

Open Research Online

The Open University's repository of research publications and other research outputs

Curriculum, complexity and representation: rethinking the epistemology of schooling through complexity theory

Thesis

How to cite:

Osberg, Deborah Carol (2005). Curriculum, complexity and representation: rethinking the epistemology of schooling through complexity theory. PhD thesis The Open University.

For guidance on citations see [FAQs](#).

© 2005 The Author

Version: Version of Record

Copyright and Moral Rights for the articles on this site are retained by the individual authors and/or other copyright owners. For more information on Open Research Online's data [policy](#) on reuse of materials please consult the policies page.

oro.open.ac.uk

**CURRICULUM,
COMPLEXITY AND
REPRESENTATION**

Rethinking the epistemology of
schooling through complexity theory

by

Deborah Carol Osberg

B.Sc. University of Natal

B.Sc. (Hons.) (Zoology) University of the Witwatersrand

M.Sc. (Zoology) University of the Witwatersrand

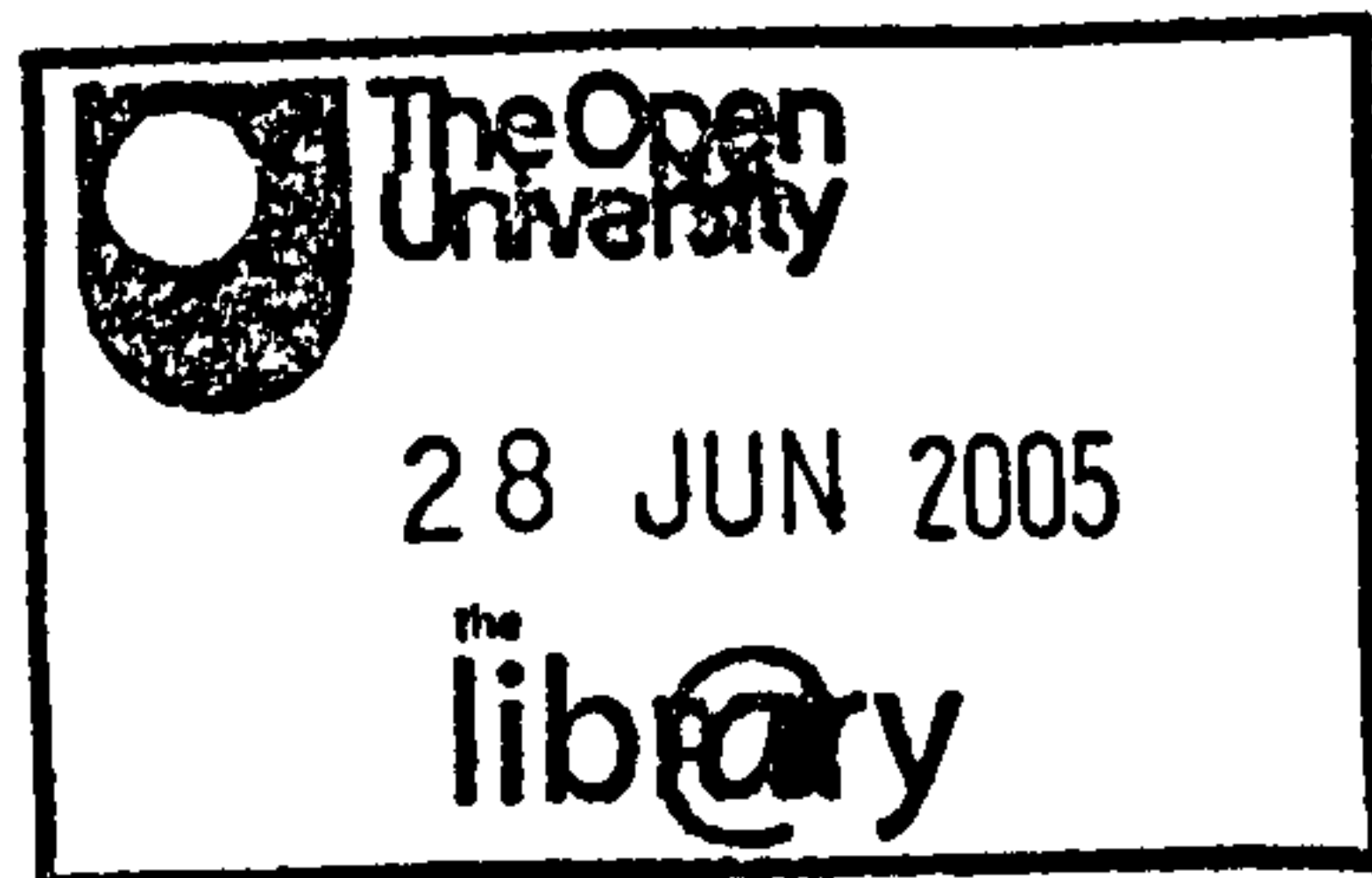
A thesis submitted in partial
fulfilment of the requirements for
the degree of

Ph.D.

Educational Theory

The Open University

31st March 2005



DONATION

T370-1

A

For my teachers
with thanks

THE OPEN UNIVERSITY

RESEARCH SCHOOL

Library Authorisation Form

Please return this form to the Research School with the two bound copies of your thesis to be deposited with the University Library. All candidates should complete parts one and two of the form. Part three only applies to PhD candidates.

Part One: Candidates Details

Name: DEBORAH OSBERG PI: T9210609

Degree: PHD

Thesis title: CURRICULUM, COMPLEXITY AND REPRESENTATION. RE-THINKING THE EPISTEMOLOGY OF SCHOOLING THROUGH COMPLEXITY THEORY.

Part Two: Open University Library Authorisation

I confirm that I am willing for my thesis to be made available to readers by the Open University Library, and that it may be photocopied, subject to the discretion of the Librarian.

Signed: [Signature] Date: 13/06/05

Part Three: British Library Authorisation [PhD candidates only]

If you want a copy of your PhD thesis to be available on loan to the British Library Thesis Service as and when it is requested, you must sign a British Library Doctoral Thesis Agreement Form. Please return it to the Research School with this form. The British Library will publicise the details of your thesis and may request a copy on loan from the University Library. Information on the presentation of the thesis is given in the Agreement Form.

Please note the British Library have requested that theses should be printed on one side only to enable them to produce a clear microfilm. The Open University Library sends the fully bound copy of theses to the British Library.

The University has agreed that your participation in the British Library Thesis Service should be voluntary. Please tick either (a) or (b) to indicate your intentions.

[X] I am willing for the Open University to loan the British Library a copy of my thesis. A signed Agreement Form is attached

[] I do not wish the Open University to loan the British Library a copy of my thesis.

Signed: [Signature] Date: 13/06/05

Acknowledgements

Many are my debts for the profound support I received during all stages of this work. First of all I would like to thank my family and friends in South Africa and the friends I have made in England over the past four years for their much needed emotional support during a difficult period of my life. In particular, Carol, Ivar, Nicola, Lorian, Derick, Teresa, Claire, Vivienne, Moira, Andreas, Mandy and Marc. Thanks also to Professor Philip Higgs at the University of South Africa for his kindness, generous hospitality and advice during a difficult time with the research, and for introducing me to the work of Gert Biesta. I am deeply indebted to my four supervisors: Joan Solomon for having offered me an opportunity to do this work, despite a lack of theoretical background in this field. Without this initial supportive gesture this work would not have begun. Roger Harrison for his encouragement, and support throughout the process. Paul Cilliers for his patient engagements with my many, tedious emails about the paradoxes of complexity, a task he undertook with considerable good humour, and Gert Biesta, my principal supervisor, for his inspirational theoretical input and for always 'complicating the scene' thereby taking me further and further out of my depth. I now know that when one is out of one's depth, it is not simply a case of learning how to swim. We survive in unimaginable ways.

This work was partially supported by a grant from the Epistemology Group.

Contents in brief

<i>Abstract</i>	<i>v</i>
<i>Acknowledgements</i>	<i>vii</i>
<i>Contents in full</i>	<i>xi</i>
<i>List of tables and figures</i>	<i>xix</i>
Chapter 1: Introduction	1
<i>Presenting/prefacing the research</i>	
Chapter 2: The epistemology of schooling	59
<i>Modern curricular thought and its representational foundations</i>	
Chapter 3: The crisis of representation	99
<i>Representation, semiology, Cartesian epistemology and beyond</i>	
Chapter 4: Introducing complexity	149
<i>A brief review of various attempts to represent the unrepresentable</i>	
Chapter 5: The epistemology of complexity	195
<i>Thinking beyond representational conceptions of knowledge</i>	
Chapter 6: Curriculum and emergence	247
<i>Re-thinking schooling from an 'emergentist foundation'</i>	
Chapter 7: Summary and conclusions	297
<i>Significance of the research and possibilities for further study</i>	
<i>Appendix</i>	<i>315</i>
<i>References</i>	<i>321</i>

Contents in full

<i>Abstract</i>	<i>v</i>
<i>Acknowledgements</i>	<i>vii</i>
<i>Contents in brief</i>	<i>ix</i>
<i>List of tables and figures</i>	<i>xix</i>
Chapter 1: Introduction	1
<i>Presenting/prefacing the work</i>	
1.1 Preamble	1
1.1.1 Presenting/prefacing a work	1
1.1.2 Presenting/prefacing and pedagogy	3
1.1.3 A note on transdisciplinarity	6
1.2 The Research 'Fields'	8
1.2.1 The 'field' of curriculum studies	9
1.2.2 The 'field' of epistemology	13
1.2.3 The 'field' of complexity science	16
1.2.4 Positioning the research	24
1.3 The Research Focus	24
1.3.1 The argument and the research questions	24
1.3.2 Significance of the research	25

1.3.3 Contributions to the literature	26
1.4 The Research 'Methodology'	29
1.4.1 The methodological approach	30
1.4.2 The road taken	37
1.4.3 The structure of the argument	43
1.5 Summary of Chapters	47
1.5.1 Chapter 2: The epistemology of schooling	47
1.5.2 Chapter 3: The crisis of representation	49
1.5.3 Chapter 4: Introducing complexity	52
1.5.4 Chapter 5: The epistemology of complexity	53
1.5.5 Chapter 6: Curriculum and emergence	55
Chapter 2: The epistemology of schooling	59
<i>Modern curricular thought and its representational foundations</i>	
2.1 Preamble	59
2.2 Curriculum and Representation	62
2.2.1 Different uses of the term 'curriculum'	62
2.2.2 Modern curricular assumptions and questions	63
2.2.3 Two representational theories of knowledge	66
2.2.4 A representational theory of signification	69

2.3	The Origins of Representational Curricular Thought	74
2.3.1	Aries's account of the origin of modern schooling	74
2.3.2	Mollenhauer's account of the origin of modern schooling	77
2.4	Representational Vs. Presentational Pedagogies	82
2.4.1	Comenius and representational pedagogy	83
2.4.2	Dewey's progressivism. A 'presentational' pedagogy	85
2.4.3	Situated learning and 'presentational' pedagogy	88
2.4.4	The representational-presentational binary	92
2.5	Summary and Closing Remarks	96
 Chapter 3: The crisis of representation		99
<i>Representation, semiology, Cartesian epistemology and beyond</i>		
3.1	Preamble	99
3.2	Representation and Personal Knowledge	103
3.2.1	Von Glasersfeld's 'radical constructivism'	104
3.2.2	Difficulties with the subjectivist position	108
3.3	Representation and Scientific (Public) Knowledge	110
3.3.1	From 'positivism' to 'post-empiricism.'	111
3.3.2	The objectivist view	114
3.3.3	The relativist view	117
3.3.4	Beyond objectivism and relativism	121

