a word which most nearly satisfies the demand of the content and metre? As an activity, the search for such a word is much like finding the next number in a number series, a thoroughly convergent activity.
immature. That the scientific outlook should be cemented so early is probably because children in general, between the ages of five and ten, are much interested in 'reality testing'. They are in the psychological phase of 'latency' and have temporarily withdrawn, to explore the effects of the material world, from human relationships. The qualities of convergent thinking, then, tend to crystallise in this phase of latency, which of course correspond to the primary sector of the continuum (see 5.6). Thus, if there is already in the cogniser a tendency to convergent thinking, previous to the latency phase, the exercise and excitement of reality testing would serve to exaggerate it still further.

Divergent thinkers, on the other hand, would find the phase of latency rather inimical to the development of their epistemological interests. The materialistic orientation of latency, with all its accompanying 'misanthropy', is not particularly conducive to bringing to consciousness the diverger's more artistic temperament. In fact it tends not to surface until adolescence when, following the phase of latency, there is a reawakening of an interest in the more emotional affairs of life. People once again enter the scenario of an individual's psychological development. Naturally the proto-scientist who, when it comes to people, is inclined to be reticent and uneasy, remains unmoved by the social interests of adolescence. He is happier cultivating the materialistic outlook, whereas the diverger, who has a more innate sympathy for the irrational and capricious subjectivity of human affairs, often discovers a burst of epistemological enthusiasm for the arts. For it is they which resonate most strongly with the diverger's desire to enumerate and understand the emotional issues that are pressing on him in his own dealings with other people (Hudson, 1973).
Adolescence, arguably, is an age of art, whereas the stage of latency, which precedes it, is essentially one of science. Thus it is more likely that a loyalty to the arts and the disciplines at the left-hand end of the knowledge spectrum comes into existence during the secondary sectors of the continuum, whereas that for science, as has been noted, develops in the first.*

It is cogent to reflect that perhaps 'trans-disciplinary' experiences have as much impact on the choice of disciplinary allegiance as those formal mechanisms which are performed in education to encourage that allegiance; and that apart from the psychically embedded factors that might predispose a cogniser to the right- rather than the left-hand end of the knowledge spectrum, there are also some seemingly very peripheral factors, like being bed-ridden and coming from a family of Unitarians, which also exert an influence on disciplinary choice. For it has been found that many an eminent scientist suffered a major illness during childhood, which, it is suggested, provided the opportunity for the development of a rich fantasy life (Roe, 1953, pp.87-89). As to their religious background the vast majority of scientists come from liberal Protestant families. The Unitarian Church has a particularly good record for producing scientists. Roman Catholicism, it seems, is unconducive to breeding the rational mindedness that is a requirement for science (McClelland, 1962).

To some extent, then, a student's disciplinary persuasions are...

* Not that such loyalties are irrevocable. Apart from the student cogniser who has a change of disciplinary heart in mid-stream, there is also the well documented phenomenon of something like fifty per cent of science students, after graduating, leaving their chosen discipline altogether (Zinberg, 1974, p.242). Paradoxically, it is often because, at University, they have discovered the pleasure of being a diverger.
provisionally moulded by factors which educators may be powerless to mollify or negate. The pre-educational experiences of early childhood might have a more pronounced impact on disciplinary preference than has hitherto been conceded (Hudson, 1973, p.71). But if it is these experiences that finally determine where a student will 'plant' his epistemological loyalties, it is also true to say that other 'trans-disciplinary' experiences can compound to influence the emphases that are apparent in a cogniser's epistemological sensitivity. The world around a cogniser, for instance, can in quite tangible ways affect the construction he places upon it. In its own way, the environment can act as a pedagogue upon the cogniser's sensitivity and lead to distorted pictures about the nature of reality. Geologists, it was noted in 2.7, brought up in the Middle West of the United States, far away from the manifestations of dramatic coastal erosion, were inclined to the view that high plains or plateaux were formed by sub-aerial denudation. On the other hand, their more littorally inspired colleagues in Britain - who had the sea all around them and could see its erosive power - took the view that only this power could be responsible for such geological formations.

It was indicated earlier that the cognition vertex of the triad served to impress itself upon the student cogniser's vision of the world, transforming it in all manners and modes. It was suggested that it added a dimension - the dimension of knowledge - to the cogniser's outlook that he did not previously possess. The argument which has followed this initial assertion, whilst not actually superseding it, has tended to indicate that the student cogniser's role in the process of epistemological initiation is not quite so inert as all that. Whilst he might be an epistemological tabula rasa in the very
substantive aspects of knowledge, it does seem that he might often have some very archetypal predisposition to certain sorts of knowledge: and that the role of education is not, after all, to implant these predispositions, but to encourage and render them more substantial. Thus the influence of the \( C^*_n \) vertex is not to subvert the cogniser's 'un-epistemological' disposition to the world, but to make it more overt and known to him. Its influence, when exercised, enables him to see that the epistemological path he is 'instinctively' treading conforms to the canons and directions of science or art.

Whilst the cogniser's contact with knowledge might serve to displace some of his more personalized responses to the world, it is true to say that some of them, together with certain autobiographical experiences, are instrumental in eliciting from the cogniser the commitment to knowledge which education will try and evince from him. The student cogniser's awakening to knowledge, then, is compounded not just from epistemological experiences, but from personal, cultural and sometimes topographical ones as well. In fact, his cumulative epistemological sensitivity arises from a conjunction between his private experiences of the world and the more generalized and public 'readings' of it available in knowledge. It is the teacher who first introduces the student to those public readings.

6.4 TEACHER COGNISER \((tC^*_r)\)

The role of the teacher can be summed up quite succinctly: it is to act as an intermediary between knowledge and the student. He acts as the medium through whom knowledge flows on its travels from the cognition to the cogniser radicals of the triad. His role helps to justify turning the triad into a tetrad:
The teacher, then, in a disciplinary community is very much concerned with marketing and distributing knowledge. He is the 'salesman' in the knowledge manufacturing business. He is the middleman between the knowledge producer and the customers of knowledge, its students. He is the link between the acquisition of knowledge at the research frontier of a discipline and its consumption by cognisers stationed very remote from that frontier.

Conceptual analysis has tended to reveal that some overall aim or purpose is logically elemental to the activity of teaching (Hirst, 1973, p.167; Downie, Loudfoot and Telfer, 1974, p.4). Without that aim, the philosopher of education is usually loathe to supply the epithet 'teaching' to the activities being considered as potentially 'teacherly'. Teaching, then, is teleologically orientated, and the telos to which it is orientated is learning or the development of the mind's capacity to reason. Now the latter, it has been argued (see 5.2), is the sine qua non of knowledge: hence teaching's bondage to it is quite in accordance with this aim.

The distribution of knowledge is usually executed in one of two ways. The first occurs by proxy, through books, journals and other means of
'literary' dissemination; and whilst they might not be intentionally didactic,* clearly anything which communicates knowledge and which therefore has the power to raise understanding and develop reason, rightfully deserves to be seen as a 'teacher'. However, the 'teacher by the book' - and he will have a section to himself (see 6.8) - and whose 'existence' can only be read 'between the lines', is a teacher of a totally different order from the teacher who distributes knowledge, so to speak, in the flesh. It is with the role of the latter sort of teacher that this section will be concerned.

It is also worth bearing in mind that teachers are relatively ubiquitous 'creatures'. Attempts thus to cordon them within the limits of educational institutions does not make sense when plainly, these days, teachers are equally at home on television and radio as they are in the classroom. The sense of doing so rests mainly on the fact that teachers in educational institutions are involved in giving 'tokens' to their students which are needed to gain entry into the next stages of the disciplinary continuum. On the other hand, their colleagues 'on the air' are not involved in giving tokens. Television and radio, for instance, do not generally award exchangeable tokens for viewing or listening to a 'lecture' given on them by a Jacob Bronowski or a John Kenneth Galbraith.** On the other hand, it would be hard to deny that such men are not teachers, and great ones at that, who,

* Some modes of 'literary' dissemination, for example, are intentionally didactic. Their purpose is 'to teach'. The average school textbook is like this.

** There are, of course, nowadays, many exceptions to this; for example, the 'Open University' in the United Kingdom, which conducts many of its courses on radio and television, thus successfully bringing the lecture theatre into the living room.
very much in the tradition of T.H. Huxley and Michael Faraday, have made profound and major intellectual movements accessible to the ordinary man in the street. It is just that the teaching they do does not directly accrue to its recipients anything in the way of educational recognition. By itself, then, the act of watching "The Ascent of Man" or "The Age of Uncertainty" confers nothing on its viewers except the deepest enlightenment; and unfortunately that buys very little on the Academic market! The paradox of the matter is that, had Professor Galbraith given "The Age of Uncertainty" at his token-giving Alma Mater, Harvard, the students who ventured to his lectures would have no doubt obtained the same deep enlightenments plus - if they satisfied course requirements - some educational tokens for their trouble.

Teachers, then, can be employed in both token and non-token giving institutions. It is with the teachers in the former institutions, however, that this section will be primarily concerned. It has already been noted (see 5.7) how the institutionalization of knowledge has tended to make disciplinary communities very qualification conscious. The 'token dispensing' teachers, who are 'employed' by a disciplinary community, are therefore expected to possess the token they are responsible for awarding. In fact, their disciplinary training is generally expected to be one institutional stage in front of the students they are teaching (see 5.6). Credentials signal at what level a teacher is permitted to teach. However, his capacity to do so - more than his legal right to do so - rests on something more than the credentials he has managed to collect. For, as was also noted in 5.6, the actual ability and authority to teach are not logical extensions of the formal authority to do so. Paper qualifications are not
necessarily a measure of teacher effectiveness. Of course, some measure of expertise in the discipline is expected of the teacher. But that expertise is really only the substantive backcloth of what is the principal métier of the teacher: namely the ways of conveying that expertise. The teacher is not only an authority on some subject, but also on the methods of teaching it as well (Peters, 1970, p.252). And this embraces not only a 'feeling' for the rhetoric of communicating knowledge, but also an understanding of the psychological and social nature of the student cognisers to whom he does his teaching. For acumen in these things is a necessary element of the process of converting $C_n$ knowledge into terms that students can readily assimilate. The teacher's art, then, is very much a matter of rendering the 'consonances' at the $C_n$ part of the triad audible to the maximum number of students. The teacher's plane of interest on the triad is the 'b-dyad'.

The teacher's disciplinary competence comes from his 'long march' along the continuum. The multiplicity of skills involved in the art of teaching (Symes, 1977) come from another quarter altogether. To accommodate that quarter, the continuum really needs inserting into it what, in the jargon of the computer programmer, would be called a 'branch'. For, as was indicated in 5.6, the student cogniser does not always have to reach the quaternary sector in order to secure a place in the disciplinary continuum. For instance, if he desires to teach in the primary sector of the continuum, that 'march' can reasonably conclude at the end of secondary education. His disciplinary training need not go any further. But before he can actually teach 'primary', the student cogniser will have to go through a period of pedagogic training. Thus, the cogniser's route back to the primary
sector - as a fully credentialized teacher (t^C_r) - is diverted through an institution specifically in the business of training teachers.

So far, it has been indicated only that a disciplinary community is longitudinally organized. Its members, it could be surmised, perhaps only relate upwards and downwards on the continuum. For nothing has been said of possible 'side-ways' relationships. There might be, for instance, in addition to the overall longitudinal community, some latitudinally organized institutions within that community designed to consolidate and perhaps elaborate 'side-ways' relationships. Institutions of teacher education, for instance, are a case in point. They are a 'branch' off the main programme of the continuum. They only relate indirectly to the movement of personnel and knowledge up and down the continuum. In fact the education of teachers, and the institutions which carry it out, could be regarded as 'meta-communities'. Their principal orbit of interest and responsibility centres on the pedagogic ways of distributing a knowledge that they themselves, as institutions, do not engage in. Rather, Svengali-like, they leave the presumption of that role to the teachers they train. In the meanwhile, it is hoped that the training received will leave the student-teacher cogniser better prepared and equipped to serve his role on the continuum. For if, as Green (1971, p.4) suggests, that role consists of three major types of activity, the logical, the strategic and the institutional, then the training and education most student-teachers receive embraces specialities designed to offer understanding on these activities. The curriculum theory he will study, for instance, will encapsulate ways of presenting knowledge more effectively. It will embrace Green's 'logic' of teaching.
On the other hand, the sort of techniques of motivation and persuasion urged by the educational psychologist will fall within the province of the strategies of teaching. The point is that the meta-community has itself proliferated a plethora of specialities designed to make the distribution of knowledge more scientific and efficacious. The 'b-dyad' has almost become a continuum (if not a cognised) in its own right. But it is a 'continuum' which exerts most of its influence on the continuum, as a whole, in latitudinal rather than longitudinal directions. That is, the province of most teacher education is exclusively directed at either the primary or secondary sectors of the continuum.

Then, of course, within the 'family' of practising teachers - working directly on the continuum - there are further latitudinal concentrations of interest. Most teachers, for example, form themselves into disciplinary associations whose function is to promulgate new developments of pedagogic technique in their particular disciplines. Thus within the overall horizontal bureaucracy of the knowledge community there are also minor vertical bureaucracies - of the teacher education type - which have a particular and specific function to play in a limited domain of the continuum.

Teachers are trained basically to learn the gamut of 'rhetorics' that can be used to convert knowledge into terms which student cognisers can assimilate and understand. Whilst dexterity of exposition might be uppermost amongst those rhetorics, it is not always the most effective way of securing that assimilation and understanding. Indeed, as Green (1971, p.8) points out, in the more elementary sectors of education the teacher is often more successful if he foregoes logical exposition altogether and adopts a more
strategically based teaching. Particularly where the primary school teacher (t) is concerned, ability to motivate and interest the child counts for much more than eloquence - which will frequently be lost on the child anyway. Hence, as was noted in 5.7, the accent of the primary school teacher's training is usually upon method rather than matter. Not that the rhetoric of persuasion need be absent or any less evident in teachers domiciled in other parts of the continuum. It might be less "strategic" and less childish in its appeal, but part of the lure of all good teaching is, as Peters (1970, p.259) has pointed out, that it gives to its recipients the impression of having the mysteries and secrets of some epistemological cult revealed to them. Nine-tenths of motivation involves surrounding knowledge with an "aura". That is one way to effect excitement and enthusiasm for it.

The quasi-religiosity of Peters' metaphor tends to disguise, yet emphasise what the real business of the educator is: epistemological evangelism. For though the seeds of a personal disposition to a particular form of knowledge might have been sown in a cogniser's early infancy (see 6.3), the teacher, to use a Froebelian metaphor, still assumes a very active role in nurturing that seed into bloom and flower. Besides, the Max Plancks of this world, who need no convincing about their true epistemological avocation in life, are hardly the norm in the educational arena. So it remains very much the responsibility of the teacher to proselytise his students to his epistemological way of thinking. Indeed, it has been held that the mark of the gifted educator is that he can transform a modicum of disinclination towards a discipline into a lasting enthusiasm (Peters, 1970, p.39). The measure of a teacher's ability, then is not tested in preaching to the epistemologically converted, but in turning the
eyes of the apostates. In fact, the old argument of whether it is more apposite pedagogically to derive the etymology of education from educare or educere can be stood on its head. There is as much 'seduction' in the enterprise of education as 'drawing' or 'leading out'. Thus if appositeness is being sought, it might be equally as appropriate to call teachers 'seducators' as educators!

Given that knowledge does not generate enthusiasm unless it is rhetorically dressed up, a pointed critique of education might be that if it takes that much trouble to get people interested in knowledge, why bother? That critique is often answered — as it was in 5.2 — normatively, by imputing to knowledge all sorts of beneficial psychological and cultural repercussions. It is said, for instance, that since knowledge represents a celebration of rationality and since rationality improves the existential calibre of human beings, all ought to be exposed to the manifestations of knowledge. Education represents the baptism of that exposure. It is supposed to lay the foundations for a lifelong appreciation of knowledge for its own sake, rather than any utilitarian ends it might be partially instrumental in realising. However, it does not seem that teachers — and presumably many of them would subscribe to this liberal defence of education — are particularly successful at encouraging a reverence for knowledge for its own sake. Many students at universities — which after all, as an institution, represents the apogee of liberal education — tend to regard the learning they receive there in purely 'journeyman' terms (Miller, 1970, p.63). They regard it as an investment for their occupational rather than cultural future.

Perhaps some of this ambivalence stems from the nature of education itself. For if the student cogniser consciously rejects
the liberal defence of a university education, and if he himself has
no intention of joining a 'knowledge community', then he has effectually
excluded himself from two of the primary justifications for having
institutions like universities. For, as has been noted previously
(see 5.2), education functions ambidexterously. On the one hand, it
serves to introduce each generation of a society to what the poet W.B.
Yeats aptly described as the "monuments of unaging intellect". That
is the liberal ideal of education. And on the other, it is instru-
mental in perpetuating both itself and the knowledge communities for
which it acts as an 'employment agency'. Whether the one end is
interlaced in the other, or is subsumed under it, is quite irrelevant,
for it is more a matter of convenience that education, in educating
people in general, can train some of their number to become bona fide
members of knowledge communities. The two functions, at least until
the tertiary sector of the continuum, live in co-existence with one
another. What was made clear, however, by the systems treatment of
disciplinary communities (see 5.7 and 5.8), was that such communities
need to recruit to their ranks a minimum number of student cognisers to
carry out certain roles and necessary functions within the community.
If it is unable to, the community will soon degenerate into 'entropy'
and eventual desuetude. As a matter of functional priority, then, the
training function of education assumes for knowledge communities far
more importance than its educating function.