3.4	Representation, Semiology and Writing	124
3.4.1	De Saussure's 'semiology'	125
3.4.2	Derrida's 'deconstruction'	135
3.5	Summary and Closing Remarks	145
Chapter 4: Introducing complexity		149
<i>A brief review of various attempts to represent the unrepresentable</i>		
4.1	Preamble	149
4.2	Defining Complexity	152
4.2.1	Why 'defining' complexity is difficult	152
4.2.2	The distinction between chaos and complexity	153
4.2.3	The 'generic' features of complexity	155
4.2.4	A 'sketch' of a complex system	156
4.3	Describing Complexity – Insights from computer modelling	158
4.3.1	A computer model of a complex system	159
4.3.2	Non-linearity and determinism	164
4.3.3	The notion of emergence	167
4.3.4	Problems with the modelling approach: boundary issues	174
4.4	Explaining Complexity – Insights from thermodynamics	178
4.4.1	Background to Prigogine's work	179
4.4.2	Non-equilibrium and self-organisation	182

4.4.3	Bifurcation and chance: the roots of ‘strong’ emergence	185
4.4.4	Probability and irreversibility	187
4.7	Summary and Closing Remarks	191
Chapter 5: The epistemology of complexity		195
<i>Thinking beyond representational conceptions of knowledge</i>		
5.1	Preamble	195
5.2	The Structuralist Challenge to Representation	197
5.2.1	Nonlinearity (‘incompressibility’)	198
5.2.2	The undecidability of boundaries	207
5.2.3	The relativist and pragmatist alternatives	213
5.3	The Poststructuralist Challenge to Representation	220
5.3.1	A non-linear understanding of temporality	220
5.3.2	Two challenges to linear temporality	221
5.3.3	Complexity’s challenge to the notion of presence	226
5.4	The Epistemology of Complexity	228
5.4.1	Epistemology without ‘presence’	231
5.4.2	Knowledge of the past (the loss of truth in history)	232
5.4.3	Knowledge of the future (openness to the unimaginable)	237
5.4.4	Knowledge of the present (experiencing the impossible)	239
5.4.5	Complexity and poststructuralism	242

5.5	Summary and Closing Remarks	244
Chapter 6: Curriculum and emergence		247
<i>Rethinking schooling from an 'emergentist foundation'</i>		
6.1	Preamble	247
6.1.1	The 'emergentist' critique of representational schooling	248
6.1.2	The logic of the argument	250
6.2	The Emergence of Knowledge. Pedagogies of invention	253
6.2.1	Inventing meaning in 'romantic' progressive education	254
6.2.2	Inventing knowledge for the 'knowledge society'	255
6.2.3	Ulmer's 'applied grammatology'	259
6.2.4	The pedagogical effect of 'discipleship'	264
6.2.5	Double emergence	267
6.3	The Emergence of Subjectivity. Pedagogy without humanism	269
6.3.1	Moving from 'what' to 'who'	270
6.3.2	Arendt and Levinas on human subjectivity	273
6.3.3	Biesta's 'pedagogy without humanism'	277
6.4	Undoing the Representational Logic of Schooling	285
6.4.1	The death of the subject not the death of education	285
6.4.2	Transcending the crisis of representation in education	288
6.4.3	Schooling, curriculum and emergence	290

6.5 Summary and Closing Remarks	293
Chapter 7: Summary and Conclusions	297
<i>Significance of the research and possibilities for further study</i>	
7.1 Summary of thesis	297
7.2 Main findings and contributions to the literature	300
7.3 Shortcomings of the research and further work	303
7.4 Afterword: Beginning again	306
<i>Appendix</i>	<i>315</i>
<i>References</i>	<i>321</i>

List of Tables and Figures

Table 1: A classification of different methodologies and paradigms	33
Figure 1.1: The sequence of emergence of the content.	42
Figure 1.2: The logic of the argument: 'Linearising' the emergent structure.	42
Figure 1.3: The logic of the argument in conventional terms.	44
Figure 1.4: Stage 6: Developing the argument by rewriting the chapters a second time in the sequence shown.	45
Figure 1.5: Stage 6: Refining the argument by rewriting the chapters a third time in the sequence shown by the solid black line (with considerable back-and-forth movement between chapters throughout this process).	46
Figure 2.1: A dualistic or representational understanding of the sign.	69
Figure 2.2: The ternary sign: A sign which makes it possible to see in one thing (e.g., a fingertip) the mark of a second thing (e.g., an astrological principle).	73
Figure 2.3: The binary or dualistic sign is a representation or reflection of what exists, as is the case in this biological drawing representing the bones in the hand.	73

Figure 2.4: A lesson from Comenius's <i>Orbis sensualium pictus</i> . The book simplified the 'real world' in such a way that children could gain an 'adequate' understanding of it.	81
Figure 3.1: de Saussure's diagrammatic representation of the 'sign' as a two-sided psychological entity (adapted from de Saussure 1983/1916, p. 67)	127
Figure 3.2: de Saussure's illustration of the shifting 'nothingness' of (A) thought and (B) sound (reproduced from de Saussure 1983/1916, p. 111, with permission of Duckworth Publishers, London).	127
Figure 3.3: The individual meaning of the signified emerges from the play of difference between signifiers (illustration adapted from, de Saussure 1983/1916, p. 113)	131
Figure 4.1: A checkerboard.	160
Figure 4.2: A cell surrounded by its 'neighbourhood' of eight adjacent cells	160
Figure 4.3: Some possible neighbourhood configurations that would lead to state changes of an initially black cell, in a cellular automaton operating according to 3 rules of interaction.	161
Figure 4.4: Localised structures such as the one made of five cells in the top left hand corner of the grid above, 'emerge' and 'glide' across the grid (shown by arrows) as individual cells in the grid 'blink' on or off (black or white)	163

following the simple set of Class 4 rules that guide the automaton's behaviour.

Figure 4.5: A linear cause-and-effect sequence results in a predictable 'final' state that is the sum of the effects of the component parts. 165

Figure 4.6: Complex, non-linearly connected systems produce unpredictable 'emergent' effects. 167

Figure 4.7: A hierarchical model of emergence. As non-linear interactions produce emergent features at new hierarchical levels, these in turn interact to produce yet another emergent hierarchical level of order. In this diagram, different shapes represent different hierarchical levels of order (i.e., 'State 1', 'State 2' and 'State 3'). 170
However note that each of the three 'states' can exist simultaneously and, although not shown in this diagram, there can be interactions which cut across different hierarchical levels.

Figure 4.8: Fractal tree showing how simple binary branching can quickly lead to an inordinate number of outcomes. 188

Figure 5.1: In this illustration the 'rules' are depicted by means of interconnecting lines. Note that the light grey 'system' in the dotted circle in the centre of the illustration – which is 'isolated' in the solid circle in the top left-hand corner – is only a 'system' if it is artificially 211

delineated as one. Its 'behaviour' is therefore contingent on 'rules' which cannot be contained within its boundaries. The 'isolated' model in the top left-hand corner would therefore exhibit different behaviour from its interconnected 'real' counterpart, or, if it showed the same behaviour, it would do so only by means of a completely different set of rules, i.e., a set that operated with different boundary parameters.

Figure 5.2: A linear understanding of temporality, in which history is immutable. 233

Figure 5.3: Diagram to show how each new present brings a reconstruction of the past. For example theories 'a,' 'b' and 'c' about the possible origin of the universe (these being theories which arise from different presents, a, b and c, respectively) would be qualitatively different not cumulatively different. 235

Chapter 1

INTRODUCTION

Presenting/Prefacing the Research

1.1 PREAMBLE

But to seek to know before we know is as absurd as the wise resolution of Scholasticus, not to venture into the water until he had learned to swim (Hegel, in Derrida 1981a, p. 47)

...the problem of the 'preface,' discussed in [Derrida's] *Outwork*, is identical with the problem of pedagogy in general – of a communication between teacher (the one who is supposed to know) and a student (the one who thinks he is supposed to learn what the teacher knows). Everything that Derrida says apropos of the deconstruction of the preface applies equally to the pedagogical discourse, with the student being in the position of the reader of a text about which as yet he knows nothing (Ulmer 1985, p. 161).

1.1.1 *Presenting/prefacing a work*

To preface a work, to *present* it as a completed body that can be grasped, implies the 'completed' work *has* been completed before the preface is

written, that it *closed*, and hence 'prefaceable' or presentable (in particular Ph.D. dissertations should be presentable). The preface, then, should be nothing other than a repetition of what is presentable, a re-presentation, or 'mere' supplement to the work 'proper.' But

while pretending to turn around and look backward, one is also in fact starting over again, adding an extra text, complicating the scene, opening up within the labyrinth a supplementary digression, which is also a false mirror that pushes the labyrinth's infinity back forever in mimed – that is, endless – speculation. It is the textual *restance* of an operation, which can be neither opposed nor reduced to the so called 'principal' body of a book (Derrida 1981a, p. 27).

For Derrida it is not possible to look at a work (i.e., a text, in Derrida's terms) without touching it. Every repetition produces a supplement, a remainder, which is outside the text/work it supposedly represents. Every attempt at 'transmission' is therefore also a self invention. The problem with 'representing' my research – this work – as a 'completed' entity, which I have attempted to do in this chapter (and which has hopelessly complicated the scene, inciting me to begin again, this being something I shall do *outside* the confines of Ph.D. research), is identical with the pedagogical problem I explore *through* the research process itself.

1.1.2 Presenting/prefacing and pedagogy

Gregory Ulmer makes the point that every pedagogical presentation, just like every reading of a text or 'work', *adds something to what it transmits* (Ulmer 1985, p. 162). Yet pedagogical practices are organised as if what is presented is a 'mere' representation. Ulmer offers the following translation of Derrida's thoughts on this (Derrida 1976a) which, to my knowledge, have not appeared in English.

Derrida's analysis of the place of pedagogy in Western thought is a corollary of his analysis of writing in general... It is necessary, he argues, to bring educational practice into line with contemporary epistemology – to help pedagogy negotiate the same paradigm shift that altered the arts and sciences at the beginning of our century, leaving pedagogy behind in the age of Hegel (Ulmer 1985, p. 163).

It is towards this aim that the current research contributes. It is focussed on 'rethinking' the epistemology of schooling taking into account the 'paradigm shifts' (Kuhn 1996/1962) that have taken place in the arts and sciences which have problematised the idea that a representation is nothing other than a repetition of what is present or presentable.

In modern Western societies it is largely *taken for granted* that the function of the school curriculum is to represent real world environments – to

'preface' them – such that school-goers know something about these 'real' world environments before they are faced with them in their 'reality.' It is assumed that by the time those being educated leave the academic institution, they will, through the 'prefacing' of these real worlds in schools, have acquired knowledge *of* these 'real' worlds and so be 'prepared' for them. This assumption about schooling (and prefacing) relies on representational theories of knowledge, which hold that knowledge is always knowledge *of* something that exists outside knowledge itself. The challenges to this representational epistemology have come from fields as diverse theoretical physics,¹ analytic philosophy,² philosophy of science,³ history of science,⁴ sociology of science⁵ and postmodern⁶ and poststructural philosophy⁷, to name but a few, which have argued again and again that the idea of a faithful correspondence between the world and our knowledge of it is insupportable and should be put to rest once and for all. The point is, *despite* these moves, a representational understanding of knowledge in its

¹ E.g., Heisenberg's work in quantum mechanics and in particular his formulation of the 'uncertainty principle'.

² E.g., Frege's analysis of the referent. Wittgenstein's later work on 'language games'.

³ E.g., Popper's conclusions about the logic of scientific discovery.

⁴ E.g., Kuhn's critique of scientific 'progress.'