The teacher's role of 'seducator', then, operates on two mutually
inclusive planes. Firstly, he must cultivate amongst all his
students, a more than transient enthusiasm for the knowledge over
which he is curator; and then, amongst the most enthusiastic of those
students, a desire to develop and use that enthusiasm in a knowledge
community. The teacher makes a speciality of luring people into the kingdom of lore. In that way he helps to sustain the 'genealogy' of a discipline. But as well as being the agent of disciplinary conservation, the teacher is also, paradoxically, finally responsible for generating disciplinary change (Peters, 1970, p.261). Unless a discipline is to stagnate and the springs of 'content' development in it are to dry up, the students the teacher trains must be more than passive recipients of the knowledge delivered to them. Unless the respect for knowledge they develop is also fringed with a legitimate and appropriate disrespect that goes beyond accepting the validity of all knowledge as absolute, teachers would only be instrumental in perpetuating the epistemological status quo. Teachers, in order to facilitate the growth of knowledge, then, must ensure that amongst some of their students the spirit to preserve knowledge is also fired with the desire to change some of it.

But some students are more capable of doing this than others. Thus it is another function of teachers that they partake in the process of allocating intellectual resources (Wilson, 1962, p.20). Much of that allocation, of course, is decided meritocratically (see also 5.8 and 6.1). For disciplinary communities are organised very much about a hierarchy of talent. They conform in fact to that ideal form of society that Plato envisaged in The Republic, with the intellectual "gold" clinging to the top of it, ringing most of the changes of knowledge, and the "brass" and "iron", at the bottom, doing much of the most menial and pedestrian work in the community.

Construed in such terms, one of the teacher's jobs, then, is to overlord the 'metallurgy' of student cognisers, and to see that their intellectual 'ore' gets to that part of the disciplinary system where
it can be most effectively utilized. In this respect, teachers are very much academic talent scouts, or as Merton (1960, p.308) aptly characterizes them, intellectual "truffle dogs" ever trying to snuffle out the possible excellence in cognisers. That feel for talent which teachers might presume to have is not the only barometer that enables them to spot the intellectual 'gold'. Aside from controlling the "formal avenues" into the stocks of knowledge, the public examination has, since the Nineteenth Century, also tried to play the "truffle dog" - although not always with conspicuous success. The matriculation examinations, for instance, which occur at the node of transition (see 5.6) from the secondary to the tertiary sectors of the continuum, do not have an impressive record for predicting academic success at university (Miller, 1970, p.100). There is evidence, particularly from England, that the intense coaching which goes on for 'A' levels often has a "brain wash effect" on students, which secures them matriculation all right, but yet ill prepares them for university. Not that the final examinations at university are any better at picking the "truffles". The best possible of undergraduate degrees is not always a good barometer of the capacity to do research. Many a good scientist only gained a 'second' - Francis Crick was one - or even a 'fourth'! Formal academic attainment, as measured in examinations, then, is often not the crystal ball it is intended to be (Miller, 1970, p.135).

Of much more significance perhaps are the ramifications that flow on from the inter-cogniser rapports which prevail between a teacher and his student. It is of note, for instance, that in passing along the continuum the nature of this rapport becomes increasingly personalized and more one-to-one. In the jargon of administrators,
the teacher/student ratio is reduced. Thus, graduate students in the quaternary sector, theoretically, have the most profound (if profundity is measurable in quantitative terms) rapport, and the primary student, the least. The justification for this of course is that the quaternary student, who in the process of having the 'power' of the discipline devolved to him, needs much more contact with his teachers if he is to import into his sensitivity those *je ne sais quoi* aspects of a discipline (see 5.4) that can only be acquired in a close student/teacher relationship. Not that graduate students themselves report that such associations are enormously fruitful. On the contrary, they find the inter-cogniser rapport that occurs between their peers rather than their professors of much more epistemological significance to their research and professional development (Berelson, 1960, p.105). Of course, this is not always the case. Some teachers are notable for the way they are able to evoke excellence in others, and father a whole generation of considerable cogniser talents. Descartes' teacher, Father Mersenne, was one. Many Seventeenth Century thinkers acknowledged their gratitude to Mersenne as a catalyst of intellectual challenge and as "a clearing house of Seventeenth Century science". Pascal said of him, for instance that "il a donne l'occasion de plusiers belles decouvertes qu (sic) peut-être n'auroyent jamais este faites d'il n'y eust excite les scavans" (Merton, 1960, p.317). It is as though such teachers are able to fulfil their own research ambitions through the work of their students; and, so to speak, fulfil their epistemological dreams vicariously. Then there are the teachers who leave a kind of intellectual inheritance, on which several generations of cognisers seem to capitalize. T.H. Huxley is accredited with being one such teacher. The departments of psychology
and biochemistry he founded at Cambridge nurtured a whole generation of influential English psychologists and biochemists (Crowther, 1968, p.134). And at the same university, John Newport Langley appeared to have much the same impact on experimental biology and physiology. Sometimes it can happen too that a university can suddenly become the 'centre of the universe' as far as disciplinary developments are concerned. This happened at the Georgia Augusta University in Göttingen. In the 1920's, because of the remarkable constellation of teachers and students it was able to attract, it became a centre of restless intellectual activity in physics. It was not that any one teacher or teachers dominated Göttingen, but that students and teachers "became comrades into the interior of matter" (Jungk, 1964, p.28) which seemed to catalyse this activity. For out of that collaboration came a whole generation of cognisers whose names are virtually eponymous with nuclear physics. For Oppenheimer, Heisenberg, Dirac, Fermi, Pauling ... were all students at Göttingen sometime during the 1920's.

The teacher, it has been said, administers the transmission of knowledge and acts as a talent scout for the disciplinary community. His role also includes making himself redundant to the student. Advancement along the continuum should be marked by the progressive release of the student from dependence on his teachers. Education is the means by which a disciplinary community transfers its power and epistemological values to successive generations of cognisers. It is the vehicle by which the genetics of the discipline are conveyed from the 'parents' to the 'children' in a disciplinary community. And in that process of transfer, the teacher is the principal messenger carrying the 'genetic code'. But although one goal of teaching and
education is to replicate the discipline and the bureaucratic structure which supports it, that replication is only the means to securing the more epistemological end of producing new knowledge. And the realization of that end requires a rather different role cogniser from the ones hitherto examined. It is a role whose main plane of interest is centred on the 'c-' rather than the 'b-dyad'.

6.5 RESEARCH COGNISER ($r_c$)

The nutrient of a disciplinary community is new knowledge. In terms of a very crude metaphor, sections 6.3 and 6.4 have been concerned with how that nutrient is 'dished up' and 'eaten', and by whom. For they described the roles that are associated with the distribution and assimilation of knowledge. In that sense, the student's and teacher's roles are both roles that are contingent, in the first place, upon the existence of some knowledge to distribute and assimilate. Without that, there would be no need for teachers or students. Thus, within a disciplinary community, the most antecedent of all roles is that associated with gathering the epistemological 'nutrient' which all the other role-cognisers in the community, so to speak, survive off! Teachers and students alike live in symbiosis with the harvesters of knowledge in a disciplinary community. It is to their role that their employment in the community is ultimately indebted.

The triteness of this observation demands that the import of the Humean ethic (see 5.1) be made more encompassing. For not only can it be said that there is 'no knowledge without knowers', but, reversing the dependency condition, it is equally true to say that
without knowledge there would be no knowers. Certainly the community of a discipline, as it is being described here, and the roles it would appear to spawn, comes from the existence of knowledge, and the need to differentiate responsibilities in terms of its management. A discipline, then, is born at the frontier of knowledge, and as it matures and develops it gradually works its way down the continuum (see also 6.10). As it does so, it accrues a community of cognisers whose responsibilities are focused on the distribution of the discipline's knowledge and the training of other cognisers to appreciate and eventually acquire that knowledge. But without its 'frontiersmen', a discipline is nothing.* It is the role, then, of research cogniser (rC_r) which this section will principally consider.

In 6.4, it was suggested that whilst a knowledge community overall is longitudinally organised along the phases of the continuum, within certain of its phases there is also a good deal of latitudinal

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* This might seem like a contradiction of an earlier and very forthright assertion. After all, when a discipline was being likened to an 'open system' (see 5.7), it was argued that one of the features which contributed to its systemicness was that in order to maintain itself in homeostasis, it required a continuous 'input' of cognisers. Not only were they required to manage the 'throughput' mechanisms, but also 'content' output from the discipline was also somewhat dependent on them. As far as new disciplines are concerned, this could well leave the argument in a 'chicken or egg' dilemma: what came first, cogniser or content output? But from the point of view of their 'history', disciplines do not appear to have immediate and spontaneous autonomy. They do not, overnight, become independent systems. For they usually originate from beneath the panoply of another discipline, and their first practitioners are usually role-hybrid disciplinarians: that is, their first interest might have been applied rather than pure, or they might have been trained initially in a discipline altogether different from the one they helped to establish (Hagstrom, 1965, p.215). Thus, Louis Pasteur was by training an oenologist, and his pioneer work in bacteriology was a later offshoot from it; Freud began as a physician, but was struck by the possibility that scientific principles could be applied to the study of the mind.
organization as well. This was first noted in connection with those aspects of the propaedeutic phase that are associated with the education and preparation of teacher cognisers. It was indicated that the problems of pedagogic apprenticeship were rather specialized, and of a rather different emphasis from that encountered in the normal apprenticeship of cognisers. It was therefore quite natural that institutions should evolve to deal with the problems of teacher education, and that these institutions should be situated off the 'mainstream' of the disciplinary continuum. A similar latitudinal elaboration of the knowledge community exists in the 'metapaedeutic sector' of the continuum. It will be recalled from section 5.6, that the metapaedeutic sector is largely populated by cognisers who, having survived the exacting tests of disciplinary initiation, have secured a 'licence' to harvest knowledge for themselves. The metapaedeutic sector, then, is very much the domain of the 'frontiersmen' in knowledge. It is where the 'research cogniser' practises his earned and credentialized right to seek out and promulgate new knowledge. He is therefore the major protagonist in the metapaedeutic sector; and it is his principal activity - the production of knowledge - which forms the fulcrum around which all the other tasks and responsibilities of the metapaedeutic community are balanced and organized. For the research cogniser needs that community, and the services its members are able to perform, in order to have his ideas criticized and his routine modes of thinking revamped. A "Robinson Crusoe" researcher, as Agassi (1975, p.209) has indicated, would be anathema to the development of knowledge. Thus, within disciplinary communities are to be found a whole array of specialized roles and institutions designed to 'process and handle' the knowledge that the research cogniser produces.
They are his 'Man Fridays'. And they form part of the latitudinal organization of the metapaedeutic sector. They include such things as the professional societies to which research cognisers are virtually obliged to belong; the conferences which they attend to promote public discussion of their research findings; and the various specialized journals in which they publish those findings (Kuhn, 1974c. p.462; Toulmin, 1972, p.27). Moreover, although it has not been drawn as such, there exists in the metapaedeutic sector a kind of continuum along which, by dint of recognition, a research cogniser can make it to the 'top' of the disciplinary community. For just as in the propaedeutic sector of the continuum, equivalent 'tokens' are awarded to those cognisers who, in the opinion of the community at large, have made the most significant contribution to the knowledge of a discipline. Instead of certificates and letters after their names, the cognisers in the metapaedeutic community quest after things like the Nobel Prize, or the prestige that accrues from being admitted to L'Académie française or the Royal Society. These are always the ultimate accolades for the cogniser.*

It was indicated in a previous Chapter (see 5.5), that the principal mecca of cultural advance is the university. It is there that most of the new discoveries in knowledge are made, and there that most, but not all, of the members of the metapaedeutic knowledge community are located. However, not every knowledge advance is made

* Although they do not always signify much prestige as far as immortality is concerned. Take, for instance, the membership of L'Académie française; whilst its membership had admittedly always, during its history, been restricted to forty, it has managed to exclude from its ranks such notable French worthies as Descartes, Molière, Rousseau, Diderot, Saint Simon, Flaubert, Proust, to name but a few (Merton, 1960, p.323).
in a university; nor is it the only institute to sponsor the livelihood of the research cogniser. This is particularly true of those cognisers specialising in right-hand knowledge. Outside the academic institute, such cognisers have the choice of working in a government establishment or industry (Sklair, 1973, p.74). In fact, in purely quantitative terms, the patronage that the academy once gave to science has declined markedly. Government and industry have taken over, and are in fact the biggest employers of scientists. In the United Kingdom, for instance, something like 28% of all scientists are employed in industry alone (Cotgrove and Box, 1970, p.1). But whilst both government and industry have been havens of research, they are havens of a research that has a rather different character from that to be found in the academy. For one thing, the matter of answerability tends to guide government and industry funded and sponsored research much more than it does in the university. In this sense, the researcher in the university had a comparatively free 'epistemological' hand! Unlike his colleagues in industry, his can be a research not particularly obliged to satisfy utility or profit margins. His quest for knowledge does not have to have the market place in mind to justify it. For the industrial scientist, those things are all important. The disinterested progress of knowledge is of no concern to him. He is more interested in patents than publications, and of pleasing his board of directors than the community of science at large. It is a matter, then, of different research workplaces promoting a different kind of science (Sklair, 1973, p.127).

By contrast, the workplace of the academy tends to promote the kind of research that is done for its own sake, without any extrinsic motive guiding it. The academy tends to worship the 'god Episteme'
rather than Mammon! This is, of course, an attitude that is wholly commensurate with the ideals of education anyway; and one that, although students often volunteer a disclamation of (see 6.4), they are somewhat affected by. For upon graduating and entering the less idealistic avenues of industry, the student usually has to be re-enculturated to appreciate its particular ends and demands (Cotgrove and Box, 1970, pp.8-9). The university has to be purged from his system. He cannot afford, for instance, to transfer the notion that knowledge should be purified of utility to industry, for industry's existence fairly obviously depends on the exploitation of a contrary homily altogether. Yet students often do.

It is only in the university, then, that the research cogniser can pursue his own research, and remain uncompromised by one extraepistemological goal or other. But on whatever pretext, it does seem that the preferred milieu of the brightest and most talented students who 'come off' the continuum is the university. This is because the tradition still persists that industry is usually the province of the intellectually second rate. The real intellectual aristocrats, the gold of the community, remain in the universities, preferring not to have to 'dirty their minds' on applied knowledge. A magical quality would appear to inhabit 'pure knowledge' which makes it so much more enchanting and appealing to the best intellects that they can easily justify turning their gaze from the sometimes very material persuasions of a job in industry (Sklair, 1973, pp.82-83; Cotgrove and Box, 1970, p.165). Indeed, such are the virtues imputed to 'pure' knowledge that the consequent stigma attendant upon applied knowledge often overflows into the knowledge community itself. Theoretical physicists, who do their physics largely 'on paper' and 'in their heads' are usually
considered to be a higher species of science 'animal' than the experimental physicist who works directly with the things of the empirical world. And even within the community of theoretical physicists there is a precedence that places in a scale of value the "phenomenologist" above the "intermediaries", and the "intermediaries" above the "abstractionists" (Gaston, 1973, p.30).

Whilst the context of knowledge gathering is not exclusively the university's, it is the only context which, at least in principle, does not intimidate the researcher into satisfying goals other than the purely epistemological.* It is also true that it is only in the university and academic setting that epistemological values are upheld with any earnestness and rigour (Sklair, 1973, p.169). But then the 'industrial' cogniser's values are basically more orientated towards the market place than the discipline. Profitability and utility are more likely to determine his epistemological ideology than communalism and disinterestedness. Whilst the industrial cogniser, then, belongs to a community dedicated to the pursuit of knowledge that is allied in some ways to a bona fide disciplinary community, its axiological structure and system of values differentiate it from that community. The community of industrial cognisers must be regarded, therefore, as a tributary off the major knowledge community. It still makes epistemological gains, but in the pursuit of 'monetizing' those gains, it imposes on its cognisers a set of ordinances strange to the research cogniser 'brought up' in the orthodox knowledge community: hence the

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* Intimidation, for instance, is likely to occur in the attempt to obtain funds for a proposed research project. For in obtaining those funds, there is often a concomitant obligation to ensure that that research has some utility for, or is within the parameters of interest of, the funding agency.
need for him to be 're-enculturated'.

In whatever region of the knowledge enterprise the research cogniser is located, he remains loyal to the task of wresting knowledge from the 'world' he experiences. That is the objective to which he is committed, or else he is not technically a research cogniser. It is an objective which, in terms of the triad, has already been expressed (see 4.11) as the desire to cement a rational and empirically demonstrable nexus between the triad's cognised \(C_d\) and cognition \(C_n\) radicals. The knowledge 'gained from experience' serves to substitute substance for the "airy nothingness" that would otherwise persist between \(C_n\) and \(C_d\). Not that that nexus is entirely vacuous.

If, for example, a relatively broad view of knowledge is taken, and it is held that, no matter how primitive and epistemologically coarse, all attempts to explain the 'workings' of the cognised are scientific - and thereby attempts to bridge the heuristic gap between \(C_n\) and \(C_d\) - then the cogniser has always had available to him a repository of knowledge to help him explain the nature of his surrounds. Even the sometimes outlandish misconstructions that metaphysics has sometimes placed upon the cognised can be counted as confrères in that pursuit. It's just that occasionally those confrères have been shown to misinform the cogniser; and what was taken to be a wholly compatible marriage between \(C_n\) and \(C_d\) was in fact a divorce!