⁵ E.g., Latour and Woolgar's work on the social construction of scientific facts.

⁶ E.g., Lyotard's analysis of knowledge in contemporary 'postmodern' society.

⁷ E.g., Derrida's deconstruction of the 'metaphysics of presence.'

relation with 'reality' still underpins modern Western education. Knowledge is still conceived as representing that which is present.

In the last few decades an additional challenge to representation has been posed by 'complexity theory' and it is complexity's challenge to representation that is taken up in this thesis. More specifically, the purpose of the thesis is to explore the implications, for modern Western schooling, of complexity's challenge to representation.

This research therefore takes place on the margins of *three* research fields: curriculum studies, complexity science, and epistemology. I say 'on the margins' of these research fields (rather than *within* them) because, to a certain extent, the work transgresses accepted thinking in these fields. In this sense the work can probably be described as 'transdisciplinary'⁸ (see Klein 2004). It is 'transdisciplinary' in that it not only *transits* disciplinary boundaries moving, for example, between disciplines lodged in the 'hard' sciences (complexity), the humanities (education) and the arts (epistemology) but it also *transgresses* the disciplines from which it draws.

⁸ See Appendix 1 for the Charter of the First World Congress of Transdisciplinarity held at the Convento da Arrábida in Portugal on November 2-7, 1994.

1.1.3 A note on transdisciplinarity

Nicolescu suggests that transdisciplinarity ‘concerns that which is at once between the disciplines, across the different disciplines, and beyond all discipline.’ Using a transdisciplinary approach – so Nicolescu argues – therefore propels us beyond ‘either/or’ thinking into the space that lies beyond (Nicolescu 2001, p. 44). But what lies beyond ‘disciplinarity’? What does it mean to ‘transgress’ disciplinarity? Let me first try to delineate the concept of ‘disciplinarity.’

Klein holds that standard models of disciplinarity connote stability and normality and this is portrayed by images of foundations and structure ‘and even an autonomous territorial regime.’ But she is quick to point out that disciplinarity is not as simple as this. There are also other models which focus on the dynamism, heterogeneity, and ‘the sheer complexity of disciplinarity.’ Here the images are of ‘networks and systems and webs, not foundations and structures’ (Klein 2004, pp. 4-5). To this she adds

But a discipline is not just a functional differentiation that produces a world view. A discipline is also system of power... Disciplines control not only accounts of their histories but the kinds of questions we ask and the kinds of answers that will be believed and accepted (Klein 2004, pp. 3-4).

To *transgress* disciplinarity is therefore not simply to cross 'old' disciplinary boundaries in order to create new, or more encompassing boundaries. Disciplines are *already* in the form of complex webs and networks with overlapping and/or indistinct boundaries. To *transgress* disciplinarity is to challenge the systems of control which dictate the kind of questions we can ask. According to Klein, transdisciplinarity 'contributes theoretical structures, research methods, and modes of practice *that are not located on current disciplinary or interdisciplinary maps*' (Klein 1994, p. 2, my emphasis).

The need for transdisciplinarity, according to Klein, arises from developments in knowledge and culture that are characterised by 'complexity, hybridity, non-linearity, and heterogeneity' (Klein 1994, p. 1).

In Klein's words

...transdisciplinarity, transculturalism, transnationalism have blurred and reordered older binary cultural, social, political, and epistemological distinctions and categories. As older borders and identities have weakened, the need for transdisciplinarity has become greater... (Klein 1994, pp. 3-4).

Drawing on Gibbons *et al.* (1994), Klein argues that the transdisciplinary approach operates by continuous linking and relinking of influences across a dense communication network such that new configurations of

knowledge are *continuously* generated. Interacting knowledge bodies keep changing the very structure of knowledge itself. Such processes, according to Klein (1994), are *ongoing*. As such, transdisciplinarity necessarily rejects all globalising projects, all closed systems of thought, utopian ideas, any enslavement to an ideology, religion or philosophical system. A 'genuinely transdisciplinary attitude,' according to Klein '*must therefore not establish from the very start, self-imposed borders*' (Klein 1994, p. 5, my emphasis).

Having outlined the 'transdisciplinary' impetus of the research, let me now describe the three main 'disciplines' or 'fields' around which the current research is located.

1.2 THE RESEARCH 'FIELDS'

As mentioned, the research occurs on the margins the fields of curriculum studies, complexity science and epistemology. None of these 'fields' can be described as a stable 'discipline' with a clear structure and foundation and an 'autonomous territorial regime' (Klein 2004, p. 4). Rather, each consists of a dynamic, complex, heterogenous network of ideas and knowledge which can in no sense be unified in terms of a common 'logic,' historical trajectory, or even purpose. Nevertheless, as 'disciplines,' they manage to structure the kinds of questions we can ask and the kinds of answers that are considered acceptable. In what follows, and as background to my own

research, I provide a brief account of each of the conflicted 'fields' which my research works around.

1.2.1 The 'field' of curriculum studies

According to Ian Westbury (2000), the idea of 'curriculum' as a 'field' of study that endeavours to develop 'curriculum theories' is taken up in rather different ways in different geographical areas in the 'West'. The North American tradition, which goes by the name of 'curriculum studies,' has grown out of a practice of 'curriculum development' which has drawn heavily on John Dewey's progressivism and more recently also on psychology and other social sciences to justify its aims and methods (Kalantzis and Cope 1993). In this regard it focussed instrumentally on the needs of the individual learner and on how to achieve given goals. The European counterpart to 'curriculum studies,' known as 'Didaktik'⁹ in Germany and other north European (Scandinavian) countries (see for example Gudem and Hopmann 1998), on the other hand, adopted a more normative approach that sought to create an overall attitude or approach to teaching, a set of norms that prescribe how professional teachers should conduct themselves rather than prescribing the content and method of

⁹ I use the German spelling – Didaktik – to differentiate this word from the English word 'didactic' which has a different collection of meanings.

teaching. In short, Didaktik is a teacher-focused, philosophically and historically grounded activity while its (traditional) American counterpart was a student focused (individualistic), and scientifically grounded activity (Westbury 2000).

Interestingly, although there is currently some dialogue between the American and European curriculum traditions (see for example Gudem and Hopmann 1998; Westbury, Hopmann and Riquarts 2000) neither of these theoretical traditions, as Reid (1997) points out, has ever exercised any significant influence in England. Reid argues that England has not even adopted a 'third' tradition.

For a curricular tradition England has substituted a multiplicity of traditions of subject teaching, under the banner of Method, which for the most part have been only marginally and incidentally concerned with purposes or principles fundamental to the overall enterprise of education.... Method is knowledge about subjects, and, within its purview, *broadly curricular arguments about purpose or practice tend to fall on stony ground* (Reid 1997, p. 679, emphasis added).

In England the emphasis on subject matter is at the expense of the more theoretical curriculum questions to the extent that the diversity of work that could be called curriculum work is seldom classified under the label of 'curriculum studies' nor is it explicitly delineated as a university

programme, or 'special interest group' or division in the annual conference of the British Educational Research Association (BERA). Instead, when such work is carried out it is under a different banner (e.g., philosophy of education, sociology of education). In the US and Canada the situation is quite different, with 'curriculum studies' being considered a distinct, if broad, field of research. As a legitimate 'field of study' it is conspicuous in many North American university programmes and also has a division of its own in the annual research conference of the American Educational Research Association (AERA). However, despite the seeming 'coherence' of the North American field, it is also described as 'fragmented.' In their comprehensive thousand-page analysis of the contemporary field, Pinar, Reynolds, Slattery and Taubman (1995) describe it as comprising phenomenological, feminist, psychoanalytic, poststructural, postmodern, hermeneutic, historical, action and advocacy-orientated, aesthetic and institutional perspectives, among others, which resist any unification. More recently Miller has remarked that

any singular prescription for what counts as curriculum studies, what counts as the field, what counts as the relationship and location of theory to practice, founders on the situated diversity of our work and lives. It is obvious that there is no one field, no one fixed, coherent, and shared version of what our work in curriculum studies should be (Miller 2000, p. 259).

It is mainly the curriculum discourses within the 'institutional perspective' of the North American curriculum field that the current research addresses. This area of curriculum research is concerned with what actually goes on or, at least with what 'should' go on in schools. In contrast some of the other North American curriculum discourses, according to Pinar *et al.*, are moving *away* from school concerns 'towards exploration of concepts indigenous to curriculum, *independent of institutional agendas*' (Pinar *et al.* 1995, p. 853, emphasis added).

Within the 'institutional perspective' there is fierce curricular debate around the notion of 'school reform.' Again and again curricularists have expressed their dissatisfaction with the failure of various school reform movements to improve the quality of teaching or learning in public education (for two opposing perspectives on this, see Ravitch 2000, and Kohn 1999). The debate is generally framed as a choice between

- (i) desiccated 'teacher-centred' schooling practices where children are forced to imbibe decontextualised facts, OR 'mindless' child-centred practices where both the position of the teacher and the content of the curriculum are marginalised (see Kohn 1999) or
- (ii) elitist 'liberal' curricular practices which are focused on the Western canon – i.e., the 'academic curriculum' – and aim to pass it down as a

‘received truth’ OR democratic ‘progressive’ curricular practices which ‘set aside’ the canon as antiquated or oppressive, the remnant of outmoded aristocratic values and beliefs (see Ravitch 2000, Silberman 2002).

The entire debate, so Gibbons (1994) suggests, is structured around a rhetoric of ‘mastery learning’ which is underpinned by technocratic, behaviorist, and reductionistic premises. My work touches on (and ultimately brings into question) this debate through an exploration of the representational foundations of its logic.

1.2.2 The ‘field’ of epistemology

According to most general or introductory texts on the topic (e.g., Greco 1998, Newman 2000, Ross 1998), epistemology as a separate discipline within philosophy is said to have emerged with Descartes’ *Meditations on First Philosophy*. Prior to Descartes, and ever since the ancient Greeks, ‘first philosophy’ was metaphysics. Thus the first question for philosophy to answer was about what is real. That decided, everything else could be done. With Descartes, however, questions about knowledge become prioritised. If there are problems about what we can know, then we may not even be able to know what is real. But if questions about knowledge must be settled first, then this establishes *epistemological priority* for philosophy. Indeed, this

leads to the creation of the Theory of Knowledge, Epistemology, as a separate discipline within philosophy for the first time. Modern philosophy has therefore been driven by questions about *knowledge* and so epistemology has therefore been thought of as the 'first philosophy' (i.e., before metaphysics).

Modern epistemology is almost wholly dominated by Descartes' mind-world scheme (which separates knowledge in our minds from the objects of our knowledge) and is largely concerned with questions about the relationship between knowledge and the objects of our knowledge (Newman 2000). Epistemological questions are therefore premised on the assumption that knowledge 'stands for' something that is not itself. Knowledge, in other words, is representational. The central importance of the notion of representation in modern epistemology should not be underestimated. The 'field' is concerned with every conceivable question about whether, why or how knowledge can represent something else and with the accuracy of the representation (Rorty 1979). This means it is 'only with a justified sense of artificiality' (Dancy 1992, p. xiv) that modern epistemology can be separated from other philosophical fields like the philosophy of mind (mental representations), the philosophy of science (scientific representations) and metaphysics (the object of representation). Because representation is the guiding logic behind all modern

epistemological theorising, modern epistemologies, can all be understood as *representational* epistemologies. They are all guided by the idea that knowledge 'stands for' or corresponds to (i.e., represents) something that is not itself.