Initially a cogniser is contracted to understand the world in terms of the knowledge which is available to him. He is very much, in his visions of the cognised, the victim of his epistemological inheritance. And at times this inheritance can occasionally split the cogniser's vision between the truths of empiricism and the dogma of metaphysics.
The latter, and its advocates, can sometimes object to the findings of the former and often, as in the case of Galileo, for instance, result in at least its temporary suppression. Thus, scientific disciplines, particularly when 'getting off the ground', usually have to struggle out of an embryo of metaphysics, which is frequently their epistemological 'backcloth'. It has been said, for instance, that the Copernican view of a heliocentric solar system was "inspired by a neo-Platonic worship of the light of (a) Sun who had to occupy the 'centre' because of his nobility" (Popper, 1969, p.257). All that astronomy did was to corroborate the consonance that was already in a pre-scientific cosmology. It is more common, however, for that backcloth to mislead notions about what reality is really like. Properly construed it should yield, in such cases, a programme of what Lakatos (1974, p.132) has called "negative heuristic"; that is, it should indicate a course of research not to take, because it would only lead to specious conclusions. However, this is often not the case. It happened, for instance, when geology began to emerge as an autonomous discipline. Before the geological propositions of Sir Charles Lyell, the discipline tended to suffer - obviously to its empirical disadvantage - from the desire to make its findings compatible with the chronology of the Bible (Gillispie, 1960, p.297). It was as though the ultimate arbiter of geological fact was not the fossils and the rocks in the Earth, but the Book of Genesis.

This intermixing of the metaphysical with the scientific, particularly in the primitive stages of a discipline's history, highlights the thoroughly evolutionary character of knowledge. It points to the possibility that there are 'dinosaurs' in knowledge which the seemingly greater 'brain power' of science will eventually render
extinct. It also suggests, as Comte (1970) and others (Toulmin, 1972, p.135) have indicated, that knowledge is largely the story of periodic supersession. And while the dramaticness of this supersession is most marked at the turnover from metaphysics to science, the narrative that science itself recounts about reality is not without its regular retelling! There are times when science too 'gets it all wrong' and has to be corrected. For there is just as much 'dinosaur' thinking in it as any other epistemological mode.

In 4.11 it was shown how this phenomenon of knowledge obsolescence could be accommodated on the triad. The periodic 'break up' of the marriage between the $C_n$ and the $C_d$ radicals and their subsequent reconciliation, it was suggested, amounted to the triad pendulating between a condition of 'consonance' and 'dissonance'. It was also noted in 4.11 that the advance and progress of knowledge is brought on by the modulation of dissonance: therefore it is that modulation which remains the constant preoccupation of research cognisers. There is, however, a qualification that must be added to this ascription of the research cogniser's role. It is, that what is often one cogniser's consonance is another's dissonance. This has to be an acknowledged possibility because, whilst the great virtue of knowledge is its consensual appeal, it does not always agitate one singular phalanx of cognisers who are totally and unequivocally in its favour. Inevitably there are dissenters who are not always convinced that the marriage between $C_n$ and $C_d$ is as compatible and 'blissful' as some of its apologists make out. Amongst Nineteenth Century geologists, Lyell was one such dissenter. His views on the evolution of the Earth's structure, for instance, were entirely dissonant with those of establishment geology. Whereas its representatives, like Adam Sedgwick and Roderick Murchison,
were ever trying to prove geology consonant with the Bible, Lyell set about debunking their "diluvialist" mentality by showing that the geological facts were utterly discordant with the preachings of the Bible. In fact, by bowdlerizing geology of the Bible, Lyell put geology on a thoroughly scientific footing.

The research cogniser's attitude to cognition, and the nexus which prevails between it and the cognised, can in fact take one of three positions. Basically all three positions involve coming to terms with a level of epistemological dissonance. However, it is the way that that dissonance is modulated, and the gravity of the ramifications that flow on from it, which ultimately determine the characteristic features of these three positions. The first is that style of modulation which can be looked upon as an extension of the "coherence theory of truth". It accepts a certain state of epistemological affairs 'as given' and then seeks out the sort of evidence and knowledge that will corroborate the 'given' and supply further justification for following it as an epistemological 'mentor'. For as a mentor, it is considered 'beyond suspicion'. All modulation does, then, is confirm the basic accord of already established cognition. It is just that there are certain 'gaps' in our understanding of the cognised which the application of the cognition would fill. Those gaps constitute dissonance, the filling of them consonance. Not that the concept of this epistemological procedure is at all novel, only the names for it are different. Kuhn (1973), for example, draws attention to it when he talks about "normal science" and pursuing a paradigm to the limits of its empirical expressiveness, whilst Klima (1974, p.110) would see the procedure as harvesting the seeds of a paradigm's "consistency". Normal science seeks to populate the
vacuity of ignorance between $C_n$ and $C_d$ with knowledge that is already somewhat in accordance with a dominating epistemological mentor. Even though their research was grossly misguided, this was what Buckland and Sedgwick tried to do in perverting the course of geological history to suit the genealogy of the Earth given in the Bible. Biblical genealogy was the paradigm, and geological knowledge had to be made consonant and consistent with its teachings.

The second style of modulation is in fact a 'de-modulation'. It is a style which is employed when it is found that certain epistemological anomalies exist which are beyond the accommodating power of the paradigm. Findings in the cognised are simply not consistent with the 'teachings' of the paradigm. De-modulation, then, serves to unveil previously unsuspected 'dissonances' between $C_n$ and $C_d$. It perceives discord where previously only harmony was thought to prevail. It thus serves to challenge the "intellectual authority" of some received paradigm (Toulmin, 1974, p.40). It indicates areas that, where knowledge was taken to be, there is in fact none; and proves that taking one particular course of heuristic is to commit epistemological heresy; for taking it only serves to exacerbate, not accelerate, the progress of knowledge. A typical example of this is the shadow that Newtonian mechanics and their application cast over the gradual understanding of the 'make up' of the Solar System. Whilst, for instance, Leverrier, in 1859, had been able to predict the existence of the planet Neptune using those mechanics — as a way of accounting for the perturbations in the orbit of Uranus — when the same mechanics were applied to Mercury (similarly perturbated) they did not prove nearly as efficacious (Hanson, 1962). In fact they led to the prediction that between Mercury and the Sun there existed
another planet, Vulcan, which a number of astronomers even claimed the percipience to observe. And it was not until the experimental evidence had accumulated to explode the theory of Vulcan that astronomers finally stopped 'seeing' the "fictional planet". Its disappearance as an aberration, however, did no more than make the problem of Mercury's perturbation more difficult to solve; and the obsession with making whatever solution was pondered absolutely consonant with the laws of Newtonian mechanics led to even wilder postulates than that of postulating the existence of the planet Vulcan. For instance, an asteroid belt was proposed. But yet again the experimental evidence did not live up to the expectations of the proposal. And with so many seemingly credible postulates being 'shot out of the sky', it began to look as though the universe was not always a slave to Newton. And as some research cognisers began to look askance at its epistemological virtues, de-modulation of the Newtonian paradigm set in. The infinite generalizability of its consonance became a less powerful object of defence, as it proved to be guilty of dissonance in certain quarters of the cognised. But it is just this kind of discovery, that a knowledge is not quite so knowledgeable about the cognised as it was once thought to be, that is a prelude to the third style of modulation.

Laconically expressed, that style amounts to a modulation of de-modulation; or introducing a consonance to where previously there had only been dissonance. It also amounts to rebridging the heuristic gap that that de-modulation opened up. It results in a new kind of knowledge being used to cross the abyss of ignorance. It is one that derives its effectiveness from its capacity to accommodate those anomalies that de-modulation unveiled. It has the power, then, to
reconcile the two partners – cognition and cognised – in the epistemological marriage, which dissonance temporarily split asunder. The new knowledge does so by counselling the cognised into submitting itself to a completely novel set of laws. For a disciplinary community, this often represents a "revolutionary" turn of events which requires that cognisers adopt a correlative 'change of mind' about what they took to be the nature of reality (Kuhn, 1973). This happened in geology when Lyell insisted that if geology was to mature as a science, it had to divorce itself from theology. But more than just offering a manifesto of geology's desired independence, Lyell offered convincing proof why that independence was at all possible; for he showed "that existing forces, given time enough, account for the observable state of man's habitat" (Gillispie, 1960, p.299). Sedgwick's deus ex machina was unnecessary. And such a proposal proved not only to be an enormous purgative for the Earth sciences, but the life sciences as well. It is arguable, for example, that Darwin's Theory of Evolution is as much a product of Lyell's Principles of Geology, as it is of his observations on the Galapagos Islands.

This third style of modulation, then, always has the profoundest of ramifications on the development of a discipline or disciplines; for not only does the disciplinary coup d'État initiated by this modulation overthrow the current centres of epistemological power in a community (Weingart, 1974, p.65), it also serves to launch, after the unheavals of revolution have settled, a new era of "normal science". Only this time round, that science has a new mentor as its guide.

If the first style of modulation, then, indicates that there is nothing wrong with a knowledge, that it is quite normal, and the second points out that that is not so, that there are abnormalities
inherent in it, then the third represents a cure and a return to epistemological normality. In effect, each style of modulation may be regarded as participating in what could be called the 'dialectic of knowledge gathering'. After all, '1' could be said to correspond to a thesis, '2' an antithesis and '3' a synthesis. But of more immediate use here is that it is possible to extend this analysis of 'modulative' styles to accommodate a typology of research cognisers themselves.

The research behaviour of cognisers, then, can be typed into three kinds. The vast majority of research cognisers, for instance, employ style one modulation. They "bow to the magisterial authority" of a paradigm, take a suitable problem seemingly answerable within its orbit, and simply "puzzle solve" (Kuhn, 1974a, p.4; Toulmin, 1974, p.40). Leverrier's research, as has been seen, displays all the traits of this kind of modulation. He bowed to the "magisterial authority" of Newton's celestial mechanics, and from them was able to postulate why Uranus was perturbated. Such research, and Leverrier's is typical of it, can be regarded as consonance hunting. It serves to reinforce the validity of the paradigm and supply further evidence for believing in its explanatory power. It is a style of research that is conservative rather than iconoclastic, and for which a great deal of the initial "puzzle solving" has been done by the paradigm. Without Newton, Leverrier would, for example, have got nowhere. He was, therefore, only building on what the architect Newton had planned.

Style one modulators are paradigm 'addicts'. Their research depends on the availability of a paradigm, otherwise the epistemological problems they confront would prove invincible. Because of its parasitic nature, 'consonance hunting' is really a lesser species
of research. It is the activity of the *hoi polloi* in the research community; it represents the work of 'follow the leader' kinds of researchers (Mills, 1973, p.117). It is the research of those who exploit rather than formulate paradigms and who are footnotes to the big names in a disciplinary community.

Not that a discipline can afford to disparage the work of its drones and *lumpenproleteriat*. After all it is they who do all the routine epistemological work upon which major discoveries are frequently contingent (Cole and Cole, 1973, pp.216-217). For it is often in the very pedestrian elaboration of a paradigm that the sort of anomaly is unveiled which subsequently leads to a paradigm's downfall. Leverrier's work is an example of this. Hanson's apt description of it as the "zenith and nadir of Newtonian mechanics" (1962, p.359) is very revealing. For it was the pedestrian application of Newtonian mechanics to Uranus that gave further mandate to the continued efficacy of their explanatory power. Yet on logically extending their application to Mercury the consonance hunters proved to be out of their depth. The behaviour of Mercury was really quite dissonant and beyond the explanatory power of Newtonian mechanics. It needed quite another paradigm to explain it. Yet the drones relentlessly pursued the problem of Mercury in Newtonian terms and ended up only collecting evidence that was to indict, not prove, the viability of Newton in every astronomical circumstance.

Working out the 'thesis', then, leads eventually to an 'anti-thesis' and the emergence of a second type of research cogniser. He is the sort who specializes in 'de-modulation' and in discovering dissonances in a paradigm. He is interested in the aetiology of the abnormalities in a paradigm, although rarely brings off a cure for them.
Style two modulators, then, are usually afoot when an epistemological revolution is in the offing. They are the 'guerillas' in a disciplinary community who fire the 'initial shots' in a concerted campaign to overthrow a paradigm. They thrive in an atmosphere of discord and dissonance, as they work towards a satisfactory replacement of that paradigm. And just as in a political revolution, a number of rival 'cadres' - each with its own particular revisionist strategy - are often competing with one another to gain legitimate epistemological 'power' before the other.

As Watson (1968, pp.15-18) recounts it, this was certainly true of the story of the discovery of DNA's structure. Three main 'cadres' were located around the world: at Caltech in California, King's College in London, and at the Cavendish Laboratory in Cambridge; and all three were periodically to renounce each others' attempt to decipher the "secret of life". There was, for instance, a major split between Cambridge and London over whether DNA exhibited a helical structure or not. Pauling's apparently "unorthodox chemistry" at Caltech had indicated that it did. Franklin, at King's, however, was obdurate in her conviction that her X-ray pictures of DNA indicated a different structure altogether. Cambridge, meanwhile, tended to side with Caltech, much to the chagrin of Franklin (Watson, 1968, pp.164-171). It had good reason to suppose that the King's group had simply misconstrued their pictures, not realising that what they counted as evidence for an antihelical DNA was engendered by "minor distortions needed to pack regular helices into a crystalline lattice" (Watson, 1968, p.166).

Not only do style two modulators tend to be antithetical to the current understanding of a phenomenon, they are also often antithetical
amongst themselves. Cadres fighting the same epistemological enemy, ignorance, frequently 'draw blood' from one another over the proper ways of defeating him. Yet it is these minor skirmishes, in which, overnight, would-be consonances are turned into dissonances, that provide the series of little leaps which eventually lead to the one giant and certain saltation into truth. And that is where the style three modulator enters the scenario of knowledge gathering.

In disciplinary communities, it takes one man to make an epistemological revolution, but another five hundred to make it possible. Epistemological revolutionaries are not loners in the turrets of cerebration; they require the results of the researches of other cognisers to effect the closing of the heuristic gap in their field. It was Watson and Crick in Cambridge who finally brought off the DNA coup, but without Messrs. Pauling, Wilkins, W.H. and W.L. Bragg, and Rosalind Franklin and the 'phage' group who preceded them all, there would have been no revolution. Knowledge, then, always builds on the shoulders of the immediate past, but it is the revolutionaries who ultimately put knowledge head and shoulders above the past. For at the apex of every disciplinary community there are a few - often very few - research cognisers who are the originators of new paradigms. They are the architects of revolution in a discipline (Cole and Cole, 1973, p.40); they are its superlunaries who, in rendering a long standing dissonance consonant, move a discipline massively onward and often down previously unenvisaged paths. Newton was of course one such superlunary, possibly the most super of them all.*

* Judged in terms of the number of 'revolutions' he set in motion, Newton's contributions to the advancement of knowledge are simply staggering. In one particularly fecund phase of creativity, he produced the binomial theorem, differential calculus, the theory of colours, integral calculus and the law of gravity (Gillispie, 1960, p.119).
Superlunaries are of course not just peculiar to physics. Most disciplines in fact have some figure or figures who are hallowed above all the rest, basically because after their contributions the discipline was never quite the same again. It is a matter of their consonance, having once been sounded, echoing through the minds and thoughts of many generations of cognisers. In this respect, what Newton is to physics, Lyell is to geology, Darwin to biology, Marx to sociology, Plato to philosophy, and so on. But all these "stars" are only a few amongst a whole constellation of minor luminaries, from whose insights their's are, in some measure, compounded (Cole and Cole, 1973, pp.216-217). And it is very often only because the "stars" have had the singular prescience to see a sudden and very often quite elementary illumination on an epistemological problem, that they are 'giant' rather than 'dwarf' stars in a disciplinary community. In a 'there, but for the grace of God, go I' mood, T.H. Huxley, for instance, is reported to have said of Darwin's theory of adaptation, "How extremely stupid not to have thought of that" (Gillispie, 1960, p.302). But simple or not, it is such insights that make for the highest reputations in a disciplinary community, and that, as will be argued in the next section, for those who want to reach the apex of the community, is all important.

6.6 OF HIGH REPUTE AND THE RESEARCH COGNISER

Only the zealous romantic would argue that the cogniser's desire to smother ignorance with a capsule of knowledge comes out of an utterly altruistic wish to add to the stock of man's epistemological awareness, and nothing else. True, there might be an ingredient of that in it, but generally research cognisers, as Roe (1953, p.59)
reported in her study of scientists, are frequently "doing what they 
most want to do anyway". They have been lucky in the sense that 
their intellectual talent has turned out to be suitable for the niche 
in life that would give them greatest satisfaction. Moreover, if 
that can be at all construed as satisfying a slightly selfish desire, 
there is the added fact that research cognisers also have the autonomy 
to pursue an area of epistemological investigation for which they have 
some strong sympathy and enthusiasm. Within their overall job, then, 
research cognisers have a great deal of free choice about what sorts 
of jobs they take on. They might, for instance, choose to pursue an 
enthusiasm that developed in childhood, as Lord Rayleigh did when he 
turned a precocious interest in photography into researches into wave 
motion and optics; or then again it might be a much more 'apocalyptic' 
experience, as was the case with Charles Wilson, the inventor of the 
Cloud Chamber. It is said that his lifelong and resolute desire to 
understand atmospheric electricity and other nephologic effects stemmed 
from the occasion when he witnessed a spectacular thunderstorm on the 
summit of Ben Nevis (Crowther, 1968)! Crick, on the other hand, who 
was an apostate from the world of physics, got into molecular biology 
via Schroedinger's *What is life?*. Its suggestion that physics and 
chemistry could be applied to disentangling the genetic message was 
enough to cement Crick's belief that life could be explained 
mechanistically without resort to vitalist or quasi religious 
explanations. Ever after, he became committed to producing a 
"chemical-physics of biology" (Olby, 1972, pp.231-233).

If the research cogniser is at all motivated by the desire to climb 
epistemological 'mountains' because, so to speak, they are not there, 
then the choice of mountains is often a very personal decision, rooted
in some seminal event in the cogniser's life. But these personal and selfish motives can sometimes be subsumed under a more basic institutional imperative, which affects all research cognisers in a knowledge community, and that is the need to establish a reputation. After all, if, as was suggested earlier (see 6.5), the metapaedeutic phase is also conceived of as a kind of continuum within which a hierarchy of members and institutions prevails, then there must be some means by which hierarchical ascension is achieved. That ascension in fact is achieved not, as in the propaedeutic parts of the continuum, with 'tokens' and certificates,* but with this very thing called 'reputation'. So how is that achieved in a knowledge community?

As far as a knowledge community is concerned, research, publication and reputation are a veritable ménage à trois. The fact that these three things do form a convenient marriage is to a community's advantage, for it would not function nearly as well if they did not. This can best be seen if the nature of that marriage is spelt out in propositional terms:

(i) Content output is the ultimate goal of knowledge systems (see 5.7);

(ii) Output which is not published is research that is "still-born" (Wilson, 1964, p.197). It is a fruitless exercise to do research without the intention to publish.

* The research cogniser is usually as fully 'certified' as he can be, otherwise he would not have been admitted into the metapaedeutic phase (see 6.3). In fact it is perhaps not quite true to say that the cogniser ceases acquiring 'tokens', rather that those tokens take on a rather different form. Vide, the way auctorial citation and number of publications is regarded in the research community, has all the hallmarks, so to speak, of the 'tokenism' encountered in the previous phase of the continuum.

Reputation and recognition in a disciplinary community is secured by having one's research taken notice of. That in turn is a function of publication, which can be regarded as an attention seeking act (Wilson, 1964, p.195; Hagstorm, 1965).

Reputation is what a cogniser requires to ascend the hierarchy of a disciplinary community.

In short, research means knowledge, knowledge means publication, publication means reputation, and reputation means ascension. Thus if the research cogniser wants ascension — as some do — then he is obligated to do that research which a knowledge system needs to continue perpetuating itself and thereby justify its continued existence. It is almost as if the 'publish or perish' ethic, which is often used to incite cognisers into knowledge production, also defines the survival chances of the disciplinary system itself: unless there are publications within it, it will perish.

For the research cogniser, reputation is a kind of payment for contributing significant epistemological results. It is what he gets in return for making a knowledge "gift" to a disciplinary community (Hagstorm, 1965, pp.12-13). But there are reputations and reputations, and of whatever variety, neither follows from the mere appearance in print. Of course that is important because it helps, more than anything else, a cogniser to circulate his name in public, and to make him visible in the "invisible college". Publication, then, gives the cogniser an audition in the cosmopolitan, not just local, arena of knowledge. It allows him to deliver his epistemological 'message' to the maximum audience possible.
Auditions, however, do not make reputations, indeed they can occasionally wreck them (see, for example, Koestler, 1973). Equally, it is a mistake to link reputation with the number of said appearances in print a cogniser has made. One small paper can often do more for a reputation than numerous big ones of trivial epistemological worth. Nine hundred words in *Nature*, for instance, was enough to make Watson's and Crick's names. What this means very simply is that, as far as knowledge is concerned, quality and quantity are not commensurate. Reputation goes beyond the annals of prolificness. It is not, then, how many papers or words a cogniser has written that ultimately laureates his reputation, but rather the quality of the research and the epistemological ramifications it has for the discipline that counts. Reputation is computated qualitatively not quantitatively (Hagstrom, 1965, p.168). The cogniser therefore who makes the most qualitative additions to knowledge has the most prestige. Inevitably, this shifts the question of reputation to questions about the kinds of 'qualitative additions' which lead to the making or boosting of a reputation. It is at this juncture, then, that the 'styles of modulation' discussed in 6.5 are able to prove enlightening. For it was noted there that, when attempting to make a contribution to the corpus of knowledge, the research cogniser can employ one of three strategies. Firstly, there is that most conservative and least adventurous of approaches which is simply to 'harmonize' with a proven-effective paradigm and gather knowledge which is consonant with it. It involves making heavier the weight of evidence in favour of a paradigm. Secondly, there is that approach which adopts a more doubting air and unveils dissonances in the paradigm which cannot otherwise be accounted for, and, therefore, which demand that the paradigm be replaced. Lastly there is that
research approach which achieves what the second intended to do, but never quite managed, and that is to secure a replacement for the falsified paradigm. Of these three strategies, the first, because it is only reinforcing and expanding the import of an already accepted paradigm, is unlikely to have massive ramifications for the discipline. It is likely to leave things as they were before. Therefore its practitioners will not have their reputation much enhanced by doing it. It will be the modulation mode of the 'potboilers' in a research community. The second, on the other hand, is rather more risk orientated, and the research cogniser practising it either stands to gain or lose a great deal more in the way of reputation. He works in the penumbra of a possible epistemological revolution, and whilst he might not participate directly in its realization, the fact that some of his research helped to fire it into existence usually results in his prestige being raised. Certainly the fact that Rosalind Franklin and Maurice Wilkins were involved in the 'battle' to decode DNA undoubtedly led to their reputations being raised. They have been thought of as much protagonists in the narrative of DNA's decoding as Watson and Crick. If not quite the agents provocateurs who made the DNA revolution possible, they were certainly in there as major conspirators, who, had 'fate decreed otherwise', might have 'seen' the double helix of DNA first!

But what is interesting is that with a possible mammoth boost in reputation at stake, an atmosphere of de-modulation and epistemological dissonance of the style three kind prompts a productivity of research unknown in conditions of straightforward consonance and normal science (Blume and Sinclair, 1974, pp.231-232). For if one thinks in terms of the half-life of a reputation, then that of style one modulators is
likely to be the shortest lived, that of style three the longest. It is the makers of disciplinary revolutions, those who sew up long standing and important gaps in our understanding of the cognised, upon whom most laurels and honours are thrown. It is they who occupy the Mount Olympus positions of a disciplinary community; it is they who have the positions of most prestige in the community.

Thus, if a research cogniser wishes to ascend the rungs of the metapaedeutic hierarchy - as quickly as possible - he would do well to suspend any of the personal motivations, mentioned earlier, that might dictate an area of research interest, and concentrate on one which will boost his reputation in the shortest possible time (Klima, 1974, p.114). That research, it has been argued in this section, will, of necessity, be of the style three kind. But before any reputation will be at all forthcoming, the research cogniser will have to encounter, and often respond to the suasions and sometimes censures of, a fourth type of cogniser, the evaluator cogniser.

6.7 EVALUATOR COGNISER ($eC_r$)

Knowledge is the 'life blood' of a discipline, and its principal 'donor' is the research cogniser. But not all the 'blood' a cogniser gives to a disciplinary community is necessarily of uniform quality. Therefore, before it can be used in 'transfusion', it must rigorously be tested and analysed. The 'sanguinometer' of a disciplinary community, who carries out that testing, is the evaluator cogniser ($eC_r$).

All knowledge is on probation until its validity is attested, so to speak, by those 'in the know'! It always requires their 'seal of approval' if it is ever to leave the laboratory or the study where it
was conceived. Thus part of the role of the research cogniser involves drawing public attention to his knowledge gains. The act of this promulgation, as was indicated in 6.6, is as much an extension of the epistemological enterprise as the actual fabrication of knowledge; for a knowledge which does not attempt to engage the interest of a disciplinary community is still-born. Secrecy is an ethic foreign to disciplinary communities, for it contradicts a fundamental premise of knowledge, that it is a communally inspired and determined act. Nowhere is this more evident than in the act of knowledge evaluation.

Scientific knowledge is not knowledge (as art is often these days) because its maker says so. In fact, part of the function of a disciplinary community, and the evaluations it exacts, is to purge from its members the possibility of purely egotistical knowledge acts. To ensure that they are not egotistical acts and to carry out this purge, each discipline, as was noted in 5.3, possesses publicly accredited criteria. These criteria, however, are not only designed to ensure objectivity in knowledge, but also to ensure that any consonance claims inherent in the knowledge do not contravene the normal standards of epistemological authenticity contained within the discipline. It has been noted also (see 5.6), that the research cogniser, in any case, during his long period of apprenticeship, would have assimilated these standards and criteria. One of the tacit obligations, after all, that accrue to a cogniser, on being admitted to a disciplinary community, is that he contracts himself to observe the values and standards which prevail in it. But whilst in theory every cogniser is sworn to a kind of Hippocratic oath of knowledge, not all of them are as 'honest' in their dealings with knowledge as their oath proclaims them to be. Knowledge is not without its
occasional Tom Keatings, who will forge data in order to realise the knowledge they want. It is therefore to protect the disciplinary community from the would-be epistemological counterfeiter that it applies rigorous standards to the knowledge claims of a research cogniser. Therefore on its journey to epistemological establishment, all $C_n$ knowledge will pass through the 'hands' of a number of evaluator cognisers, who will subject it to the shibboleths of validity, and make sure they can hear 'harmony' where the research cogniser claims he can.

The evaluator cogniser can be regarded as the 'lawyer' in a disciplinary community, and the context in which he works as the 'law court' of knowledge. By virtue of suitable experience and the calibre of his expertise, the evaluator cogniser is charged with the responsibility of defending the validity of new knowledge or, where necessary, prosecuting its indefensibility by arraigning its inconsistencies and weaknesses. But, all in all, it is the "jurisdiction of rationality" - and it does, of course, vary very much from discipline to
discipline - which is the ultimate judge in the case of epistemological litigation (Toulmin, 1972, p.95).

In a sense, directly a research cogniser courts an audience for his 'knowledge' he encounters an evaluator cogniser of one sort or another. Initially, for instance, that audience is likely to consist of those colleagues and quaternary students he encounters in the milieu of the university or research establishment in which he works or with whom he is in communication. They are usually the first guinea pigs of a new knowledge. This was certainly the case with the discovery of the structure of DNA. The 'dress rehearsal' of the Nature article occurred around the Cavendish Laboratory and at King's College, London; for Watson and Crick initially took their postulates about the structures of DNA to Lawrence Bragg and John Kendrew of Cavendish, and then to Maurice Wilkins at King's (Watson, 1968, pp.207-209). Bragg, at first, was not thoroughly convinced, and lest, through a specious claim, Watson and Crick should bring some disrepute to Cavendish, he rigorously checked that the organic chemistry of their DNA was at least credible. That was Bragg's métier, and the principal area over which he could exercise jurisdiction and offer 'legal advice'. Wilkins, on the other hand, who was always much closer to the scene of the DNA 'battle' - indeed, as has been seen, he was one of the 'combat troops' involved - than Bragg, could offer a judgment about the plausibility of the structure itself. "Maurice needed but a minute's look at the (DNA) model to like it" (Watson, 1968, p.209) and then he went away to compare the experimental evidence with the diffraction patterns predicted by the model. They proved to be in accord.

The first front of epistemological approval, then, is "inter-personal" (Hagstrom, 1965, p.29), and occurs either within the circle
of a cogniser's immediate confrères, as happened with DNA, or in the forums of a professional academic society. It represents a preliminary evaluation of new knowledge which aims to make - prior to its release on the open market of a discipline - the consonance of the knowledge involved as concinnate as possible. It is, then, a kind of epistemological equivalent of vernissage, when research cognisers 'touch up' their new knowledge before seeking a more public eye for it.

Interpersonal approval is often, then, the first prelude to publication. A 'rejection slip' from that first of all evaluative quarters will presumably - but not always - send the research cogniser back to the epistemological drawing board to redesign his knowledge. Success, however, in the local milieu of evaluation, will persuade the cogniser to seek a more cosmopolitan, and sometimes more practised and critical eye, for his knowledge. The passport to the more cosmopolitan centres of knowledge is the journal.* A passport into the pages of the journal, however, is not a fait accompli. For like everything else in a disciplinary community, journal appearance is largely a matter of meritocratic selection. It is also penned in by the same sorts of standards and values which constrain every other epistemological move in the community. Journals, for instance, have their own 'quality control' bureaucracies that check the intellectual integrity of the 'knowledge' submitted to them for publication. The

* Perhaps this is less true of the social sciences. In them, the principal media for marketing new knowledge still tends to be the book. In the more right-handed disciplines, however, the book is generally only the vessel for passé knowledge (Crane, 1972, p.116), whilst in the arts, it is only in literature, that the 'bibliio-form' is a medium for attaining public visibility. For in painting, it is the exhibition, and in music, the concert, that serve to promulgate new knowledge (however, compare 4.6).
research cogniser, then, who wants to be published, has to appear in yet another law court of knowledge, and that is the one presided over by the 'referees' of a journal. For it is they who act as the journal's 'quality control' agents, and who 'check out' the knowledge for faults and defects, and who finally decide whether the knowledge is worth publishing or not (Hagstrom, 1965, pp.26-27). And if they do not reject it outright, the referees will often make suggestions whose incorporation would serve to make the 'knowledge' acceptable to the journal concerned (Ravetz, 1973, pp.255-256). The risk of promulgation is, then, accompanied by the risk of distortion.

The journal is the umbilical cord between a local and cosmopolitan appreciation of knowledge. If the cogniser and his knowledge are not to remain hermetically sealed from the potential public, the cogniser needs access to that umbilical cord. Yet the referees of journals, and the judgments they can exercise, can often deny that access and prevent a knowledge issuing forth to the general disciplinary public at large. The evaluator cogniser, then, when he manifests himself as a journal editor or referee, can exert a good deal of influence over the circulation of knowledge. He can be regarded as one of the "gatekeepers" of knowledge, who has the power to screen that information which is permitted to circulate widely amongst the members of a disciplinary community (Crane, 1970, p.489).

When that screening is done under the declared auspices of objectivity, and it involves 'winnowing' the good epistemological 'grain' from the 'chaff', it would appear to be a wholly reasonable and desirable service. After all, cognisers have enough trouble keeping up with the good 'grains' of knowledge, without also having to labour over the 'chaff'. Screening, however, is not always as
meticulously objective as the theories of disciplinary behaviour often pronounce. Non-epistemological factors, for instance, can often intrude upon the "gatekeeper's" work and upset what should be a wholly disinterested appreciation of the knowledge submitted to him. Very often, for instance, it is not so much the knowledge that counts, but where it comes from and who it is by. Papers which emanate from prestigious institutes of learning are likely to have a headstart over those that do not. Yale is automatically taken to be a better 'stud' for knowledge than Boise State, and therefore its research cognisers are likely to get preferential treatment by editors of journals and their referees. A cogniser's publication chances are further preferred if, in addition to being 'stabled' in a traditionally good 'stud' of knowledge, he also has a well established reputation. Evaluator cognisers are less likely to find 'fault' with knowledge that is 'out' of someone who is 'known' than by someone who is yet to establish a respected 'pedigree' of knowledge. It seems it is harder to break into print than to keep going; for the more a research cogniser publishes, the easier it becomes to publish (Jevons, 1973, p.42).

Then there are the more human preferrals that come through the cogniser having fraternal links with the editor, or being part of the same 'old boy' academic network to which he belongs. It seems editors look more favourably upon the work of those whom they personally 'know', than those they do not. Of course all sorts of strategies have been devised to prevent such academic nepotism, and to rid knowledge evaluation completely of the "halo effects" that stem from a cogniser's institutional and personal affiliations (Crane, 1970, p.489). But it seems the use of anonyms and other devices to conceal
authorship rarely work: editors are usually so au fait with the work of their confrères that they can see through any disguise of it. It seems, then, that the jurisdiction of rationality can occasionally be swayed by that prejudice. Accordingly, knowledge does not always get the fair trial it deserves. Contra Toulmin and Merton, it is not unknown for the law courts of knowledge to find a 'knowledge' guilty of all sorts of epistemological misdemeanours, before being given any trial whatsoever. The spirit of an open-minded debate that usually characterizes epistemological litigation can be suspended altogether, and the knowledge involved censured completely without being given a chance to defend itself and prove its innocence. The "Vellikovsky affair" is an instance of this. What was interesting about it, was not that Worlds in collision managed to contravene all the canons of astronomical plausibility, but that the scientists, in receiving it, should contravene, almost to a pathological degree, all the Mertonian norms that are supposed to prevail in scientific debate (Mulkay, 1969, p.126; Polanyi, 1967, p.74). The community of orthodox astronomy did its best to silence Vellikovsky altogether and would not allow him to champion his views in any of the orthodox forums of astronomical debate. Indeed, such was the scientific community's hostility to Vellikovsky that they even prevailed upon his publisher, Macmillan - normally a publisher of thoroughly respectable academic texts - to give up their rights to Worlds in collision. "They passed them on to Doubleday who felt less vulnerable to the hostility of scientific opinion" (Polanyi, 1967, p.74).

Given the notorious fickleness of evaluation perhaps the only real judge a cogniser can have any confidence in is the one Ravetz (1973, p.275) has pointed to, and that is "posterity". For a
knowledge which, at present, might be eschewed as a piece of epistemological quackery, might, sometime during its "future career", be construed as having profound ramifications for a discipline. It took biologists, for instance, thirty-four years to discover the significance of Mendel's work. They did not become appropriately 'wise' until long after Mendel's experiments had been completed, written up and published. It was as though Mendel's famous paper, "Experiments in plant hybridization", went straight into 'suspended animation', instead of public approval (Gillispie, 1960, pp.329-337). But though Mendel's contemporaries were at a loss to understand the full significance of his experiments, the experiments were not finally lost to humanity; for his experiments were preserved in a form which could be brought out of 'suspended animation' and rediscovered. That form was the scientific paper. Had Mendel preserved his experiments in his head, instead of on paper, they would have passed on with him, and the Hugo de Vries' and Carl Correns' of this world - who rediscovered his work - would have been none the wiser. Posterity, then, can only judge 'knowledge' if it exists in a form that allows it to be judged; and it is to expedite the possibility of retrospective judgment and to allow knowledge to be disseminated in perpetuity that, in the disciplinary communities, things like the book and the paper have, as Popper has pointed out (see 4.3), as much "ontological" autonomy as the cognisers themselves. For, to some extent, they represent the life insurance policy of knowledge; for whilst some contemporary generation of evaluator cognisers might try to prevent the promulgation of a knowledge, if it exists in some literary form - if only as an unpublished manuscript - its survival is guaranteed.
Thus, it is possible to add one further qualification to the Humean ethic (see 5.1): not only is there no knowledge without knowers, equally there is no knowledge without recordings of it. When a research cogniser makes a 'gift' of knowledge to a disciplinary community he must therefore 'wrap' it in some disseminative paper which will endure in case the gift (as Mendel's was not) is not immediately opened! Knowledge might initially be 'all in the mind', but unless it becomes, at some stage, narration, that is all it will remain, a figment of the mind. Research cognisers in fact have a variety of narrative forms available to them to disseminate their knowledge. But it has been suggested in this section that access to those forms is restricted and controlled; access is not the sine qua non of a research cogniser having some knowledge 'to market'. However, to get any access whatsoever to the 'market places' of knowledge, the research cogniser must first make his knowledge 'marketable' and to do that he must don another cogniser role altogether.