In the last century, however, Cartesian epistemology has been faced with a challenge. A critique of representation emanating from linguistics (e.g., de Saussure 1916), pragmatism (e.g., Dewey 1981/1925) and the philosophy of language (e.g., Wittgenstein 1953) which takes issue with the dualistic logic of representation, has put into question the dualistic (Cartesian) logic upon which modern epistemologies rely. If epistemology can no longer be driven by (dualistic) representational logic, such that we can have knowledge of that which exists *outside* knowledge, then what constitutes epistemology? What is its 'object'? Does the notion of an 'object' of epistemology even make sense? In this regard there have been, in the last three decades, pronouncements about the 'death of epistemology' (see in particular Rorty 1979). What these pronouncements seem to be suggesting is not the end of epistemology *as such*, but the end of modern epistemology, the end of representational (Cartesian) epistemology in all its forms (and perhaps the birth of a 'postmodern epistemology'). It is here that my own work can be located, i.e., it is concerned with the 'death' of representational

epistemology and so transgresses the boundaries of traditional (Cartesian) epistemology.

1.2.3 *The 'field' of complexity science*

In the last two decades a multidisciplinary area of investigation has emerged that has come to be known as 'complexity science' or even more broadly 'complexity studies.' In trying to describe the 'field', a useful way forward is provided by Richardson and Cilliers (2001). In their editorial to a special issue of *Emergence*, focussing on the question 'What is complexity science?' they respond by providing 'a view from different directions,' suggesting that one (simple) way of thinking about the field is in terms of three broad 'schools of thought', these being

- 'hard' or 'reductionistic' complexity science – an approach that is concerned with understanding the mechanics of complexity. In other words it is concerned with *the nature of reality*.
- 'soft' complexity science – an approach that uses insights from hard complexity science as metaphors to describe, explain¹⁰ or understand

¹⁰ A distinction between descriptive and explanative causality is made in Chapter 5. It is argued that a description is not an explanation, in the sense that reductive explanations are explanations.

complex social interactions. One could say this approach uses complexity as *a way of seeing the world*.

- ‘complexity thinking’ – an approach that is concerned with the epistemological or ‘philosophical’ implications of assuming a complex universe. It represents *a way of thinking and acting*.

Richardson and Cilliers do, however, admit this classification ‘conveys a neatness that is really rather illusory’ (ibid., p. 8) as these three ‘schools of thought’ are highly intertwined. Changes in perspective always come with different ways of acting, thinking, seeing, relating and working and so any attempt to define the ‘boundaries’ of these ‘schools of thought’ creates caricatures that cannot do justice to the ‘school of thought’ in question. Moreover, even ‘within’ each of these schools of thought there are deep conflicts and disagreements about what constitutes the nature of complexity. In what follows I provide a very brief review of the above three ‘schools’ of thought, making mention of their internal contradictions and inconsistencies.

First, let me deal with the ‘hard’ approach. This area of research now spans almost all areas of science, to the extent that the idea of a ‘complexity science’ that is something *different* from what is going on in science *itself* is a misnomer. Although there is a research institute – the Santa Fe Institute –

which is devoted to the study of 'complexity science' as a discipline in and of itself, many scientists now work within this paradigm and were doing so long before the advent of 'complexity science' itself. Quantum mechanics, for example, which originated in the first half of the twentieth century, operates by means of what could be called a complex systems approach. Complexity is a way of scientific thinking which has moved beyond traditional 'reductionist' or 'mechanistic' understandings of the universe. What seems to be emerging in science is a new 'organic' (as opposed to 'mechanistic') worldview (Dent 1999). Nevertheless, despite the seeming coherence of a 'new worldview' there is no agreement in the 'scientific community' over what constitutes complexity and whether the organic metaphor constitutes a *shift* in scientific thinking.

The 'soft' or metaphorical approach in complexity science is used largely to 'understand' social interaction. In most cases, the language and insights of 'hard' complexity science are used as *analogies* or *metaphors* to draw attention to certain features of complex social phenomena that were not visible before. Thus, behaviours such as nonlinearity, recursiveness, self-organisation, emergence and a host of others, are brought into focus and given meaning in many different areas of investigation. Since the metaphors are largely organic (rather than mechanistic), these provide a conceptual framework that enables researchers to deal with themes such as

connectedness, participation, uncertainty, diversity and instability, all issues which linear (mechanistic) conceptions of the world were less able to deal with.

The steadily increasing number of serious academic studies that draw links between complexity and broad topics such as social science (Byrne 1998, Kiel and Elliot 1997, Vallacher and Nowak 1994), sociology (Eve, Horsfall and Lee 1997), social psychology (Vallacher and Nowak 1997) and education (Badenhorst 1998, Davis, Sumara and Luce-Kapler 2000, Doll 1993) attests to the utility and/or thought-provoking potential of this approach. However, useful as the metaphorical approach may be in 'broadening vision,' it is also criticised for being both *limited* and *limiting*.

There are those who contend the approach is *limited* because the generic features of physical, chemical and biological complex systems, so they claim, are also features of complex *social* systems. Maguire and McKelvey (1999), for example, argue that social phenomena are complex systems *in their own right* and can therefore be studied in the same way as any other complex systems. They would therefore like to see the metaphorical approach moved to a more 'rigorous' (i.e., mathematical or computational) base (Maguire and McKelvey 1999, McKelvey 1999). In this regard Goldspink (2000, 2002) suggests that the application of computer simulation

to social research can result in the development of a social theory consistent with a complexity perspective, following which a research programme can then be implemented to explore its validity. Such arguments suggest the complexity metaphor can be used not simply to *describe* complex social systems but also to *explain* them. Complexity is then seen as the new 'paradigm' by means of which the social sciences can (at last) be brought under the umbrella of the 'rigorous' (hard) sciences. Everything is now explainable in terms of the logic of complex dynamic systems (for this kind of view see, in particular, Kelly 1995 and Capra 1996).

Although complexity science *does* offer a new and exciting lens for engaging with social complexity, it has also been argued that applying complexity to social systems is deeply *limiting*. Steven Best and Douglas Kellner, for example, have argued that applying the organic metaphors of complexity to social systems is 'exceedingly risky, for one can easily lose sight of the enormous differences between biological and social systems' (Best and Kellner 1999, p. 153). Most importantly we lose sight of the fact that the social world is constituted through language and meaning and is therefore a political world. When the language of complexity is used to 'see' the world this doesn't simply 'enhance' our understanding of the world, but forces us to see the world *in a particular way* and can therefore be used to reinforce and validate a particular way of thinking. Best and Kellner therefore argue

that complexity '*like any scientific theory...* can be deployed for different political purposes' (ibid., p. 154, my emphasis) and that 'the totalising application of systems theory and complexity theory... is epidemic in the genre' (ibid., p. 155). I believe however that Best and Kellner's critique of complexity in the social sciences is possible only because of something that it has in common with both the metaphorical *and* the 'hard' approach to complexity. The assumption that complexity science is inevitably *quantitative* in disposition (see also Van Uden, Richardson and Cilliers, 2001).

Those seeking to use complexity in a purely metaphorical sense are specifically concerned with *not* applying it in its quantitative mathematical sense, while proponents of the harder approach, such as McKelvey, want to see 'a systematic agenda linking theory development with mathematical... model development' (McKelvey 1999, p. 24). Best and Kellner assume that complexity is 'like any scientific theory...' i.e., it is *quantitative* in nature. It is precisely this quality of scientific theories that enables their 'deploy[ment] for different political purposes' (Best and Kellner 1999, p. 154).

The assumption that complexity theory is inevitably quantitative in disposition is incorrect, however. Granted, the quantitative approach *is* the one used by the majority of 'hard' complexity scientists who are trying to

understand the 'nature' of a wide variety of seemingly dissimilar complex systems. However, in spite of this focus on quantitative approaches to understanding complex systems, it must be stressed that even within 'hard' complexity science it is acknowledged that complex systems *resist* precise mathematical formulation (Auyang 1998, Oreskes, Shrader-Frechette and Belitz 1994, Prigogine 1997, Prigogine and Nicolis 1977). This aspect of complexity *is* acknowledged by some researchers working with complexity in the social sciences. Byrne (1998) for example, in his book *Complexity Theory and the Social Sciences*, comments

It is worth noting that in a handbook written for doctoral students in physics and chemistry, Nicolis remarks on the impossibility of a full quantitative understanding of complex phenomena and the consequent requirement to turn to qualitative approaches (Byrne 1998, p. 7).

Interestingly, however, although this aspect of complexity is acknowledged, what seems to have been largely ignored is the fact that the irreducibility of complex systems to a precise quantitative description means it *cannot* be used 'like any scientific theory' (Best and Kellner 1999, p. 154). It is here that 'complexity thinking' – the third approach in Richardson and Cilliers's classification of the 'field' of complexity science (Richardson and Cilliers 2001) – makes an entry.

Using as a base the understandings of complex systems that have been developed by the 'hard' complexity science approach, Richardson and Cilliers, together and independently, have begun working out the epistemological implications of complexity and developed an epistemology which they call 'complexity thinking.' This epistemology is largely inspired by the idea that complex systems are 'relational' systems which means the information which 'characterises' them is in the relationships between the parts not the parts themselves. This means complex systems cannot be understood by taking them apart. They cannot be reduced, and therefore they cannot be *represented* (representation being a means of reduction). This conclusion, of course, brings into question much of the work carried out at the Santa Fe Institute which, for the most part, is explicitly concerned with modelling or representing complexity. Understandably this has generated a considerable amount of polemic around the status of scientific knowledge of complex systems (see for example Cilliers 2000a, 2000b, 2002, Horgan 1995). It is on the edges of this debate about the epistemological status of models of complex systems – i.e. the domain of 'complexity thinking' that my own work takes place.

1.2.4 *Positioning the research*

In this section I have shown that my research takes place on the edges of three debates that are located in the fields of curriculum studies, epistemology and complexity science. The first debate is about curriculum reform. The question driving this debate is what kind of knowledge should be represented in the curriculum and how. The second debate is about the status of representational knowledge. This debate is driven by the question of how to make sense of the notion of knowledge when representational logic is brought into question. The third debate is about the epistemological status of complexity. Here the central question is what the unrepresentability of complexity means for epistemology.

1.3 THE RESEARCH FOCUS

1.3.1 *The argument and the research questions*

From a position on the edge of three broad fields of study – as outlined in the previous section – I argue, in this research, that the endless curricular debate about *what* to present in the curriculum and *how* to present it relies on assumptions about knowledge that are driven by representational logic. It is assumed that knowledge stands for ‘something’ that exists in and of itself, somewhere ‘outside’ of knowledge and that the purpose of the curriculum is to ensure that the student acquires knowledge *of* this

‘something.’ But if representational epistemology is brought into question – which means the idea that we can have knowledge *of* something that exists in and of itself is brought into question – then the whole debate about what students should have knowledge *of* and how best to facilitate their getting to know it, is unfounded. This, in turn, suggests there is a need to ‘rethink’ the epistemology of schooling. Three broad questions that arise from this suggestion are:

- (i) What might take the place of the representational epistemology of schooling?
- (ii) What would be the ‘shape’ or ‘geography’ of a schooling practice that is *not* premised on representational epistemology?
- (iii) Is complexity helpful for addressing either of these questions?

1.3.2 *Significance of the research*

My research shows that complexity *is* helpful for addressing questions (i) and (ii) above, because it provides a way of understanding the relationship between the world and knowledge which is not a *representational* relationship. For this reason the ‘epistemology’ of complexity has far reaching implications for practices of schooling that, for the main part, are based on conventional representational epistemology.

1.3.3 Contributions to the literature

There are at least five areas of this research which make an original contribution to the literature.