6.8 DISSEMINATOR COGNISER \((dC_r)\)

A cogniser's research is never fully done until it is written up and published. As much an extension of the research act, then, is the act of its dissemination. The one is incomplete without the other. In every research cogniser, then, dwells a disseminator. He is the publicist in the cogniser, wanting to get out. He is responsible for spreading the cogniser's name. For unlike most other social systems, that of knowledge and disciplines is engineered not by 'face to face' contacts, but by 'page to face' contacts. The cogniser has to write rather than speak his way into the metapaedeutic part of the
disciplinary community. His entrance there must be made by written rather than vocal exposition. It is a matter of socialization occurring by publication (Storer, 1966, p.131).

It has already been noted (see 6.6) how this imperative to disseminate works to the advantage of disciplinary systems. On a very trite level, for instance, the written expression of knowledge represents a convenient and manageable form of making a 'prosthesis' of what a cogniser has in his mind. As a publication, that mind can, quite literally, be read! Then there is the fact that the progress of knowledge marches on antecedence, both immediate and remote. New knowledge does not develop parthenogenetically; it is very much the progeny of its 'forebears'. It is created out of a congress with knowledge of near consanguinity. The fertility of knowledge, then, is increased if the research cogniser has the *dernier cri* developments in his discipline available to him. The pressure to publish and disseminate is partly a function of the need to accelerate the accretion of new knowledge. Not that that pressure has to be applied too strongly, for it is in the interest of the research cogniser to publish. It was noted in 6.6, that a cogniser's standing in a disciplinary community is enhanced if it can be seen that he has made significant and original contributions to the development of knowledge. Publication, then, is a way of gazetting those contributions and of advertising to the 'world' whose "intellectual property" a particular piece of knowledge first belonged to (Price, 1963, p.69).* It is a way for the cogniser to raise his particular flag over the piece of epistemological territory he has discovered.

* Since reputations are at stake, "priority claims" to having discovered a knowledge first are often an issue of considerable contention in disciplinary communities. The issue is made all the more exigent
In the sense that his role is, in the main, 'distributive', the disseminator cogniser \(d_C\) shares something in common with the teacher (see 6.4). Like him, it is within the measure of the disseminator cogniser's expertise to bring a knowledge to the attention of others. However, that expertise goes well beyond mere attention seeking. The disseminator cogniser, if his knowledge is to 'get through' to those less au fait with it than himself, must be able to articulate his knowledge in terms which will enable it not only to be appreciated, but assimilated and understood as well. He must be able to broadcast echoes of the consonance he himself can hear in a knowledge, and convince others that the echo is real, not illusory. The disseminator, then, is very much a rhetorician of knowledge, who, like the teacher cogniser, addresses his power of rhetoric to the problem of converting knowledge into terms that will allow other cognisers to master it. He, again like the teacher, lives his life out on the 'b-dyad' of the triad.

Whilst the roles of distribution that the disseminator and the teacher engage in are similar in definition, they are not in method. There is also some difference in the audiences to which they respectively address themselves, and also in the manner in which that address because identical knowledge discoveries are often made by cognisers working independently of one another. The history of science is full of such instances. And as if conscious of the phenomenon, scientists have gone to all sorts of convoluted lengths to certify their priority claims. As late as the Nineteenth Century it was not uncommon practise to report knowledge discoveries anagrammatically. Hooke did this with his 'hypothesis of springynesse'. In the race to priority, science has also seen fairly close finishes. Weiner and Bouligend reached the same mathematical theory almost simultaneously, but Weiner managed "to get off a short note for publication" (thus officially staking his priority) one day after Bouligand deposited the same theory in a sealed envelope at the academy (Merton, 1970, p.75).
is done. One way of differentiating the disseminator's from the teacher's role, then, is to consider these respective audiences, and the modes by which the two types of distributor cogniser make contact with them. A teacher's audience, for instance, is predominantly made up of student cognisers, or those of diminished expertise in a discipline. And his role mainly focuses on upgrading that expertise. Of course the disseminator is also doing this in that he is making a disciplinary community aware of the knowledge that they lack and he possesses. However, the degree of intellectual discrepancy between his audience and that of the teacher is usually considerably less. For the most part, the disseminator cogniser is normally addressing his cognition \( (C_n) \) - initially anyway - to other cognisers of near equivalent expertise; his is an audience primarily of equals.

**Figure 6.4**

- TEACHER COGNISER AND DISSEMINATOR COGNISER -

In the matter of method of knowledge distribution, the two roles are even more dissimilar. The teacher, for example, usually has his audience directly in 'front of him', and his method of dissemination, in that context, is in the main of an expositional kind. The line of communication between \( tC_r \) and \( sC_r \) is direct and of the face to face kind.
Knowledge is conveyed by word of mouth, and in circumstances which allow students to have dialogues with their teacher. That is not a situation which the disseminator enjoys; for one thing he can only see his audience through the 'eyes' of the printed page. The rapport is not direct, but mediated. The lines of communication between them are not those the disseminator chooses 'to speak', but write. In short, whereas the teacher cogniser converts his knowledge into pedagogy, the disseminator converts his into prose. In fact the use of the possessive is very apposite, for it underlines yet another difference between the disseminator and the teacher. For in a very real sense, the knowledge the disseminator cogniser is interested in distributing often belongs to him. The act of disseminating new knowledge, as was noted earlier, is a way of confirming the property rights a research cogniser has over it. The same cannot be said of the teacher's 'disseminative' act. It is not property claiming, for the knowledge the teacher distributes is rarely his own, but somebody else's. He makes a speciality of declaiming other people's claims to knowledge.

It could be construed from the argument thus far that all new knowledge is promulgated on the page, all old knowledge in the classroom, and there is no distribution that goes on between them: in other words, that there is no middle man between the research disseminator and the teacher disseminator. This in fact is not the case. There is an intermediary breed of disseminator; and he is the one who, like the research/disseminator cogniser, 'writes' rather than 'talks' his knowledge, but who does not (and here he is like the teacher) have any property rights over the knowledge he declaims. Instead he makes a speciality of the 'disposing' of other cognisers' intellectual property,
and of extending its circulation beyond the bounds of the metapaedeutic community. He serves to make an epistemological vernacular - which everyone can understand - of highly esoteric and specialised research. By so doing, he serves to bring the frontier of the discipline within the reach and understanding of the knowledge community at large.

Disciplinary communities would appear, then, to support two types of disseminator cogniser. The first - who will be known as the primary disseminator \( (d_1^C_r) \) - is that type of cogniser whose sole and most prior interest is in communicating his cognition to other researchers. The second, the secondary disseminator \( (d_2^C_r) \), sees it as his obligation to distribute knowledge to a much broader community of cognisers than just researchers. In short, whereas the one \( (d_1^C_r) \) is interested principally in the latitudinal distribution of knowledge in the metapaedeutic section of the continuum, the other \( (d_2^C_r) \) seeks its longitudinal distribution over all parts of the continuum.

6.9 PRIMARY DISSEMINATION, OR COMPLETING THE RESEARCH ACT

That it is useful to demarcate two types of disseminator becomes more apparent when the particular exigencies of primary dissemination are considered in detail; for the entailments of primary dissemination force upon the researcher a set of obligations that, if not totally dissimilar from those that fall to the secondary disseminator, are certainly more emphasized. Firstly, there is the obligation to publish anyway. That would appear to be an absolutely inescapable qualification for having the epithet 'researcher' applied to one. The researcher who does not, or does not intend to, publish is really a
travesty of a researcher.* Not that it is an obligation that most researchers are keen quickly to satisfy. Perhaps because it is that they come to dissemination - unless they are frustrated Hemingways - by obligation, rather than by choice, that many research cognisers find the task of writing up their knowledge to be an "irksome chore" that is often "excruciatingly distasteful". It is something they are prone to postpone rather than do immediately (Hagstorm, 1965, p.16; Lowenthal and Wason, 1977, p.781). And it is often said that it takes the romance completely out of doing research.

Be that as it may, it is a necessary obligation of research and one moreover that is trammelled within the walls of its own particular etiquette. Dissemination, it seems, like everything else in a disciplinary community, is a thoroughly 'rule bound' activity. That it is so stems from two instrumental facts (both noted previously) that:

(a) the birth of new knowledge has its genetic roots in the knowledge which has preceded it, and

(b) that other cognisers have certain 'property rights' over this knowledge which have to be acknowledged when it is, so to speak, trespassed upon.

New knowledge is never a 'straight-off-the-top-of-the-head' phenomenon. It comes as much out of the heads of the other cognisers as it does the individual research cogniser. It is the result of compound rather than singular cerebration; it adds to an "accretion of learning" that already exists (Price, 1963, p.65). A great deal of the dissemination "chore", then, is given over to recapitulation of

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* Sklair (1973, p.159) has raised this issue in connection with scientists. Since a goodly number of them never publish, and since publication is the sine qua non of being a scientist, do they have any right to the name 'scientist'?
this "accretion", it involves mapping out the genealogy from which a new piece of knowledge is descended. This is in fact a relatively new obligation, for it is only since the 1850's when the modern research paper was born, that cognisers have been expected to accompany their 'cognition' with a 'fully documented' family tree of its ancestry. For this purpose, what has been called the "etiquette of citation" (Ravetz, 1973, p.257) has been developed. It fulfils two functions: firstly, it names the knowledge from which the new has developed and secondly, it indicates whose 'property' that knowledge is. Citation, then, is a kind of epistemological way of paying 'rent'. It provides "an 'income' to the owner of the property which is used by showing that his work was fruitful" (Ravetz, 1973, p.257), and avoids the possibility of 'trespassers' being prosecuted for entering under their name knowledge which is not rightfully their's.*

Step two in the dissemination process involves getting the "irksome chore" into print. Not that that is necessarily a sequitur of the chore alone (see 6.7). In fact, the dividend of publication is quite difficult to achieve, and presumably gets more so as the number of cognisers in a field increases. But, in fact, whilst this number has tended to increase, the productivity of scientist cognisers has tended to remain much the same. According to Lotka's law - an attempt to achieve some crude measure of scientific productivity - the number in a community who produce 'n' papers varies as $1/n^2$. Thus, there are

* Not that the system is entirely watertight: trespassing still goes on. Again the story of DNA is illustrative. Bragg, in a paper dealing with the "shape of the haemoglobin molecule" was accused - whilst the paper was still in manuscript - by Francis Crick of colonising, unacknowledged, an idea that he had propounded most forcefully in the Cavendish Laboratory months earlier (Watson, 1968. p.57).
many scientists who produce only one paper, one quarter as many who produce two, one-ninth as many who produce three, and so on. Only one scientist in a thousand publishes as many as a hundred papers in his lifetime (Jevons, 1973, p.41; Ziman, 1976, pp.104-105).

Of course there are certain strategies the disseminator cogniser can employ to improve his chances of publication. The most important of these is to submit his paper to a journal whose editorial philosophy regularly spans, not only the substantive content of the knowledge being disseminated, but also its broad epistemological character. For it is within the pages of the learned journal, above all biblio-forms, that the stepping stones of knowledge advances are principally set out. This has not always been the case, and still is not in some disciplines (see 6.7). Before the advent of the journal - in the Seventeenth Century - the book was the principal vehicle of knowledge distribution, and still remains so in the more diffuse and discursive left-hand disciplines. But for the more methodologically compact, scientific disciplines the virtue of prolixity that the book could provide, proved somewhat of an obstacle in the dissemination of scientific knowledge. Books suffered badly from the "iniquity of overcharge" which made any number of them - which there were in the Seventeenth Century - impossible to digest and assimilate (Price, 1963, pp.62-63). So they were superseded, in the sciences at least, by journals which had 'papers' in them instead of chapters, and many authors instead of the one.

Aside from encouraging a more laconic style of dissemination, the journal has also helped to effect the 'factionalization' of disciplinary communities. It has helped to promote a differentiation which is brought on by the need to serve the interests of cognisers of limited
areas of epistemological focus (Hagstorm, 1965, p.210). The hallmark of an emergent discipline, then, tends to be "the establishment of a specialized journal catering to the scholarly needs of its exponents" (Ziman, 1968, p.105). Not only does the journal promote "solidarity and sodality" and cement fellowship amongst the members of the new discipline, it also means that the discipline has its own 'broadcasting house' in which to disseminate the knowledge which is particular to itself. Journals also help to create divisions and 'outlets' for sectarian interests within autonomous disciplines themselves. Thus whilst of course there still remain the broad based journals, whose appeal is to the whole of a disciplinary community, and which treat of issues of general concern to the discipline, below them there have tended to proliferate a host of journals of more discrete and pointed epistemological orientation. That orientation can be determined by a common interest in a particular facet of the cognised. The efflorescence of DNA as a cognised field of interest, together with all the ancillary issues its structure has evoked, assuredly helped to promote into existence a Journal of Molecular Biology. On the other hand, a specialized journal might be brought forth because it serves the interest of those analyzing the cognised by a particular technique or form of instrumentation. Spectroscopers, for instance, have a journal to themselves, as do linguistic analysts. Then there are the journals whose editorial persuasions mark them out to prefer the speculative and the theoretical, rather than the empirical and experimental. Often their preferred methodological domain is pointed out in the title of the journal, as in The Journal of Experimental Psychology.

The effect of this factionalization means the disseminator at
least knows the journals which would or would not supply him with a favourable review of his knowledge. After all, a biological journal which publishes pre-eminently theoretical papers will presumably be less inclined to admit a thoroughly experimental paper into its pages, and vice versa (Hagstorm, 1965, p.246). This equally applies to the readership of the journal. Theoreticians will be attracted to theoretical journals, experimentalists to experimental ones. Factionalization of this kind in fact turns out to be quite a convenient rationalization of what is a perennial problem in disciplinary communities, that is, keeping up with the sheer quantities of knowledge that are around. For instance, Price (1963, p.72) estimates that a cogniser could not keep up with his colleagues and their knowledge output, if their number exceeded more than a few hundred. It would be impossible to assimilate the work of ten thousand! When a discipline becomes that populated, emigration tends to follow. Cognisers tend to leave, regroup and create a new discipline that expresses a new core of epistemological interest, and so on.

It was the inconvenience (nay, impossibility) of bulk handling of knowledge contained in books that caused the journal. It is the time that a journal takes to reproduce and circulate that is likely to render the journal extinct in the Twentieth Century. The time lag between producing a manuscript and its appearing in print is no longer short enough for the progress of knowledge! Thus, the journal, instead of disseminating knowledge, has increasingly come to harbour knowledge that everyone who is likely to derive most cognitive benefit from it knows before-hand anyway. They either saw it in manuscript or heard it in casual conversation, months before it appeared in print. For in fields like high energy physics, the informal channels of
communicating knowledge - like conversation and the phenomenon of the 'preprint' - have come to assume much more importance than the formal ones (Gaston, 1973, p.131).* In fact, in some fields - again, high energy physics is notable in this regard - the letter has, to some extent, come to supplant the paper. Indeed, a journal, the Physical Review of Letters, has been produced specifically to contain this epistolary form of disseminating new knowledge. There are of course some dangers in these newer forms of high speed communication. Aside from a certain loss of printing quality, there are the more serious defects of a tendency to flout scholarly standards and citatory obligations (Ziman, 1976, p.108).

6.10 SECONDARY DISSEMINATION AND CONTENT DESCENT

The problem that confronts the secondary disseminator ($d_{2r}$) is that of getting new knowledge into the 'hands of everybody'; and that involves translating the knowledge, circulating amongst the members of the metapaedeutic community, into terms which can be circulated in the various sectors of the propaedeutic continuum. But before he can even consider how to expedite that translation, he must first decide what to translate; and that, given the horrendous quantities of knowledge in circulation, is by no means an easy decision to make. Even someone having the most catholic appreciation of knowledge would find it

* The access to a 'pre-print' of Linus Pauling's - via his son who was at the Cavendish laboratory - latest thoughts on the structure of DNA (which proved to be grossly erroneous) was said to have put Watson and Crick anything up to six weeks ahead of their Caltec colleagues. It would take that time to get the Proceedings of the National Academy into print, after which the elementary mistakes in Pauling's work would have been spotted immediately (Watson, 1968, p.162).
difficult to appreciate much more than a minute fraction of it, such is the magnitude of its proportions. And those proportions are really quite staggering. For instance, the number of learned journals and periodicals in circulation — and these, it has been argued, are the acknowledged repositories of new knowledge — is over the fifty thousand mark, and that is excluding those journals written in the Slavic, Arabic, Oriental and African languages; and that does not account for the quantities of knowledge matter therein! In the 1970s the average number of scientific documents published yearly is over two million, and conservative forecasts estimate that it will have reached eight million by 1985 (Bell, 1977, pp.21-22)! And that is not even considering books which are still, in some disciplines (see 6.9), a disseminative force in the promulgation of new knowledge. In fact it would appear that the literature of the disciplines is doubling itself in ever shortening periods of time. Physics, for example, now takes eight years to double its literature, sociology three (Crane, 1972,p.90)! The knowledge output of a discipline, then, is indisputably considerable. However, the bulk of that output is not really necessary to breed further developments in knowledge. Since it is not, the majority of disseminated knowledge is "almost at birth embedded in the sedimentary deposits of the academy, and will never be looked at again" (Herbst, 1973, p.71). Its dissemination is virtually synonymous with it being placed straight into 'suspended dissemination'. The problem of the secondary disseminator (d,C.) mainly focuses on deciding which of that knowledge should be resuscitated and placed into greater circulation. This is not merely a problem of eclecticism, but rather one of deciding upon what, in the enormous bulk of knowledge, further developments in the discipline are eneluctably dependent. After all, the
secondary disseminator really wants to pass on down the ranks of the disciplinary continuum that knowledge and those paradigms which the current community of researchers considers vital to the formation of new cognition from the cognised. Unless he does so, he is likely to cause an epistemological rupture between the workings of the metapaedeutic and propaedeutic phases of the continuum, where the former becomes so far in advance of the latter it is unable to catch up. What the disseminator cogniser endeavours to do is to effect an epistemological connection - one based on the latest developments in knowledge - between these two phases of the continuum.

Secondary disseminators are the facilitators of 'content descent' along the continuum. They are like teachers in this respect, although, unlike them, they have no measure of control over 'personnel ascent'. However, both roles are structurally complementary in that they both involve carrying out reduction of some kind; e.g. teachers selecting personnel and disseminators selecting knowledge. In fact it is possible schematically to summarise the complementary nature of their roles using a kind of 'dovetailed gyre':

*Figure 6.5*

- THE DOVETAILED GYRE -
What Figure 6.5 shows is that the distribution of new knowledge occurs most where the number of cognisers is least, and least where the number of cognisers is most; namely in the quaternary and primary sectors of the continuum respectively. But what it fails to show is how the reduction of C output is achieved. The question remains: what determines which knowledge travels all the way to the tip of the 'gyre', and which remains where it is born, at the base of the 'gyre'?

Reduction begins with evaluation. For not all the 'knowledge' that is brought into existence goes into circulation even in the metapaedeutic sector. More knowledge is launched than ever gets into print (see 6.9). The fact that it does not get into print is largely a function of the evaluator cogniser's censuring (see 6.8), which is aimed principally at separating false from valid knowledge claims. But even after this first dissemination and evaluation - which determines what gets into print and what does not - there is still plenty of cognition around for the secondary disseminator to select from.

That selection is made somewhat easier because the pace of knowledge development, particularly in the sciences, serves to render redundant much of the C_n knowledge that is put into circulation in the metapaedeutic community. It has been calculated, for instance, that the "half-life" of most papers in physics is as short as two and a half years (Cotgrove and Box, 1970, p.1). Since they quickly become redundant to the progress of knowledge, little point would be served in propagating such papers beyond the research sector. Knowledge like this, then, which is of only passing interest to the community, selects itself out of any dissemination dilemmas. That means that a great
deal of the knowledge which arises from the practice of "normal science" or style one modulation, never gets transmitted beyond primary dissemination; for it is such knowledge that has the shortest half life. Not that any knowledge has 'eternal life'; it is always permanently under the threat of overthrow or revision. It is a matter, then, of how short that half-life is. The pace of progress in knowledge is such that inevitably a great deal of the knowledge disseminated at any one time soon becomes outmoded. In engineering, for instance, it has been calculated that 60% of that knowledge disseminated to engineering students in 1955 was redundant by 1970 (Waddington, 1977, p.36). But although that forms a considerable percentage of engineering knowledge, it is by no means all of it. Presumably there is, at the heart of engineering, as there tends to be in other disciplines, a cell of relatively immutable knowledge that does not radically change through a cogniser's career. There will be some knowledge in a discipline that has a longer half-life than two and a half years, and that does not become redundant within fifteen years of its initial dissemination. Newton's 'laws of gravity', for instance, were in no sense absolute; three and a half centuries were taken to bring them into serious doubt and yet no contemporary physicist could reasonably pursue his science without having them in his repertoire. But knowledge like that of Newton is in a thoroughly different epistemological category from that which emerges out of style one modulation. Style three modulation, and the paradigms it generates, usually offers a totally new perspective on the cognised, quite unlike anything which came before, and as a result of this it has the potential to explain many aspects of the cognised. These are definitely not the sorts of paradigms which can be exhausted
by one generation of cognisers. For these reasons, then, there would be some point in disseminating such knowledge well beyond the boundaries of the research community. How far is another matter.

As a gauge of what knowledge should be disseminated first, fairly obviously that which has the most durable ramifications for a disciplinary community needs first to be 'tramlined' into communal awareness. And that knowledge is generally that associated with style three rather than style one modulation. It is the stuff, to use Kuhnian terms, of "revolutionary" rather than "normal" science. Thus, it can be said that in content descent it is the latter which is likely, during disseminative selection, to be attenuated first, and the former which is likely to travel furthest down the continuum.

For a cogniser whose chief role is to act as the envoy of new knowledge, the secondary disseminator is not looked upon with much respect in a disciplinary community. It certainly does not improve or elevate a cogniser's status in a disciplinary community to engage exclusively in secondary dissemination. In fact, it sometimes can have the opposite effect (Hagstorm, 1965, p.34; Jevons, 1973, p.83). There is a generally held disdain for the writers of text books - the chief media of secondary dissemination. It is considered that such dissemination is really an extension of teaching, and that a total commitment to it rather than research is tantamount to a cogniser prostituting himself. He should be gathering knowledge for himself, not making a gathering of other peoples' gatherings!

The 'dovetailed gyre' (Figure 6.5) would indicate that content dissemination flows from the tertiary institute downwards, and this is, in the main, true (Musgrave, 1973, p.48). But it is not true to say that content descent only occurs in 'token giving' educational
institutions (see 6.4). Indeed, it occasionally happens that disseminative media well outside of education are often far ahead of it in the promulgation of new knowledge. Outside of the circles of professional philosophy in Cambridge and Oxford, for instance, it was the BBC Third Programme which was the principal agent of exposition for positivism and linguistic philosophy (Quinton, 1976, p.495). Not that education could ever hope to be in simultaneity with the *dernier cri* of disciplinary development. It seems that it is inevitably "half a generation behind", and that its textbooks, particularly in the sciences, should be out of date within five years (Belth, 1966, p.26; Musgrave, 1973, p.19). But at least dissemination and content descent are healthier now than they were in previous centuries. After all education was once, not half a generation behind the advances of knowledge, but two centuries! Physics is a case in point. Before the Cavendish Laboratory was opened in 1867, physics was an absolutely unthinkable discipline to have in the school curriculum (Richmond, 1971, p.24).

English literature was similarly frowned upon. The fine arts, on the other hand, had to overcome an ingrained stigma which saw things like painting, particularly for boys, as an essentially effeminate activity. This hampered its educational development, such that it took, from the beginning of the century, something like thirty years for art to establish itself as an accepted school subject. It then took another twenty five years or so, for art education to register and incorporate the pedagogic systems of abstract painting and of design that were developed at the Bauhaus in the 1930's (Carline, 1968, p.263). The content descent of knowledge into the arena of education, then, is never contemporaneous with the latest development in knowledge. There
is always a time lag, which might be short or long, depending on the discipline involved. But what seems less a matter of contention is that knowledge which the professor is today struggling to make intellectual headway with is frequently that which in a decade will be the diet of every undergraduate; and a decade after that of every high school student. The intellectual difficulties of today are frequently the simplicities of tomorrow (Riesman, 1958, p.53).

6.11 ADMINISTRATOR COGNISER (ac_r)

The cogniser types thus far identified have all been directly connected with knowledge in some way or other. That has always been the major focus of their interest, and therefore it has been possible to more or less describe each cogniser's role in terms of its 'diffraction' about what are the principal foci of interest it is possible to have with regard to knowledge, i.e. in its reception, evaluation and creation. The administrator cogniser's role is much less to do with any of these things, and much more to do with organizing the cognisers who are doing them. He is concerned with managing the social rather than epistemological body of a discipline; and with seeing that the members of that social body are carrying out their roles as effectively and efficiently as possible; and if they are not, with ways of ameliorating that carrying out. The administrator cogniser, then, assumes the role of a true bureaucrat in the bureaucracy of knowledge. He is responsible for the institutional organization of disciplinary communities and, in particular, its "visible colleges".
Since knowledge has been bureaucratized at all levels and in all corners of the continuum, the administrator cogniser is almost as ubiquitous as knowledge itself. Certainly, wherever there are 'colleges' visible there are always administrator cognisers on hand to organize them. And this is as much true of the primary sectors as it is of the quaternary sectors of the continuum. Even the gathering of knowledge itself is administered; although its administration requires that the cogniser involved be much more of an entrepreneur than a straight bureaucrat. That is because research often requires sponsorship and finance in order to be a viable proposition. Therefore its merits and worth have to be promoted and advertised to those with access to largesse. And it is the administrator cogniser who often carries out that promotion. He is the man, then, who gets the research cogniser "the job, the trip, the research grant". The administrator cogniser is a member of the 'executive branch' of knowledge; he is, so to speak, one of the managing directors of the knowledge industry. And like all those in management, he spends a great deal of his time serving on committees and in discussion with his colleagues; and instead of writing papers he writes memoranda (Mills, 1973, p.117).

Not that administrator cognisers are wholly strangers to the various epistemological arenas that they manage. Quite often they themselves are defectors from those various arenas. Sometimes indeed they use administration as an escape route for not participating in actual research (Mills, 1973, p.117). The committee sometimes is a preferred place of work to the laboratory or library; and cognisers would rather write memoranda than research papers. Often it is because their capacity to do the latter has somewhat lost momentum.
This is very much the case with a research cogniser who springs to eminence very early. The loss of research men to administration is, for instance, particularly heavy in physics - a discipline renowned for its cognisers completing most of their significant and original research at a comparatively early age (Roe, 1953, p.45). They, of course, might not become pure bureaucrats; they might, for instance, conduct their research vicariously through overseeing and managing the research of younger men in their field. They, for instance, might become directors of prestigious research laboratories or councils. This has been the fate of Francis Crick who, whilst he still retains an interest in molecular biology, is mainly engaged, these days, in entrepreneurial work (Olby, 1972, p.268). He is co-director of the Cell Biology Division of the Medical Research Council Laboratory with thirty three research graduates under him.

6.12 POLYMORPHOUS COGNISER

Cognisers rarely play just the one role in a disciplinary community. To call a researcher a researcher and nothing else is really a misnomer, for a true statement of his role would have included all the other activities he engages in, and which are often quite supplementary to his role of researcher! It has already been noted (see 6.10) how the research act is only completed when it is disseminated. Therefore all research cognisers are accompanied by a doppelganger of a disseminator, who sees to it that what epistemologically goes on inside a research cogniser's head eventually gets a public viewing. The researcher's role, then, is complemented by that of a disseminator. He is a \( \text{drC}_r \), and not just a \( \text{rC}_r \).
The plurality of these roles, however, can be extended even further. Few researchers, for example, can claim to be entirely free from the obligation to teach. Mixed in with their research, they generally have a few research students to supervise or undergraduates to teach (Storer, 1966, p.115). A researcher, then, is not just a \( \text{dr}_r \), but an at \( \text{dr}_r \)!* Nor are researchers alone in being polymorphous. Even those lower down the continuum can be affected by a range of epistemological responsibilities and roles. It is not unusual, for instance, for post-graduate students to be baptized into the ways of academic life by being given some undergraduate teaching to do. The post-graduate student, then, often is not just an \( s_{4r} \), but an \( s_{43r} \) as well. Then again, teachers from lower down the disciplinary continuum are quite often engaged in studying for higher or even first degrees, in which case they are supplementing their \( t_1 \) or \( t_2 \) work with \( s_3 \) or \( s_4 \) studies.

But whilst it is possible and proper to assign a variety of different roles to the cogniser, inevitably one role assumes dominance over all the rest. Take the role of the researcher who divides his time between teaching and research: the former, which might form a considerable part of a cogniser's responsibility, will not serve to elevate the cogniser's status in the disciplinary community at large. It will only secure for him a local, not a cosmopolitan, reputation. And the only way a cogniser can secure that is to practise research and have it disseminated as print, rather than lectures (Wilson, 1964, p.188). Therefore, whilst a research cogniser might engage in a host

* This expression symbolises the fact that the cogniser is at various times an administrator (a), a teacher of tertiary and quaternary students (t\( _{3/4} \)), a disseminator (d) and a researcher (r).
of activities apart from just research, if he wants to 'make it' in the disciplinary community, the only one which really counts is research. A truer expression of his role, then, would have to indicate that, whilst a researcher teaches, administrates and disseminates, all these activities are really subservient to that most prior of his responsibilities, namely research. It is a matter of 't', 'd' and 'a' being less than 'r', or \( t_{3/4} \leq r \). In the same way, the post-graduate student's teaching takes second place to the more overall objective of securing a higher degree: \( t < s_{4} \). On the other hand, for the secondary teacher, further study most of the time is only directed at enlightening and improving his capacity as a teacher. Study is ultimately subservient to teaching: \( s_{4} < t_{2} \).

6.13 SOME MISCELLANEOUS COGNISERS, AND CONCLUSIONS

Polymorphous or otherwise, it would be possible, no doubt, to go on further identifying cogniser roles. However, in identifying them it then becomes a matter of deciding whether the role is fully 'autonomous' or not; for undoubtedly some of the roles that can be identified are subsumable beneath others. The role of 'amateur' cogniser is a case in point. It is his status - non-professional - in the community, and not the epistemological features of his role, that ultimately differentiates him from other cognisers. After all, if the case of the ethno-linguist, Benjamin Whorf, is considered, he was undoubtedly a research cogniser of enormous significance to the understanding of language, yet he did not serve in any university whatsoever. He was not employed directly by a knowledge community. Instead he chose to work his life out as a fire protection inspector.
(Chase, 1972, p.4). But the status of amateur did not alter the calibre of his research work. It was regarded as being as significant as anything that came out of an orthodox arena of knowledge advance, like a university.

Perhaps a more autonomous type of cogniser is that one associated with the various technical services which a disciplinary community calls upon to service its needs. The role of the technician in the so-called "Big Science" is a particularly vital one, given that a great deal of experimental work is carried out using sophisticated forms of instrumentation. A thorough understanding of the whims and caprices of a particular instrument is called for if the rogue experimental result is to be differentiated from the genuine one. But "Big Science" often requires more than just technicians for it to be successful. High energy physics is a case in point. Its success depends as much on the work of technologists and engineers as it does the researcher per se. Indeed, high energy physics has even spawned its own technology, "accelerator design", to cope with the whims and caprices of cyclotrons (Ziman, 1976, p.223).

Then there are the various technical services associated with the processes of dissemination. The compilation of indexes and abstracts analyzing periodical literature is of vital necessity to the quick distribution of knowledge. Research could not function adequately and efficiently unless such services were available. Disciplinary communities, then, need their bibliographer cognisers.

But both these roles are essentially subsumable. They exist, not for themselves, but to serve the needs of the research cogniser. They function not as autonomous cognisers, but with the ends of research in mind. Without the research cogniser, they would be redundant.
What all this points to is a theme which was developed in 5.9: that disciplinary communities require, to function properly and effectively, a certain number of essential roles. This Chapter has tried to delineate those roles and describe the responsibilities which accrue to those who possess them. There has also been an attempt to illustrate the nature of these responsibilities in terms of the epistemological triad. In a sense, then, Chapter Six has been a synthesis of the ideas and propositions in Chapter Three, and developed in Chapters Four and Five; and in a sense too, this Chapter completes what the study set out to do: namely to analyse the relationship between the epistemological and sociological dimensions of knowledge. It only remains therefore to summarize the findings of this study, to indicate the questions raised by it, and to suggest further areas of research which emerge from it. That is the task of the final chapter.
SUMMARY OF FINDINGS AND RECOMMENDATIONS FOR FURTHER RESEARCH

This is my letter to the World
That never wrote to Me -
The simple News that Nature told -
With tender Majesty

Her message is committed
To hands I cannot see -

(Emily Dickinson)
7.1 INTRODUCTION

The primary objective of this chapter will be to show that, although the study has now reached its conclusion and its final words, it is by no means the final word on those matters of knowledge it elected to examine. The chapter will be concerned with showing how the study opens more doors to other areas of investigation than it actually shuts and it will indicate that the study, far from being a terminus, is a terminus ad quo.

But to return, for a moment, to the point of embarkation of this study. It will be recalled that that embarkation was sited in an area of the knowledge phenomenon that was called 'epistemological sensitivity'. Several examples were cited of how it happens that knowledge can modify the way the world is perceived and generally alert the mind to aspects of reality normally close to the threshold of sensitivity. Understanding the mechanics of how it is knowledge flows onto and influences the way the world is regarded, and how it is that epistemological sensitivity develops, thus became the initial objectives of this study. They were the 'destinations' which this study set out to reach, and which, hopefully, within the preceding pages, have indeed been reached. Before, then, suggesting what sort of areas of investigation remain to be examined if the features of epistemological sensitivity and its acquisition are to be fully understood, it will be useful to summarize the itinerary this study has taken to discover more about epistemological sensitivity and the disciplinary systems in which its acquisition occurs; and to point out what sort of discoveries and findings were made on that itinerary.
7.2 THE 'JOURNEY' TO EPISTEMOLOGICAL SENSITIVITY

In many respects, it could be said that the 'journey' to explaining epistemological sensitivity has taken two major routes. There was firstly that essentially epistemological 'route', and that involved explaining what a sensitivity due to knowledge really amounts to in terms of reality and the dispositions of the mind. Then there was the more sociological 'route', which entailed describing how it is within the context of a disciplinary community epistemological sensitivity is acquired; and once acquired, to what sort of purposes and ends within that community is that sensitivity employed. In the sense that these two distinct, though not necessarily antithetical 'routes' are observable in this study, it could be said that its overall character is socio-epistemological in tenor.