The first contribution lies in the way in which I have theorised the 'epistemology of complexity.' Those working in the area of 'complexity thinking' – who are concerned with the epistemological implications of complexity – have focussed mainly on the *relationality* of complex systems. In treating complex systems as 'relational entities' I believe the epistemologies they outline are structuralist¹¹ epistemologies (and therefore still underpinned by representational or Cartesian epistemology). I have taken this further and focussed also on the temporality of complexity. In doing this it has been possible to show that complexity cannot be understood as an 'entity' (even a relational one). This leads to a poststructuralist 'epistemology' (which is not an 'epistemology' in the Cartesian sense of the word). In this sense my work moves the 'complexity thinking' approach from the structuralist to the poststructuralist mode.

A second contribution lies in the way I have translated Prigogine's 'microscopic theory of irreversibility' (Prigogine and Stengers 1984, p. 310) into a theory of 'strong' emergence. This entirely novel approach to

¹¹ I discuss the difference between 'structuralist' and 'poststructuralist' positions in Section 1.4 .

Prigogine's work brings out the radically antifoundational logic that is evident in his work. By outlining the logic of 'strong' emergence, my work opens the possibility to explore the links between an 'emergentist epistemology' on the one hand and a 'deconstructionist epistemology' on the other. It also opens the possibility to explore links between an 'emergentist/deconstructionist epistemology' and the 'science of the infinitely small' (as the quantum universe is) which also cannot rely on a logic of 'presence.' The logic of 'strong' emergence is therefore an extremely useful link between 'science' and 'deconstruction.'

Third, my work makes an original contribution in linking two big debates in curriculum and educational theory. The debate about the implications for schooling of the loss of representational theories of *knowledge* and *signification* on the one hand and the loss of representational theories of *the human subject* on the other. My work shows that the obdurate problem of representation in modern Western schooling is *not directly* linked to representational understandings of knowledge and signification (although these, of course, are important), but to an understanding of *human subjectivity* that is driven by this logic. It is only once our understanding of *human subjectivity* is dissociated from this logic, that it becomes possible to no longer understand the school as reproducing *in* the student something (some form of knowledge) that is already present.

Fourth, my work makes clear that (and how) complexity science offers a 'way out' of the current impasse between traditional and progressive conceptions of schooling. It shows how complexity provides an alternative which takes place outside the logic that drives this long standing debate.

Finally, from the broad description of my research provided in Section 1.3.2, I hope to have made it clear that at no time is this work concerned with the 'soft' or metaphorical approach in complexity science which uses the insights generated by the hard approach to describe, explain or understand complex social interactions (such as those which take place in education). I am not concerned, in other words, with schooling as a 'complex' object which is 'there' to be observed, described, explained, understood *in itself*. I am using complexity, rather, to theorise education *from a different epistemological and semiotic base*, one inspired by complexity. To put this more plainly, I use complexity (actually 'strong' emergence) as a metaphor for knowledge rather than using it as a metaphor for the *objects* of knowledge. The resultant 'epistemology' cannot entertain the idea of a 'thing' that exists 'in itself' and so cannot 'understand' education (or any other complex social processes) as an 'object' of knowledge. When applied to knowledge the complexity metaphor suggests that there cannot be 'objects' of 'knowledge.' With this distinction my work introduces a radical shift in focus for research that is concerned with

the implications of complexity for educational theory. To my knowledge, this genre of research (complexity and educational research) remains in the structuralist mode where the objective of the research is to describe, explain or understand the 'complexity' of the complex social systems that constitute education and schooling (Davis, Sumara and Thomas 1996, Davis and Sumara 1997, 2001, 2004, Davis, Sumara and Luce-Kapler 2000, Doll 1993, Fullan 1999, 2001, Sumara and Davis 1997).

1.4 THE RESEARCH 'METHODOLOGY'

The term 'methodology' usually refers to the *general approach* to research, while method refers to more *precise techniques* for gathering data (Harding 1987, p. 2) but there is no universal agreement as to what researchers mean by methodology. Noel Gough offers the following etymology and explanation of the term:

The word 'methodology' is derived from the Greek words *metá* (with, after). *Hódos* (the way) – sometimes combined as *méthodos* (a following after) – and *lógos* (reason, account, reckoning). Thus, etymologically speaking, research methodology is the reasoning that informs particular ways of doing research, or the principles that inform its organisation. Some researchers refer to their methodology as a *conceptual framework* or the *assumptions* that guide their research (Gough 2002, p. 4, italics original).

Therefore methodology can be loosely understood as the rationale for the way the research has proceeded. Of course the reasons one does what one does in one's research also depend upon and determine the type of research one does which in turn depends upon what one believes qualifies as 'research.' According to Gough, research includes 'any means by which a discipline or art develops, tests, and renews itself' (Gough 2002, p. 2). In this regard Gough suggests that 'research' is 'anything that people who call themselves researchers actually do that is recognised by their peers as research' (ibid.). One of the problems with such a statement is that it assumes that a particular 'body of research' has a 'peer group.' This is not always the case, particularly with transdisciplinary research – such as this research – where the boundaries of the research are not just 'poorly' defined but transgressed. There is a lack of available criteria to assess transdisciplinary research on its own terms. It is not only that it cannot be judged by *particular* disciplinary standards, but that it cannot be judged by *disciplinary* standards *per se* (Klein 1996, p. 210). It is not disciplinary. This poses a problem for examiners which I cannot erase but which I can attempt to ease by providing as clear an account as possible as to why I did what I did.

1.4.1 The methodological approach

Gathering material for this exploration has meant casting my net wide, into the arena of poststructuralist scholarship, complexity science, epistemology,

curriculum and educational theory as well as talking to a range of people whose lives in some way intersected with my research. My 'methodology' (if one exists) has emerged *from* my engagement with these people and discourses and was not in place *before* the research began. It was not 'there' in its totality, to guide my actions from the beginning. Nevertheless this does not mean this research is not methodologically organised. In what follows I describe a 'methodological' basis for my work (which, strictly speaking, is a 'nonmethodological' basis, and in this sense perhaps not a 'basis' at all) and situate it amongst other methodological approaches.

As the research proceeded a 'methodology' emerged (together with the research 'focus' which also became more clear as the research proceeded). This 'methodology' fits into a category which Patti Lather calls 'post-paradigmatic diaspora'¹² (Lather 1991, p. 7) With this name she aims to unsettle the whole idea of a 'paradigm' as a system of methodological rules which structure the kinds of research that can (legitimately) be done. As such, the name also unsettles the Kuhnian notion of a 'paradigm shift.'

¹² Lather attributes this term to John Caputo (Lather 1991, p. 7, 108).

Kuhnian frameworks de-emphasize the political content of theories and methodologies and deny the dissolving of the world as structured by referential notions of language. They also diminish the play of multiple emergent knowledges vying for legitimacy. Caught up in a representational logic, they search for codifications and standards instead of asking if something more fundamental than a 'paradigm shift' in the academy might be going on (Lather 1991, p. 107).

The 'post paradigmatic diaspora' are not unitary, guided by a 'paradigmatic' system of methodological rules, but have been 'scattered,' drawing on many influences and speaking in many 'voices' (methodologies). Although it is not possible to describe the 'post paradigmatic diaspora,' by combining the work of Lather (1991) and Guba and Lincoln (1998) it is possible to shed light on its 'dispossessed' nature of by relating it to other methodological and paradigmatic approaches.

Broadly speaking, methodological approaches can be separated into three categories: empirical, interpretive and critical. The first is guided by a 'positivist' paradigm,¹³ while the latter two are 'postpositivist.'¹⁴ However, in relation to the 'post paradigmatic diaspora,' all three methodologies can be categorised as 'structuralist' by virtue of the fact that they rely on a

¹³ Grounded in empirical certainty.

¹⁴ Pertaining to the fallibilistic epistemological assumptions.

system of methodological rules, a structure. The ‘post paradigmatic diaspora,’ because they are not guided by a system of methodological rules – a legitimating structure or paradigm – can be called ‘poststructuralist’ (see Table 1).

Table 1

A classification of different methodologies and paradigms

	<i>Methodology</i>	<i>Research aims</i>	<i>Paradigm</i>
<i>Structuralist</i>	Empirical	Predict, explain, uncover ‘truths’	Positivist
	Interpretive	Understand, describe	
	Critical	Emancipate, empower	Postpositivist
<i>Poststructuralist</i>	‘Post-paradigmatic diaspora’	Deconstruct ‘truths,’ open up thought	

(Adapted from Lather 1991, p. 7, Guba and Lincoln 1998, p. 203)

The structuralist methodologies (in the unshaded part of Table 1) all have well defined principles (a self-contained ‘structure’) and, as such, adhere to fairly precise methods for ‘gathering data’ (e.g., the scientific method, phenomenology, hermeneutics, grounded theory, critical theory, discourse analysis, etc). These methods for ‘gathering data’ may be either quantitative (i.e., empirical) or qualitative (i.e., historical, descriptive, interpretive etc.) strategies, but whatever the case, structuralist methodologies aim to *improve*

on already existing understandings. In this sense structuralist approaches use 'methods' and 'methodologies' to *guide* understanding *to a point of closure*.

In contrast, the poststructuralist 'approach' (in the shaded portion of Table 1) is fundamentally different from all the others in that it does not seek to improve on already existing understandings (structures) but seeks, rather, to *unsettle* pre-existing understandings (structures), and thereby open new ways of thinking and being (i.e., open new 'structures' of thought). The idea of 'opening up' new ways of thinking presents a real challenge to the idea of 'research methodology' for it is an approach which wants to challenge pre-existing standards of thinking. It wants to challenge the idea of methodology as *guidance* for thought. The idea of 'poststructuralist methodology' is therefore a contradiction in terms. This, no doubt, contributes to the fact that the 'poststructuralist style' is often ignored or given cursory mention by methodological theorists (see, for example, Keeves 1997; Walker and Evers 1997; Lincoln and Guba 1984, Denzin and Lincoln 1998). Perhaps one could go so far as to say the poststructural approach is a 'non-methodological' or 'post-methodological' approach. Lather's methodological treatment of poststructuralism is one of the few exceptions that include poststructuralism into discussions about research methodology. For Lather, the one thing that seems to give this approach a substance of sorts – not as something in its own right but as something which counters other

methodological approaches – is its aim to move thought to some place else, to unsettle and ‘rethink’ pre-existing structures of thinking, i.e., to *deconstruct*. Since all thought is structured in some way Lather describes the poststructuralist style of research as ‘thinking and doing otherwise’ (Lather 2003, p. 267). Britzman calls this mode of thinking an ‘impertinent performance: an interest in thinking against the thought of one’s conceptual foundations’ (Britzman 1995, p. 55).

In the current research I have tried to ‘rethink’ the idea of schooling without the one notion that seems absolutely central to schooling: the idea that schooling disseminates (cognitive and/or bodily) knowledge about (pre-existing) structures. Because it is attempting to ‘think schooling differently’ the style of this research could be called poststructural (at least by Lather’s standard). I would like to stress, however, that the aim of thinking schooling differently did not pre-exist (and therefore guide) the research itself. It emerged *together with the research content itself*. If anything, this simultaneous emergence of aim, ‘methodology’ and content is what ‘characterises’ the ‘road’ or ‘way’ (*hódos*) that was ‘taken’ (*méthodos*) in this research endeavour. By this I mean the road that was taken was not there in advance, it was not something to be followed, and also, it is not something which has *now* been made or ‘laid down in walking’ (Varela 1997) and which therefore now ‘exists’ as some concrete entity which can be traced

backwards to explain what 'really' happened. As such, the 'road taken' is not a road in any ordinary sense of the word. It is an 'appearing and disappearing road' or perhaps a 'space' which continually opens up at the same time as closing behind itself. In this sense I would like to suggest the research itself 'emerged' (and is continuing to emerge) and, as such, can only be described from the logic of the temporary 'space' in which it now exists. My understanding of its structure, its rationale, its methodology, is an understanding which is appropriate only to this current and very temporary space and is always already moving into another space of logic.