Apropos the epistemological 'strain' in that character: having recorded a number of examples which showed that it was possible for perception, after experiencing a 'milieu' of knowledge, to become aware of new aspects in and facets to the milieu of reality, the first parts of this study were primarily concerned with finding a way to represent this infusion of knowledge into perception. That infusion, which is really the prelude to development of epistemological sensitivity, it was noted, represents the marriage of three components: knowledge, reality and mind or what have been called, respectively, in this study, cognition, the cogniser and the cognised. But before actually describing that marriage, and the possible relationships which could ensue from it, all the 'parties' to the marriage were first examined and described in some detail. It was found, amongst other things, for instance, that it was possible to develop a
threefold 'taxonomy' of the cognised, in which it became feasible to classify all the various and diverse 'species' of reality under three main generic headings: the sub-organic, the organic and the supra-organic cognised. These, so to speak, formed the divisions of reality to which the cogniser's attention could be potentially drawn. But it was also noted, when the 'nature' of the cogniser came to be characterized, that that 'attention' too had features which bore on the phenomenon of knowledge and the development of epistemological sensitivity. Considered prime amongst these features was the fact that in order to have a satisfactory experience of the cognised, the cogniser must in some way reduce the bulk of sensation that his senses have the potential to register. It was noted, that integrating experience and making templates of the possible progress of reality, supplied a way of forestalling the consequences of sensory 'overcharge'. It was additionally noted, however, that it is possible, particularly when man has become so good at it, to take such stimulus reduction to an extreme whereby it then becomes necessary, if his perceptual faculties are not to suffer and become lethargic, for man to seek out new areas of sensory stimulation. And it was argued that it is from this strategy to compensate for under stimulation, that knowledge, or cognition, eventually springs. In this connection, it was said that, whilst knowledge sometimes seemingly does its best to conceal its sensory origins, it is really no more than an extension of perception. As such, it displays many of the features of the latter. Knowledge was thus considered to be one further attempt to integrate and reduce experience to more manageable proportions. It was suggested that it was just one more realization of that power to coalesce, that cognisers would seem to possess and are constantly
preoccupied with applying. Knowledge, however, takes a multiplicity of forms, some of which succeed better than others at making integrations and templets of the cognised. It was to show this, and the fact that the various forms of knowledge tend to form rather different alliances with the cognised, that a 'spectrum of knowledge' was drawn up. The spectrum tried to show that the complete range of knowledge can be located on a continuum that extends from those varieties of knowledge which form a demonstrable and testable nexus between themselves and the cognised, and those which do not.

Once having thus detailed the character of the parties to the marriage between reality, mind and knowledge, the study then proceeded to try and find some way of representing that marriage. A useful analogue, it was discovered, could be found in those models of meaning that linguists have suggested operate between a name, its sense and the thing to which it refers (Ullman, 1970, p.57). It was argued that the relationship between cognition, the cognised and the cogniser is directly analogous, and could be represented schematically on the same equilateral triangle that is frequently used to represent the process of meaning. It was this analogue between meaning and the epistemological enterprise, then, which formed the basis of what was subsequently referred to as the 'knowledge triad'.

The basic advantage of the triad, it was found, was its capacity to illustrate a number of facets of the epistemological enterprise in a relatively simple and succinct way. For instance, as well as being able to picture the basic structural elements of knowledge, the triad also made it possible to abstract some of the probable relationships that might occur in the epistemological enterprise, and the kinds of epistemological issue that might be subsequently given forth by those
relationships. It was shown, for instance, that certain 'chromatic' divisions on the spectrum of knowledge could be explained in terms of the suppression of certain relationships that might occur between particular radicals of the triad. But the most important facility of the triad in this regard proved to be its capacity to explain the progress of knowledge, particularly scientific knowledge. This was achieved by seeing the progress of knowledge as largely a matter of the modulation of dissonance, or augmentation of consonance between the cognition and cognised radicals of the triad. Modulation, it was suggested, amounted to bridging that heuristic gap which is prone to open up when a previously established consonance between the cognition and cognised radicals of the triad is shown to be false or illusory. However, it is not always the case that epistemological modulation is concerned with reinforcing the conjunction between $C_n$ and $C_d$. Sometimes, as is often the case with the arts, the focus of the modulation centres not so much on refining the content of $C_n$, as on the methods for generating that content. But whether the dissonance involved owes its origins to a failure of method or content, its resolution, it was argued, always serves to alleviate psychological tension and discomfort in the cogniser. Removal of that tension and discomfort, in fact, acts as a motivation for cogniser activity. Yet whilst 'tension reduction' might serve to catalyse the search for knowledge, the cogniser, in order to carry out that reduction, must first sense tension in the triad. The capacity to do so, it was argued, in fact is very much dependent on the kinds of knowledge and theories that infuse a cogniser's vision of the world. Unless they are there, and in the right sort of variety and proportion, the cogniser will not even spot a possible dissonance between $C_n$ and $C_d$, let alone have the
Concerned to explain how it was a cogniser came to identify 'dissonances', it was at this juncture that the study changed direction, and instead of pursuing what had been pre-eminently an epistemological route, took one which was increasingly sociological in character. It had been noted, for instance, that the perception of epistemological dissonance was only open to those of an appropriate epistemological background. It required a particular mental training to do so, a training designed to supply the cogniser with the capacity, not only to identify dissonance, but also the methods to modulate it. And that training initially comes about in the essentially social context of institutionalized education; for it was argued that one of the primary functions of education is the socialization of cognisers into disciplinary communities. Education is the principal vendor, then, of an epistemological sensitivity appropriate to the need of resolving dissonances. But whilst it is principally through the agency of education that an epistemological sensitivity comes eventually to be 'bought', its buying is by no means a quick or an easy transaction. In fact, that transaction usually takes place over a considerable period of time, and it also passes through a number of distinct phases. It was in an effort to plot these phases that the 'disciplinary continuum' was put together.

What that continuum attempted to show was the kind of institutional network that has tended to evolve in education in order to control admittance into disciplinary communities. For, whilst all people now have the franchise to some form of institutionalized education, the right to 'obtain' the most developed forms of epistemological sensitivity tends to fall only to a few, carefully chosen and selected
individuals. The continuum, in this respect, is an ability filter. For the vast majority who enter the 'gates' of education, and embark on the march along the 'disciplinary continuum' do not reach its end. They go to join instead the large world outside the knowledge industry, possessing, according to the phase along the disciplinary continuum they finally reached, only a partially developed epistemological sensitivity. But even those who, so to speak, 'stay the journey' and get to the point of being admitted into the 'metapaedeutic' parts of the continuum, few of them - even though they might possess the appropriate degree of epistemological sensitivity - ever actually end up modulating knowledge dissonances. It can be said, then, that the disciplinary continuum tends to overproduce well in excess of the numbers of cognisers actually required to advance certified knowledge.

It was in order to explain why this surplus of cogniser 'manpower' was in fact necessary to the functioning of knowledge industries, that systems principles were introduced and the whole fabric of the knowledge industry treated as though it were an 'open system'. For if a disciplinary community is to survive, and that means in systems terms the staving off of entropy formation, it was argued that such communities need more sorts of cognisers to populate them than mere dissonance modulators. Disciplinary communities do not survive on the epistemological fruits of their frontiersmen. For one thing, in order for such communities to acquire such frontiersmen - who will have the appropriate capacity to modulate dissonance and advance the frontiers of certified knowledge - those frontiersmen must first pass along the disciplinary continuum. They must first be, it has been noted, initiated into the public form of knowledge that is a discipline. But that initiation, it was noted, is not a private affair. There are few
self taught men occupying positions of real responsibility in disciplinary communities. Most would only get to such positions by passing along those channels that have been designated for the purpose in education. For the initiation into disciplinary communities largely occurs in the public arena of education, and is conducted by teachers who, by virtue of their superior and publicly accredited skills in a discipline, are charged with the responsibility of training student cognisers in its epistemological ways. It is through their teachers, then, that students come to inherit what it was noted were both the explicit and tacit aspects of a discipline's tradition. Without teachers to pass on what was called a discipline's 'DNA', that tradition might get ruptured and perhaps something of its essence irrevocably lost.

Thus, the propaedeutic phases of the continuum, and the teacher cognisers who manage them, are as much a part of the fabric of the open system that is the knowledge industry as anything else in it. Indeed, they could be said to be amongst its most vital parts, for unless a disciplinary system secures for itself sufficient input of student cognisers to take over the roles currently occupied by an older generation of cognisers, the system will not find itself perpetuated. Its bureaucratic structure will collapse; it will degenerate into entropy. The knowledge industry, then, needs something like a disciplinary continuum to protect its continued existence and to maintain its homeostasis. Thus it was discovered that in order to maintain this homeostasis some of the cogniser input, who managed to reach the beginnings of the metapaedeutic phases of the continuum, are in fact fed back down that continuum, to manage and teach in some of its earlier phases. They, as it were, descend the continuum to take
Disciplinary communities, however, in order to sustain themselves, require more than just teacher cognisers. If such communities were populated solely with teachers, nothing more than the institutional status quo would end up being conserved and perpetuated. In fact disciplinary communities, and the institutions that are contained within them, are no more than a means to an end, that 'end' being the advance of certified knowledge. If that advance ceases, it was argued, the *raison d'etre* of a discipline evaporates, and the social structure needed to support its continued existence eventually becomes redundant. No new cognition, then, means that no new cognisers will be needed for the disciplinary community.

The personnel services needed to produce new knowledge turn out to be as much a bureaucracy as that serving to educate and train cognisers. For the metapaedeutic phase - where the advancement of knowledge occurs - tends to be rife with institutions and different types of cognisers, whose roles are various and diverse. It was discovered, for instance, that in addition to the 'research cogniser' who actually modulates dissonances, there are, in the metapaedeutic community, cognisers whose task it is to check the calibre and authenticity of a proposed modulation. Such cognisers, who were called 'evaluators', are, as it were, the agents of quality control in the disciplinary community. They serve to ensure the maintenance of epistemological standards; they make sure that the 'bridge' proposed to cross a heuristic gap will not collapse under the strain of criticism or empirical test.

Then there are those cognisers whose role it is to disseminate the new knowledge gathered at the frontiers of research. They, as it were, broadcast to the disciplinary community at large the new epistemological
'consonances' circulating in the metapaedeutic phase; they facilitate the descent of new knowledge to the earlier phases of the disciplinary continuum.

The second and sociological half of this study, then, was mainly concerned with identifying those roles that are essential to the functioning of a disciplinary system. The identification of the roles of researcher, teacher, disseminator and so on, thus was equivalent to developing a 'role typology' of a disciplinary community. It was a classification of the cogniser's possible roles, and it shared similarities with the earlier attempts to classify the cognised and cognition. But as if in order to vindicate the existence of the 'knowledge triad', which the first half of the study was pre-eminently concerned with developing, some attempt was then made to relate this role typology to the structure of the knowledge triad, but in its amended form as a tetrad. By doing so, it became possible, for instance, to show that the teacher's role is essentially concerned with facilitating the passage of $C_n$ knowledge along the 'b-dyad' to student cognisers; the researcher's with bridging any heuristic gap that might exist between $C_n$ knowledge and the cognised; the evaluator's with testing the epistemological strength of that bridge, and so on. Having made those connections between the typology and the triad, a synthesis was achieved between the epistemological and sociological parts of the study, and the study was brought to a close.

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In essence, this study has produced a number of what Black (1966, p.222) would call "analogue models" of various facets of the epistemological enterprise. Such models, according to Black, attempt to reproduce as faithfully as possible the structure of the originals on
which they model themselves, and the webs of relationships which prevail there. The operative word here is 'faithfully', for one of the hazards of model building is that in scaling down (or up) an original, small details and nuances that would not have a massive distorting effect on the overall form of the model, tend to be overlooked or omitted. Models, then, in the desire to encompass so much, inevitably are forced to leave out a great deal. There is a tendency for models thus to become but cartoons of the real. Some of the suggestions, then, for further research will be centred on fleshing out the knowledge triad, the disciplinary continuum, and the role typology, and showing that indeed there is likeness in these 'cartoons' of the knowledge enterprise.

The other danger inherent in model building is the tendency to confer an absolute status on models that are built. It is not within the model's province to question the integrity and merit of the system being described and reproduced. Models only portray what is, not what ought to or could be; they are descriptive rather than evaluative devices. Yet plainly, where education is concerned, the principal finding of this study - that education is mainly subservient to the knowledge ideal in order to satisfy the personnel needs of disciplinary communities - could be a matter of debate and contention. Before examining, then, the sort of research that might be done to corroborate the thesis that education is but a 'service industry' to the disciplinary community, it might be worth asking the broad philosophical question, as to whether that 'thesis' is a wrong one for education to follow; and that schools perhaps ought to attempt other things than the realization of the knowledge ideal.
7.3 EDUCATION AND THE PASSAGE TO KNOWLEDGE

It is a regular homily in philosophy that an 'ought' cannot be derived from an 'is', yet, it could be argued, this is precisely what has happened in education. For what, since the Nineteenth Century anyway, has evolved as a functional obligation of education - the need to satisfy the personnel requirements of disciplinary communities - is now frequently justified on the normative grounds that epistemological experience is good for human beings in general, irrespective of whether they eventually join disciplinary communities or not. An 'ought' justification, then, has tended to be used to justify what has become an 'is' situation, and that, on the surface at least, could be construed as being a questionable principle on which to base schooling and the contents of the curriculum. But questionable or not, it is this principle which this section will consider.

Education might be a passage to knowledge, but it is only in the last three decades or so that all three layers of the disciplinary continuum have become hierarchically integrated (Dore, 1976, p.20). Each of those layers now contributes in some way to the eventual initiation of cognisers into the public forms of knowledge. Not that all educationalists find a rather premature orientation to the knowledge ideal to be undesirable. Indeed, some of them, in their philosophies, have made a virtual cult of the knowledge ideal. Followers of the 'liberal education' tradition, in particular, as has been noted in this study, would see a schooling that idolises knowledge as not only desirable, but unavoidable if schools are not to engage in something that is a travesty of education. A school which does not engage its students, it is said, in the serious and systematic study of the
intellectual, imaginative and cultural inheritance is technically not educating (Oakeshott, 1975, pp.21-22; Wilson, 1977, p.13; Warnock, 1977, p.19). Thus it is that most school curricula have tended to pay homage to that inheritance, although more often than not for functional rather than overtly normative reasons. For the average school curriculum draws its contents from representative areas of the knowledge spectrum, and most students, whatever their intellectual ability or range of interests, tend to experience something of a Cook's tour of man's intellectual achievements. Of course, this is all very convenient and desirable for those students destined to climb to the top of the educational ladder, but, as the more radically disposed educationalists have tended to ask, if the vast majority of students never get beyond the bottom rung of that ladder, and thereby only get a cursory glimpse of man's intellectual achievements, might not those students benefit from areas of human experience not normally labelled "cultural inheritance"? Perhaps if the curriculum changed its current centre of gravity and drew more from the practical affairs of life - the 'ultra-violet' parts of the spectrum - schooling might do a great deal more good for a great many more. It could be that the very hierarchical integration which has served to knit together the various institutions of schooling, and concatenate into some logical order the process of learning, has paradoxically served to sabotage the possibility of an all-round education. After all, it is that integration which has served to introduce into the disciplinary continuum that great distemper to fair and just educational practice, the qualification. Securing it has tended to make the passage to knowledge, not so much a journey of inspiring enlightenment and awakening reverence for the cultural inheritance, but merely a matter of passing the next examination.
Education, as a result, has tended to become mere qualification earning (Dore, 1976, p.ix). The disciplinary continuum, and the "filtering devices" that exist there to differentiate student ability, in this sense, serve to debase, not support, a normative justification for education.

There are a number of questions, then, that need to be raised in connection with education's apparent allegiance to the knowledge ideal. Firstly, ought there to be that allegiance anyway? After all, it only seems to be philosophical hearsay, not empirical fact, that existential benefits accrue from experiencing knowledge and the cultural inheritance. Man, it could turn out, is equally able and competent at existence without them. There might be many other domains of human endeavour from which the vast majority of mankind could benefit apart from what is included on the knowledge spectrum. But even if there are not, and it can conclusively be proved that knowledge holds the key to the health of the human condition, need the initiation into the public forms take place in its current format?

If it is held that the appreciation of the cultural inheritance, and the forms of knowledge it embraces, is desirable then it has been a conclusion of this study that that appreciation can not spontaneously be acquired. An individual only comes to take possession of that appreciation after a protracted period of epistemological training and exposure to knowledge. At present, education supplies the context in which that protracted training occurs. The format, however, in which that training tends to be conducted, has tended to evolve by accident rather than by design. There might, then, be logically sound and empirically advantageous ways of arranging that training. For instance, one of the findings of this study is that the sciences are
more likely to be compatible with the intellectual proclivities of young children, whereas the arts seem to have much more appeal during adolescence. This would perhaps suggest that more emphasis should be given to the sciences in the primary phases of the continuum, and more to the arts during the second.

Then there is the question of whether 'personnel ascent' on the continuum need occur exactly in the phases that appear to have evolved. If that continuum is regarded, as it has been in this study, as the preliminary intellectual route a student cogniser must follow if he is eventually to secure a place in a disciplinary community, could there not be other routes for gaining that admission? Does the training of cognisers necessarily have to follow consecutively the stages of the continuum, or can there be some interruption, as is often proposed between secondary and tertiary phases for instance, in that progress? Might it not be better, as Dore (1976, p.143) has proposed, if the "entry port" to a disciplinary community, along with the professions in general, commenced, not at 22, but at the age of 15 or 16? At that early age, the would-be cogniser would start his training as a research assistant or a secretary to a university department, and continue his knowledge training concurrently, so to speak, "in-career". But the only way to measure the efficacy of such proposals, or whether genuine and practical alternatives to the current modes of disciplinary apprenticeship are indeed needed, is to discover how successful these modes are. However, such discoveries are a matter of empirical assessment, and belong properly to the category of 'is' rather than 'ought' questions about disciplinary initiation and apprenticeship.
7.4 THE PASSAGE TO KNOWLEDGE: SOME POSSIBLE AREAS OF FURTHER RESEARCH

Whilst much of what has been said in this study has been abstracted from what would appear to be the empirical facts about knowledge, the models which have been produced from that abstraction really need now to be inductively corroborated. This section will suggest areas in which that inductive corroboration would appear to be most needed, or desirable, because it might yield further important understandings about the character of the epistemological enterprise.