For the purposes of convention, I have attempted, below, to freeze this logic as it appears to me now, *as if* the road taken can be retraced. In what follows I provide a reconstruction of the progression of the research, as it would appear if the path taken could be fixed, as in a sequence of snapshots taken over a period of time, and from this sequence a pattern 'worked out' which would be the 'real' story about what happened. The 'real' story about an *immutable* past. While I believe such stories are possible, and perhaps even helpful to examiners of Ph.D dissertations, I do not believe they should be announced as 'accurate' descriptions of what really happened, nor even subjective (biased) renderings of what really happened (which someone else could prove were more or less 'accurate'). To assume a story can be judged more or less 'accurate' assumes an immutable past – a

'real' past – which the story can be measured against for its accuracy. I do not wish my 'story' to be judged according to measures of accuracy against what 'really' happened. I present it only as a reconstruction of the past *from the perspective of the present* by means of which the logic of my argument, as it currently stands, can be understood. My reconstruction of the history of this research, from the perspective of the present, is shown in Figures 1.1 – 1.5.

1.4.2 *The road taken*

The project 'began' with questions about 'creativity' and 'invention.' In particular, it opened with the proposal that creative and inventive individuals are, for the most part, 'autodidacts,' these being people 'who wish to learn for and by themselves' (Solomon 2003, p. 4). An initial one-day seminar on 'Autodidactism and Creativity in Learning' – hosted by 'The Epistemology Group'¹⁵ at the Royal Society of Arts in London on 31st October 2000 – served as a guide as to the kind of research questions that might be asked. These questions were framed in terms of 'self-teaching' and 'self-learning.'

¹⁵ 'The Epistemology Group' also provided generous sponsorship for the current project.

A preliminary exploration into the concept of 'autodidactism' revealed a paradox and this led quickly to my 'discovery' of poststructural critiques of 'autonomy' and other conceptual schemes in which themes of relatedness (as opposed to isolation and autonomy) were emphasised. These alternative 'relational' schemes seemed somehow to 'dissolve' the whole idea of 'autodidactism.' At this early stage my interest in exploring 'autodidactism' *as such* was replaced with an interest in exploring the kinds of conceptual schemes which made a notion like autodidactism seem possible or impossible. Poststructuralism therefore suggested itself as a possible conceptual framework for the research at an early stage, as did other 'network' approaches such as complexity science and Actor-Network theory. Under pressure to 'begin the research' and in line with the positioning of this research in a Faculty of Science I chose a science-based network approach for my theoretical framework – complexity science – and proceeded to explore its potential as Stage 1 of my research 'proper' (see Figure 1.1).

This deep engagement with a network approach (Stage 1 of the research) opened big questions about the (im)possibility of representing (and therefore having knowledge of) structures which are highly interconnected. This 'discovery' brought into view my previous assumptions about knowledge and strongly challenged them. It became evident that before

proceeding with any exploration into teaching and learning (which is very much about *knowledge*) it was first necessary for me to address my epistemological assumptions in a more rigorous way and work out where I stood, epistemologically speaking, having engaged with a network approach like complexity. In particular I felt it necessary to ‘understand’ and then explore alternatives to ‘representational epistemology.’ This initiated Stage 2 of the research: a deeper exploration into the logic of representational epistemology.

My engagement with the epistemological issues surrounding the notion of representation (Stage 2) led, of course, to a deeper understanding of the semiotic issues around the notion of representation and a sharpening of my own epistemological position. However it also led me to the realisation that my prior exploration of complexity (Stage 1) had facilitated a different understanding of representation and knowledge which could be further developed. This suggested that instead of moving back to educational issues *at this point* the next logical step would be to *first* make use of my work on complexity, representation and epistemology to develop more sharply the idea of an ‘epistemology of complexity’ which could *then* be used in my analysis of educational issues. The development of the ‘epistemology of complexity’ therefore became Stage 3 of the research.

In deciding to go forward with developing an 'epistemology of complexity,' the possible structure and purpose of the research also suggested itself. It became evident, at this point, that once an 'epistemology of complexity' had been formulated, the research would be well positioned to address issues about the epistemology of education and schooling. The decision to develop an epistemology of complexity therefore also – at the same time – prompted a decision to focus the research on 'rethinking the epistemology of schooling' and this eventually became the subtitle of the thesis (see Figure 1.2). In developing an 'epistemology of complexity' (Stage 3) it became clear that complexity challenged more than mere 'representational logic.' It also challenged the logic of presence and, as such, this positioned the research quite closely to deconstruction. The 'epistemology of complexity' turns out to rely on a logic of *emergence* which in many ways can be equated with the logic of *deconstruction*. This logic is fundamentally different from a logic of 'representation' or 'reproduction.' It offers in place of reproductive logic, a logic which is fundamentally 'inventionalist' and 'creative.' In a roundabout way, this also brought the research back to the original question of 'invention' and 'creativity' although the notion of 'autodidactism,' by this point, had long since been dropped.

Having realised the extent of the schism between the 'epistemology of complexity' and other (representational) epistemologies, it became evident

that the 'epistemology of complexity' posed a serious challenge to modern Western schooling, which is largely underpinned by the logic of representation. This necessitated a thorough exploration of the representational foundations of modern Western schooling, and hence Stage 4 was embarked upon, which is largely an historical account of the emergence of representational schooling practices.

Having outlined the representational foundations of schooling it then became possible to begin Stage 5 of the research, the purpose of which was to show how the 'epistemology of complexity' – or more accurately the 'logic of emergence/deconstruction' – fundamentally challenges the representational 'foundations' of modern Western schooling and in particular the notion of curriculum as a predetermined course to be followed.

With the completion of Stage 5 all the material required for the argument had been 'collected.' These pieces of writing were, however, not linked in the form of an argument. This was initiated in Stage 6 of the research. Here the individual 'stories' in each of the chapters were woven together in the overall argument during which time the introductory and concluding chapters were also added. This produced an overall 'logic' which had not been present during the initial writing stages. The emergent order in which

each of the themes explored in Stages 1-6 expanded on each other is depicted in Figure 1.1.

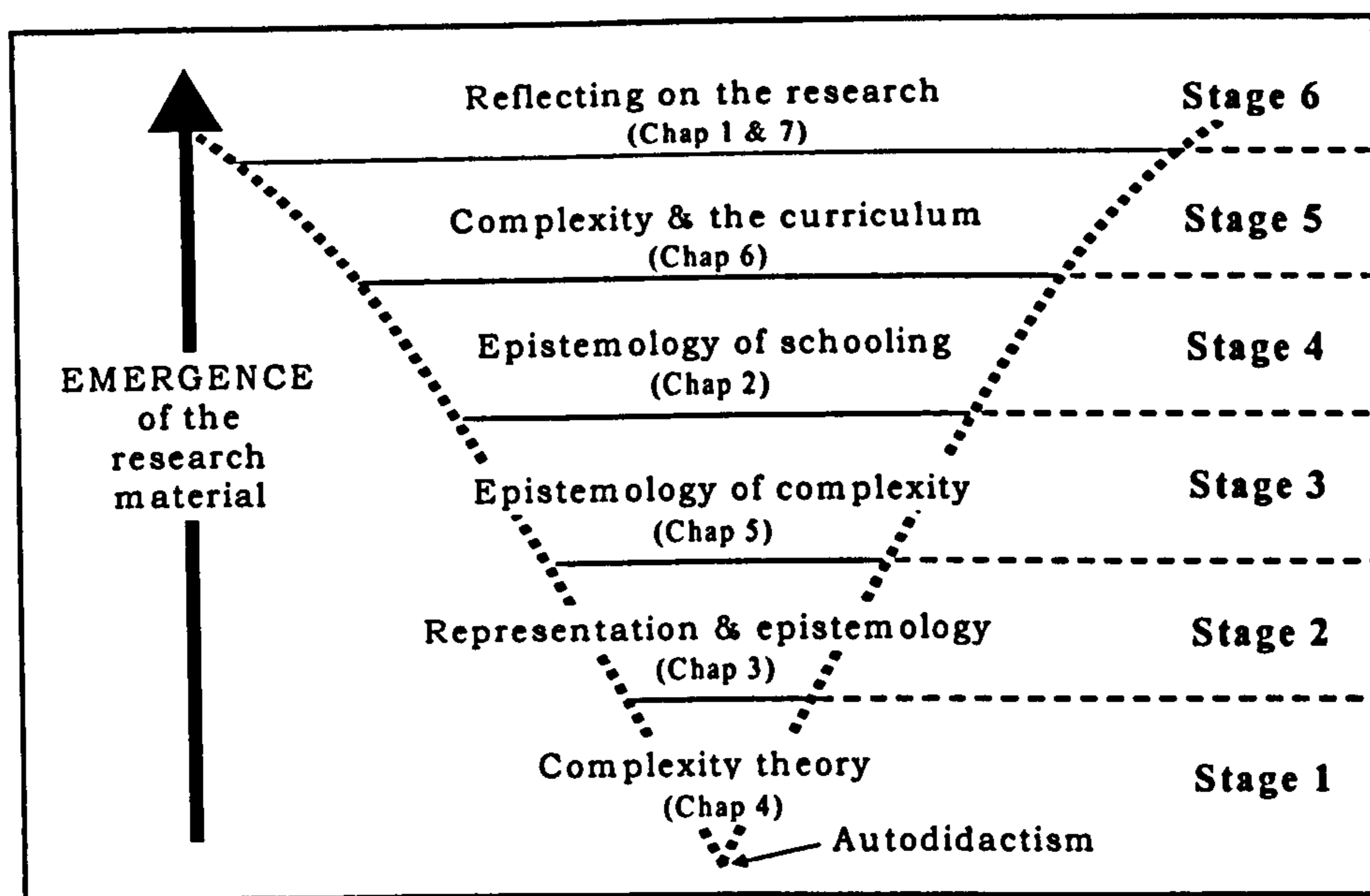


Figure 1.1

The sequence of emergence of the content

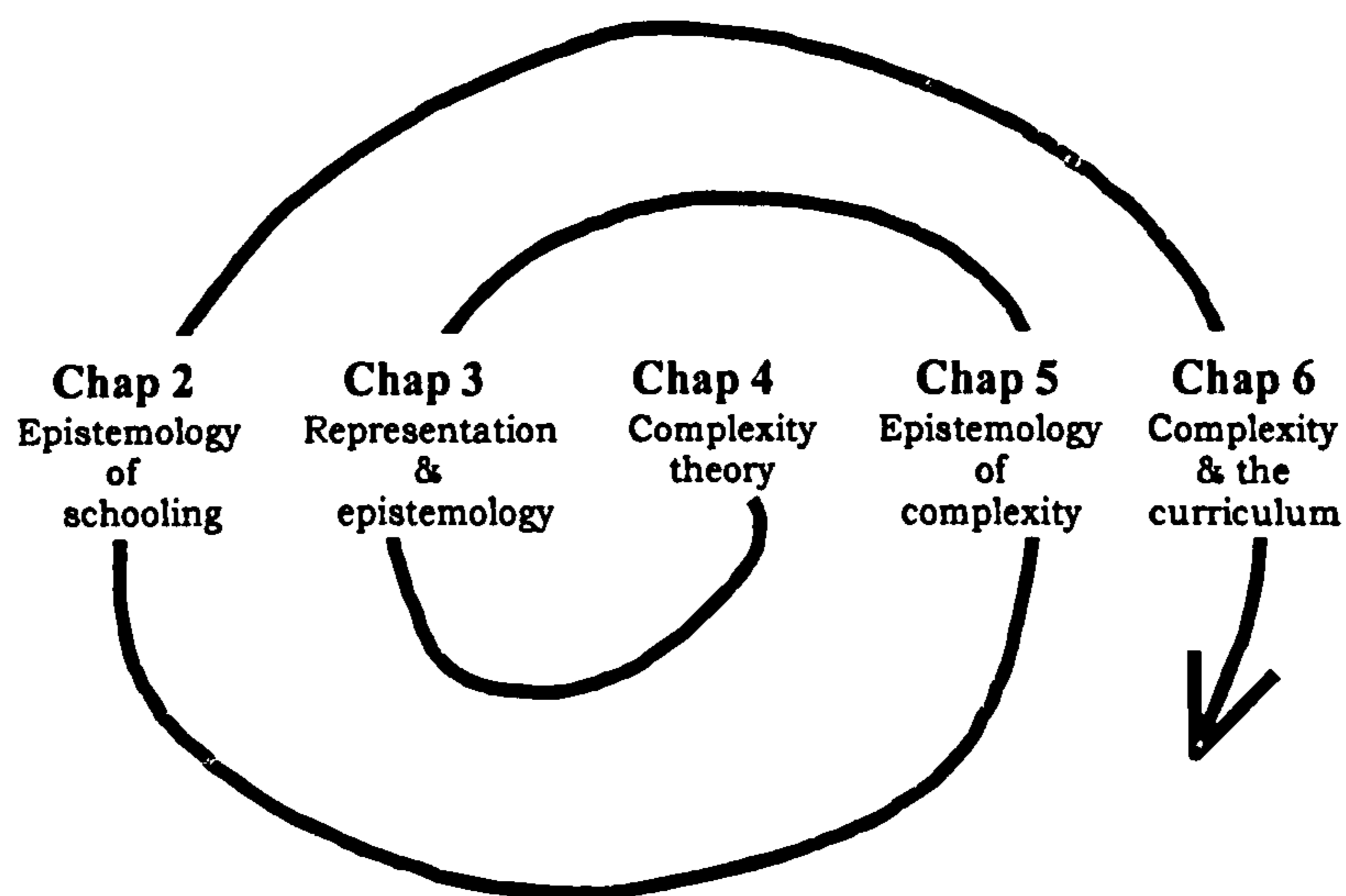


Figure 1.2

The logic of the argument: 'Linearising' the emergent structure

1.4.3 *The structure of the argument*

In Figure 1.2 I show how, if the sequence of emergence of these themes is arranged on a spiral, the linear sequence of the five chapters emerges. What the spiral makes clear is the way in which the conceptual framework – complexity (Chapter 4) – revealed the epistemological questions (Chapter 3) which necessitated the introduction of the conceptual framework itself. It also shows how the articulation of these questions necessitated their ‘resolution’ *in terms of the conceptual framework* (Chapter 5) which in turn suggested the ‘argument’ upon which the whole thesis could be pinned (Chapter 2) and the final ‘resolution’ to this argument (Chapter 6). On the left of the centre of the spiral we therefore have ‘questions’ and on the right of the centre we have ‘answers.’ Figure 1.3 illustrates this structure in more conventional terms. The chapters on the left of the centre pose the research questions and frame the argument. As such, the content therein is not ‘original’ but draws on pre-existing conceptual schemes to outline a ‘problem.’ In contrast the chapters to the right of the centre constitute the research ‘proper.’ Here the conceptual framework (centre of the spiral) is utilised to address the questions posed on the left of the centre. Chapter 5, in particular, is the crux of the research ‘proper.’ Here I develop an epistemological framework which I then use in Chapter 6, in combination with other theoretical frames, to conclude the argument.

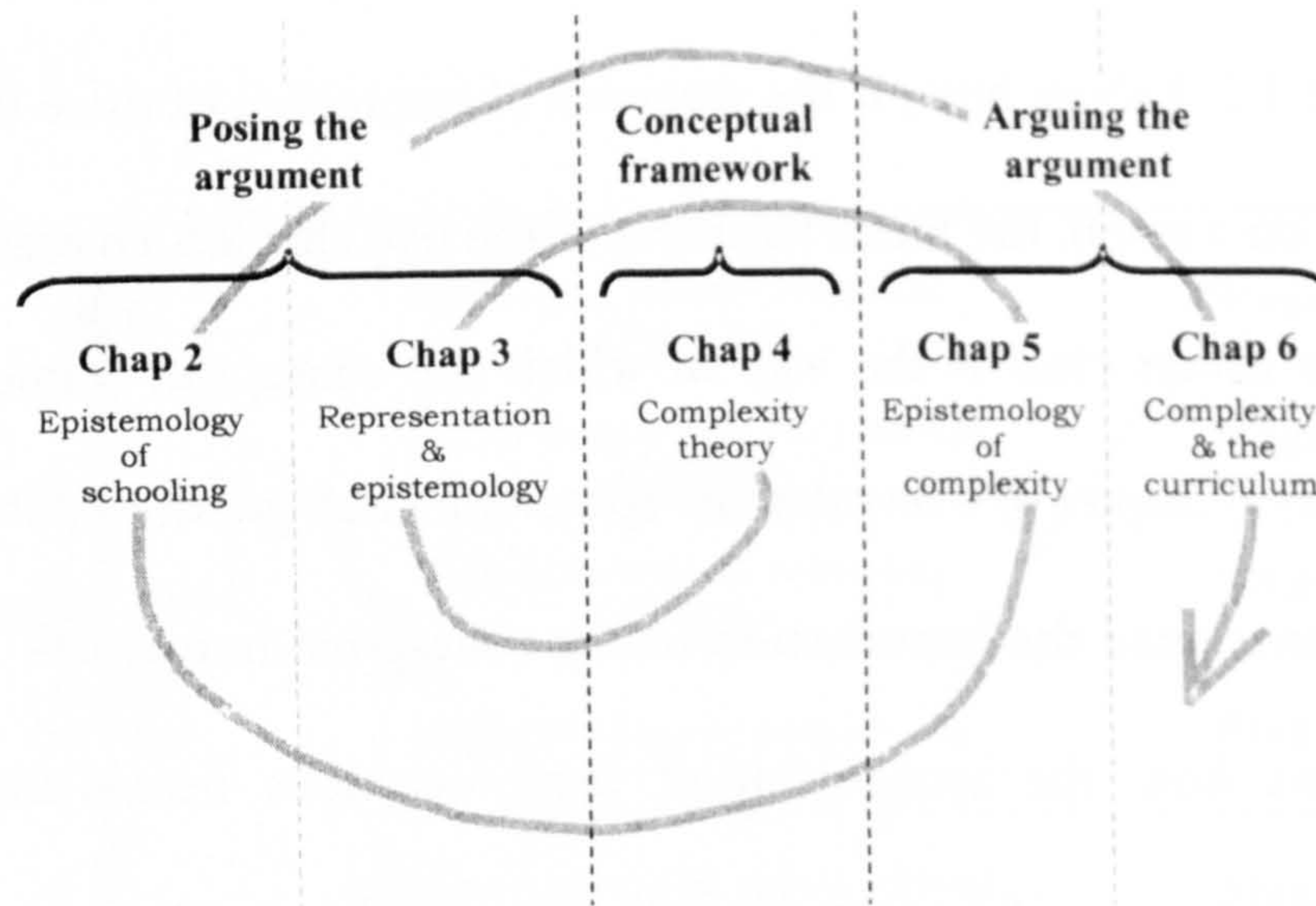


Figure 1.3

The logic of the argument in conventional terms

The whole process of the research is therefore shown to be recursive. The questions (and their answers) increase in scope with distance from the centre, where it all 'began'. The linear sequence of the chapters (which is different from their emergent order) can therefore be understood as a product of the emerging research process itself, and not an arrangement which can simply be imposed on the structure from a position outside of it. The linear arrangement of the chapters is neither arbitrary (based on the whim of the author or supervisor) nor predetermined. It is part of the emergent structure of the research 'itself.'

In Figure 1.4, I show how, once Stages 1-5 of the research had been completed and the linear structure of the argument had emerged, I then reworked the material in a particular sequence to develop the argument and tighten the links between chapters. Once this was done, I then described the overall structure of the argument and this produced the introductory chapter (see Figure 1.5).

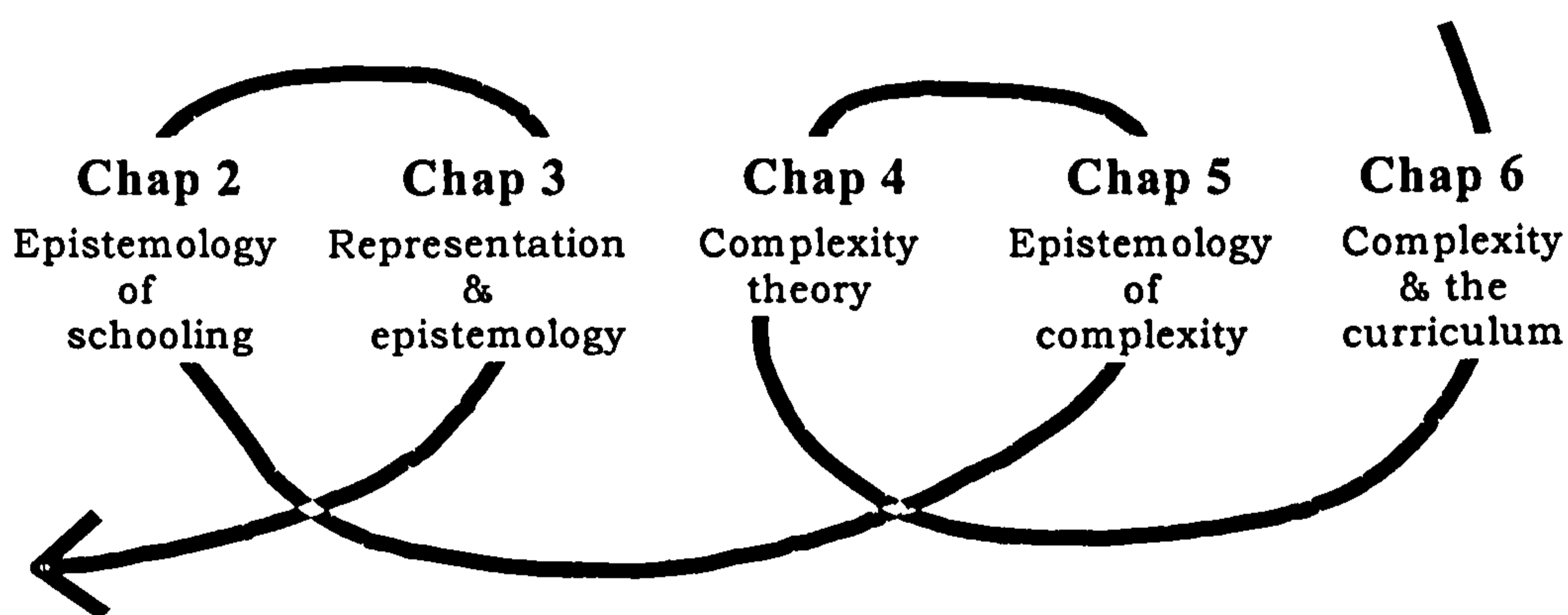


Figure 1.4

Stage 6: Developing the argument by rewriting the chapters
a second time in the sequence shown

Having everything present in the correct sequence, I then (again) reworked all the chapters, this time in a 'linear' fashion (although this still included considerable back-and-forth movement between chapters), from start to finish, to refine and develop the argument further, using insights that had

been brought to the fore in the writing of the introductory chapter. Following this the concluding chapter was written and the work submitted for examination shortly thereafter.