Firstly, there is no reason to suppose that the general principles of enculturation and their effects are necessarily exclusive to the arena of man's epistemological activities. Presumably, any cultural, social and technological activity that is worthwhile perpetuating and that is subject to innovation as it passes from generation to generation, will follow analogous practices to those of replication and modification encountered in knowledge communities. There is a possibility, then, that the model of the discipline could be extrapolated to other areas of human activity.

Secondly, an effect of exploring the specialized sensitivity that arises out of pursuing particular avocations might be that the nature of a knowledge outlook and epistemological sensitivity might itself be better understood. For whilst epistemological sensitivity has been very much the keynote of this study, as a disposition it has only been rather broadly defined. If epistemological sensitivity, with its own set of conceptual and perceptual biases, is one of the principal cumulative products of education, then plainly anything which more specifically describes how a sensitivity to knowledge is engendered and developed will have profound repercussions on the nature and practise
Thirdly, a related question is, what happens to epistemological sensitivity when dissonance is uncovered? It has been argued that psychological feelings of discomfort are registered which do not finally vanish until consonance is restored. That would be an area that the autobiographies of scientists and artists might yield support for in plenty. For if epistemological problems are a source of anxiety and tension, then it would be expected that cognisers who have encountered such tension and anxiety would describe it as such. In fact, the use of autobiographies, as well as the types of longitudinal study that Getzels and Csikszentmihalyi (1976) engaged in, might yield considerably more understanding about the results and processes of disciplinary apprenticeship than perhaps has been hitherto available. It has been said in this study, for instance, that the 'inter-cogniser' rapport which occurs between a teacher and a student is a fairly necessary feature in the 'institutional' replication of a discipline, yet little is actually known about what happens in this perhaps most key process of learning. Autobiographies of prominent scientists, artists and philosophers might supply certain insights about what it is that happens between a student and his teachers. Perhaps such research might indicate what qualities in a teacher ultimately proselytize students to their discipline and their epistemological ways of thinking. Perhaps it might be discovered that that proselytization is often a compounding of a number of factors, of which the teacher's influence is but one.

There are several questions about the composition of the knowledge spectrum that also need further exploration and clarification. There are, for instance, the wholly speculative questions about whether, with the emergence of science, the spectrum has ceased evolving; and
whether, should epistemological positivism reign supreme, all the other and older forms of knowledge will become accommodated in the domain of science? Or will the divisions in the spectrum of knowledge continue to remain much as they are now, and instead of aping the sciences, seek out their own autonomous methodologies? Or could it be that the epistemological possibilities of positivism have reached their limit, and that further understanding about man and the universe will increasingly be speculative and philosophical in character? Instead of knowledge continuing to move towards the right, it could be that knowledge will once again begin to exhibit the features of left-hand knowledge.

Then further questions should be raised about the fundamental differences between the arts and the sciences. The chronology of scientific revolutions by now have been well documented, yet if revolutions in the arts, as has been asserted in this study, are mainly of a methodological kind, their chronology has not been equivalently documented. The forces generating method dissonance, and the acceptance of the subsequent modulation were only superficially examined in this study; yet if the structure of artistic revolutions, as being based on the principle of method dissonance, is to be understood, then a history of modal changes in the arts could perhaps be drawn up. Could it be, too, that changes in the other non-scientifically based disciplines, like philosophy, are also modally based? Certainly the changeover from the 'idealism' that a Nineteenth Century philosopher like Bradley practised to the 'linguistic analysis', which became the virtual emblem of Anglo-Saxon philosophy in the first half of the Twentieth Century, could be regarded as a modal change. For after that change, instead of the pure speculation of idealism, philosophers
engaged in an examination of the words that were used for that speculation. They altered, as it were, their method of approach to philosophical problems.

The systems treatment of a disciplinary community raises certain quantitative questions about the minimum (or maximum) number of cognisers such communities need to function properly and thereby achieve a personnel homeostasis. It was noted in this study how, for instance, when a discipline becomes too large and its interest becomes too broad in compass, it tends to proliferate sub-disciplines. It might be worth ascertaining, then, the minimum number of cognisers (and of what type and variety) that are required to found and make such a sub-discipline a viable proposition.

Questions of a quantitative kind might also be asked about the various role cognisers. It should be possible to quantify the time spent in fulfilling each role, as that pertains, for example, to a polymorphous cogniser. Is it the case with the polymorphous cogniser that one role predominate over all the rest? Does, as has been suggested in the study, the cogniser in the metapaedeutic sector, do most of his most significant research when comparatively young, and then for the remainder of his career turn to administration or teaching as the principal focus of his interests? His role as a research cogniser tends to fade into the background with the coming of age. But if this is true, as it seems to be, with physicists and mathematicians, is it equally true of philosophers and literary critics? Or do their capacities as researchers and contributors to knowledge flower comparatively late in life? Certainly, this was the case with Kant, who did not publish anything until he was 59! If the 'publish or perish ethic' had prevailed at the University of Konisberg in the
Eighteenth Century, then the world would possibly not now have the 
Critique of pure reason! Equally, there is the related question as
to whether disciplinary communities need to be as highly populated with
cognisers to secure highly significant epistemological results. There
is some evidence to suggest — cited in Chapter Six — that really high
calibre contributions to knowledge would appear to come from a fixed
and finite number of cognisers in each generation. The greater
number doing research only seem to add to the bulk of relatively
mediocre knowledge, not to that which is revolutionary. It could be
argued, then, that the numbers working in the knowledge industry could
be severely cut back, and the advancement of knowledge would not suffer
unduly. Yet mankind's per capita involvement in the knowledge
industry continues to rise faster than the population (Price, 1963, p.16).
It has recently been calculated that the number whose professional
activity is predominantly mental (professors, research scientists, men
of letters and artists) has reached, in the most progressive countries,
in the order of 10% of the active population (Fourastié, 1976, p.2).
It could be, then, with more manpower 'investment' in the knowledge
industry, that the law of diminishing returns might commence to prevail,
and the growth of knowledge might, comparatively speaking, contract
rather than grow. Or it could be, since communication would appear to
be the life blood of any discipline, that the sheer quantity of
knowledge being produced might inhibit communication and the sort of
disciplinary cross fertilization from which new knowledge is generated.
It has been noted how the proliferation of new sub-disciplines is often
a way of combatting this hazard. But the hazard of this
'sub-disciplinization' is the increased concentration on very small
areas of specialization, often at the expense of having a general
purview of reality. The areas of theoretical coverage that a knowledge encompasses could become smaller and smaller, and less and less general, as the number of sub-disciplines increases. The knowledge explosion could have, as one of its shock effects, an implosion of disciplinary interest, which might make it more difficult for a Newton or an Einstein, in the future, to emerge on the scenario of knowledge.

Another problem needing further examination is the matter of 'content descent'. It was said that the school science curriculum — and the same is probably true of other areas of knowledge — is usually about a generation behind the latest developments in scientific knowledge. But what was not examined is how it is that the content of the curriculum is brought up to date and modernized. It has been said that there is a group of cognisers in each disciplinary community called 'disseminators' who, as it were, promulgate the newest developments in knowledge: but, given the bulk of new knowledge, it is worth asking what sort of criteria they use to carry out that selection. And how, once that selection has been made, does that knowledge eventually end up in the teacher's 'hands'? The dynamics of 'content descent' are not well understood, and perhaps need to be, lest, as has tended to happen in literature, the forces and powers responsible for curriculum change, are subject to pressure and lobby by publishing houses keen to see their poets and novelists on the literature curricula of universities (Kostelanetz, 1974). It might not be, then, the disinterestedness and objectivity of knowledge that determines what is promoted as desirable new knowledge worth learning, but simply the self interest of organizations like publishers, who are more often interested in selling their books rather than the knowledge contained within them. It has been noted, for instance, how the publishers,
Penguin, who once aimed their Pelican books at the general reader, now have a conscious policy of aiming the 'Pelican' at students "in the polytechnics and the universities" (Dore, 1976, p.32). The course text is a thoroughly lucrative market for publishers, probably only outranked in its profit potential by the popular best seller. The trouble with publishers is that they have a tendency to promote the popularizers in a particular discipline. This often has a malevolent effect on parasitic disciplines, for example education, which tend to draw on parent disciplines like anthropology and psychology for many of their insights. Whilst in the field of professional anthropology the work of Kluckholn, Mead and Benedict tends not to be trusted and respected, in education it is the work of these popularizers that is cited most frequently. The work of the purely scholarly anthropologist, which is often more subtle and profound than that of the popularizers, is often overlooked or eschewed. Because it is rarely given the same attention by publishers, it rarely becomes essential reading for the educationalist interested in the anthropological dimensions of teaching and learning (Spindler, 1955).

7.5 AND IN CONCLUSION

It is difficult to do full justice to a problem like knowledge, more so when it is realized that, as a problem, knowledge had preoccupied some of the best minds in the pantheon of Western culture, over two thousand years. This study has not tried to understand what knowledge is in the most general and fundamental sense - in the sense, for instance, in which Socrates asked Theaetetus to define knowledge (Plato, 1973b). Rather it has attempted to understand the nature of
knowledge in its most substantive form, as that form manifests itself in education, in epistemological sensitivity and in the disciplinary community. This study, then, has not allowed itself to be diverted by the problem of the Skeptics or Pyrrhon, and worried about whether man can ever have knowledge about anything at all. It has accepted that knowledge is something of a fait accompli, and in doing so, has come to examine how that knowledge becomes an accomplished fact. That has always been the major focus of interest in this study. It is only to be hoped that in pursuing that interest, the insights into knowledge that have been gained are not 'stillborn', but evoke further interest and possible research into the areas that have been suggested in the concluding chapter of the study.
APPENDICES

AND

BIBLIOGRAPHY
Of all areas of understanding that could have inspired the 'knowledge triad', it is that of language, in particular semiology, which is principally responsible, not only for the form the triad takes, but also the vocabulary that has been used to identify its components. It is no accident, then, that the elements of the triad have been named 'cogniser', 'cognised' and 'cognition'; for anyone familiar with the 'sign talk' of Saussurean linguistics will immediately recognize the inflexional homology that these terms bear with "signifier" and "signified" - the two major components of a "significance" system.

Not that the homology extends completely to the concepts inherent in these two sets of terms. Whilst, for example, there is a degree of parallelism - although not total - between cognised and signified, a signifier is by no means a cogniser in a semantic rather than an epistemological costume. The difference between the terms is one of focus rather than straightforward contradistinction. For in the knowledge triad the cogniser takes on the dimension of a human persona; and whilst it is possible to extrapolate this persona from the nature of a signifier, in strict Saussurean terms signifier refers to that "sound-image" part of a sign which conveys meaning. Signifier embraces the possible morphological and phonetic elements of a sign vehicle. It is the "plane of expression" as opposed to the "plane of content", or meaning in a sign. Saussure in fact uses the term signified to encapsulate the features associated with the latter (Barthes, 1967, pp.39-42; Saussure, 1966, pp.66-67).

As far as the semiology of Saussure is concerned, it is only the "signifier" aspects of his terminology which have been inspirational.
The "signified" concepts associated with that terminology are seemingly less appropriate to the knowledge triad than the evident "signifier" homologies would indicate. Not that the realms of semiology and epistemology are that distant from one another that it would be entirely inconceivable that an analogue for knowledge might be found in meaning. It is just that Saussure, in this regard, is not so apposite as the partial 'take over' of his terms would impute.

The possible propinquities between language and knowledge, however, have not escaped the notice of all semiologists. There have been attempts, for instance, to show that the compass of knowledge and the expressive range of language are, in some respects, collateral. The range of possibilities inherent in language can be seen as reflecting a basic antimony in epistemological discourse in general. For instance, if the compass of that antimony can be located between poetic and scientific types of discourse, then language too reflects that epistemological antimony. It is the option of language, then, that it yields to the possibility of being objective and emotive at one and the same time; and that poetic is the obverse of scientific discourse (Richards, 1970, p.31). It is a matter of the former capitalizing on everything that is absolutely anathema to the latter; of scientific discourse, for instance, purging itself of all the connotative and "polysemic" effects that are the 'aura' of ordinary language (Guiraud, 1975, pp.56-57). What is bane for science is boon for poetry.

In fact, it is possible to go beyond the basic Richardian antimony and find all sorts of possible specialization in linguistic discourse. Morris (1946,pp.124-126)did this when he tried classifying the compass of epistemological discourse in terms of its "mode/use" dominance. He posited that there are four possible signifying modes: designative,
appraisive, prescriptive and formative, which can be put to four possible epistemological usages: informative, valuative, incitive or systemic. On this basis, Richards' poetic and scientific discourses become appraisive/valuative and designative/informative discourses respectively. In fact Morris' "mode/use" classification offers the possibility of sixteen major types of discourse within the spectrum of knowledge (see 4.6).

But above all it is the semiological models of meaning that have most propinquity to the knowledge triad. Perhaps this is not so surprising because, after all, knowledge and language can both be regarded as templates of the world around which notions are drawn and explanations conceived. They both operate within a sphere in which an agent of consciousness tries to make a partnership between knowledge or language and the world which exists beyond the corporeal limits of the agent. The process of semiosis, for instance, has been described as a "co-operation of three subjects ... a sign, its objects, and its interpretant" (Peirce, 1934, p.484). Meaning is a triangular relationship, a fact which Ogden and Richards (1936, p.10) in their famous representation of the process of meaning took to be quite literally true:

![Diagram of the meaning triangle]

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THOUGHT OR REFERENCE

CORRECT
symbolises a causal relation

ADEQUATE
refer to other connectedness

SYMBOL .... REFERENT

Stands for imputed relation
TRUE
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This not only looks like the knowledge triad, but, with one or two elementary modifications, can in fact be regarded as an analogue of it. Those modifications mainly centre around the ambiguity of Ogden's and Richards' terminology. In fact, exceedingly vexed by that terminology, Ullman was encouraged to simplify it altogether by suggesting that what Ogden and Richards meant by thought, symbol and referent were "sense", "name" and "thing" respectively (Ullman, 1970, p.57); or simpler still, Peirce's terms: a sign, its objects and its referents. And these three things of course correspond to what in the knowledge triad have been called cognition, cognised and cogniser.
Because it has been felt useful to devise a relatively independent nomenclature to designate some of the models and concepts used in this study, a glossary of the commoner terms used in that nomenclature follows. In particular, a glossary recommends itself because many of the terms used are what Scheffler (1962, p.13) would call "inventive stipulative": that is, they are different from conventional usage or are consciously invented neologisms that seem to suit the semantic need at hand.

It is to be hoped, then, that this glossary will help to overcome the problem that a reviewer encountered in reading a recent book on semiology: it was so crammed full of "inventive stipulatives" that he found himself unable to remember from one page to the next the difference between parole and langue, and the difference between difference and differance! In such circumstances, a glossary might have acted, as it is intended to do here, as an aide-memoire.

GLOSSARY

COGNISED (C_d) - refers to that to which all knowledge and experience is addressed. It is the 'object' in the knowing process, and can either take a sub-organic, organic or supra-organic form (see 4.2).

COGNISER (C_r) - is the agent of consciousness in the epistemological enterprise. It is he who has the capacity to translate his experience of the cognised into knowledge (see 4.3).
**Cognition (C)** - results from the translation of experience into epistemological terms. It can be taken as knowledge about the cognised (see 4.4).

**Consonance** - is the condition of epistemological harmony between cognition and cognised, which exists when the former appears accurately to translate the latter into knowledge terms (see 4.11).

**Disciplinary Continuum** - is an attempt to represent the stages and procedures a cogniser normally must pass through in order to gain admittance into a disciplinary community. It is an attempt to tell the 'life-history' of a cogniser (see 5.6).

**Dissonance** - erupts when the translation of cognised into cognition is not as accurate as was supposed. In fact, it proves to be erroneous (see 4.11).

**Epistemological Sensitivity** - is the compounded outlook, drawn from knowledge, that a cogniser has on the cognised (see 1.1).

**Knowledge Spectrum** - encapsulates the range of knowledge modes that have evolved to describe and investigate the various phenomena in the cognised (see 4.6).

**Knowledge Triad** - is formed from the three basic elements - cognised, cogniser and cognition - that have been identified as forming the principal elements in all epistemological enterprises. The model indicates the possible interactions that are permissible between these three elements (see 4.9). Note that the knowledge tetrad is that amended form of the triad which has been used to accommodate the social dimension of knowledge (see 6.2).
METAPAEDEUTIC PHASE - represents the final part of the continuum in which knowledge and research are produced (see 5.6).

MODULATION - is that epistemological action which renders a dissonance consonant (see 4.11).

PRE-PAEDEUTIC PHASE - is that phase in a cogniser's 'life history' which occurs before he embarks on the disciplinary continuum. It is the cognitive state of pre-epistemological awareness (see 5.6).

PROPAEDEUTIC PHASE - can be regarded as that phase of the continuum during which a cogniser's initiation into the public forms of knowledge occurs. It is a phase during which epistemological sensitivity develops. (see 5.6).

ROLE TYPOLOGY OF COGNISERS - represents an attempt to classify cognisers according to the role they hold within a disciplinary community (see 6.3 et seq.).
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