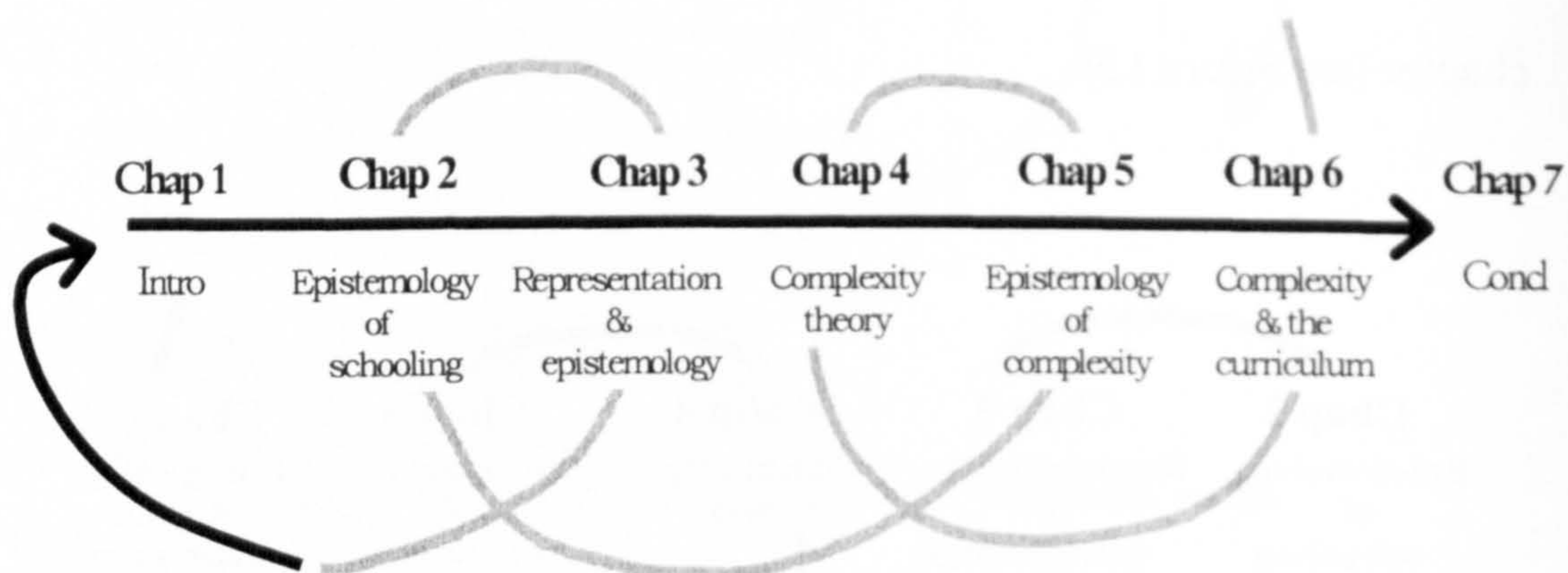


Figure 1.5

Stage 6: Refining the argument by rewriting the chapters a *third* time in the sequence shown by the solid black line (with considerable back-and-forth movement between chapters throughout this process).

1.5 SUMMARY OF CHAPTERS

In the previous section I explained the rationale behind the choice of content and the arrangement of the five chapters making up the body of this thesis. Here I describe each of these five chapters in more detail, drawing attention to the argument and to why and where the material presented is new.

1.5.1 Chapter 2: *The epistemology of schooling*

Chapter 2 provides an ‘overview’ of modern curricular thought to show how it is guided by two fundamental questions of *what* to present in the curriculum and *how* to present it. These questions are founded on the assumption that what is presented in schools already exists – i.e., it exists before it is presented in the curriculum – and so whatever is presented in the curriculum is always also a *re-presentation*. It is the function of the curriculum to *re-present* some original ‘presence’ in order that the student can acquire knowledge of it. In this way modern curricular thought necessarily relies on a representational *logic*. Moreover it relies on a representational *epistemology* for it assumes that the knowledge acquired in schools somehow *represents* this original presence which lies outside the school.

I then examine schooling from an historical perspective, to show how it became possible for this representational logic to emerge in modern curricular thought. By combining insights from the work of Ariès (1962), Mollenhauer (1983), and Foucault (2002/1970b), I show that two important contributing factors seem to have been (i) the increasing isolation of young people in schools, away from 'real' life, such that what was present outside of the school had to be re-presented inside the school (this is Mollenhauer's point), and (ii) the emergence of a representational world view which Foucault suggests is linked with the emergence of a dualistic understanding of the sign. What I try to make clear – and this is where my work differs from Mollenhauer's – is that Ariès's work on the history of 'childhood' (Ariès 1962) to a certain extent contradicts Mollenhauer's claim that the isolation of children from the 'real' world initiated a representational curricular approach. Ariès account, however, also does not explain the emergence of representational logic in curricular thinking. I argue that while important, the separation of young people from the 'real' world was *not sufficient* to initiate modern (i.e., representational) curricular thought. Using Foucault's historical analysis of knowledge (Foucault 2002/1970b) I argue that a representational view of curriculum became possible only with the emergence of a dualistic or representational understanding of the sign in the seventeenth century. In this regard, the separation of children from the

'real' world, which had begun a few centuries earlier, meant schools were 'pre-adapted' for representational logic, i.e., for presenting *in* schools a 'reality' that existed *outside* schools. Representational epistemology, which clearly splits knowledge from that which it represents, is highly compatible with the idea of a schooling system which separates young people from the 'reality' which they must acquire knowledge 'of' *in order for them to acquire knowledge of it.*

Last I show how the underlying representational logic of modern curricular thought is played out in modern pedagogical practices. In particular I point out how pedagogical approaches which claim to oppose representational schooling practices are themselves reliant on representational theory of knowledge in that they still rely on the idea that what exists outside the school can somehow be replicated as knowledge in the mind/body of the student. In other words modern pedagogical approaches still rely on the assumption that knowledge is separate from its object which is some original 'presence' outside of knowledge itself, and that knowledge in some way represents this original 'presence.'

1.5.2 Chapter 3: The crisis of representation

The point of Chapter 3 is to show that the representational epistemology upon which modern schooling is founded is itself highly problematic and

particularly in the last few decades critiques of representational logic seem to have ushered in what has popularly become known as the 'crisis of representation.' In this chapter I review only three aspects of the extensive critique of representation. I review the critique first in relation to personal knowledge, then in relation to scientific or 'public' knowledge and finally in relation to language and writing. The first two lines of argument are framed in terms of 'Cartesian dualism' (Descartes' mind-world scheme) which splits the 'real' world from our knowledge of it (Cottingham 1992). It is only when there is a split between world and knowledge that the idea of knowledge standing for or representing something more 'real' than itself makes sense. Within this dualist or 'representational' framing, the 'crisis of representation' appears as a crisis of indeterminism. The question arises as to which theory of knowledge-representation is the best. Competing epistemologies include 'subjectivist,' 'objectivist' and 'relativist' versions amongst others. With this discussion it is not the logic of representation (something standing for something else) that is put into question but the operationalisation of the logic. In this sense it has been argued that the 'crisis of representation' is not a crisis of representation as such, not a crisis of the 'phenomenon' but a crisis of 'the representation of representation' and therefore 'a discussion of representation is mainly a discussion of knowledge' (Jorna and van Heusden 2003, p. 125).

The third line of argument begins within the Cartesian framework but then puts this framework into question, i.e., it questions the logic whereby knowledge can 'stand for' something more real than itself. A different logic is developed – the logic of deconstruction – which challenges the idea that something can be 'present' and therefore renders incoherent the idea that something can be 're-presented' (that which is itself not present cannot be re-presented). This deeper 'crisis of representation' therefore opens a way of theorising which is fundamentally different from anything which has come before, the implications of which are only just starting to be explored in a systematic way in educational discourse (see Biesta and Egea-Kuehne 2001, Pinar and Reynolds 1992, and Trifonas and Peters 2004 for three collections of works on deconstruction and education).

Having outlined the problems with representational epistemology, and having pointed to the potential value of deconstruction in 're-thinking' education, I then suggest that although deconstruction presents an interesting and important way forward for theorising education along non-representational epistemological lines, deconstructionist conceptual schemes are notoriously difficult to negotiate. It is precisely at this point that complexity science – which has sparked considerable interest in the last two decades as a new 'worldview' (Dent 1999) and which has also been charged with providing a critique of representation (see for example Cilliers 1998) –

enters the discussion. While a number of authors have already explicitly drawn connections between complexity and poststructuralism (Cilliers 1998, Dillon 2000, Popolo 2003) the question of whether complexity can help with the task of 're-thinking' the epistemology of schooling has, as yet, not been addressed. It is to this task that the remainder of the thesis is devoted.

1.5.3 Chapter 4: Introducing complexity

In Chapter 4, I introduce some of the conceptual structures of 'complexity science' in order to build a 'platform' of understanding from which to launch the epistemological and educational issues taken up in Chapters 5 and 6. In this regard I focus solely on those theories of complexity that are generally considered the established orthodoxy. These originate in the 'hard' sciences, in particular the domains of computer modelling and theoretical physics/chemistry. Nevertheless, I do not try to represent complexity as a unified field. I present it, rather, in terms of two *opposing* understandings, which attempt to explain the world in terms of its interconnectivity or relationality. One style of theorising (which includes all save one theory of complexity) supports a deterministic theory of complexity while the other (which includes *only* Prigogine's theory of complexity) brings the notion of determinism into question.

The difference between these two styles of theorising complexity, I would contend, has been largely overlooked by those working on the epistemological implications of complexity, who have focussed largely on the ‘relationality’ of complex systems and the implications of ‘relationality’ for our understanding of what we can know (Cilliers 1998, 2000a, 2002, Richardson 2004, Richardson, Mathieson and Cilliers 2000). While the relationality of complexity has many important epistemological implications, the bringing into question of determinism, so I argue in Chapter 5, has *even more* profound epistemological implications, and aligns complexity with radically antifoundationalist stances such as deconstruction.

1.5.4 Chapter 5: The epistemology of complexity

In Chapter 5, I draw on the background presented in Chapter 4 to outline what I believe to be the epistemological implications of complexity. While much work has already been done on the ‘epistemology of complexity’ (Cilliers 1998, 2000a, 2002, Richardson 2004, Richardson, Mathieson and Cilliers 2000) I show in this chapter that the insights generated by complexity science lead to a far more radical epistemological stance than has previously been suggested.

In developing the 'epistemology of complexity' I first outline Cilliers' reading of complexity, which suggests that all attempts to fully or perfectly understand, model or 'represent' complexity, *miss the point of complexity*. Cilliers therefore proposes a 'relational' rather than a representational conception of complexity, but concedes that such a conception of complexity is also a representation of sorts. I then take the argument further by reframing Cilliers' argument in terms of the 'rule-based' logic he brings into question and in so doing show that the logical difficulties that arise in representing complexity suggest at least two alternatives to representational epistemology. An *interpretivist* (or 'relativist') alternative which can be aligned with many 'postmodern' philosophical positions and a *pragmatist* alternative which can be aligned with Dewey's 'transactional realism.' However, while this provides complexity with clear epistemological alternatives, it still does not take things far enough for this argument is based only on the relationality of complex systems and does not consider complexity's challenge to determinism which is connected to the role of time as an 'operator' in complex processes.

I then show that when time is taken into account as an operator in complex processes – and here I draw on Prigogine – we can no longer take for granted the idea that the world is 'there' for us (as a presence which exists in and of itself). This means we can also no longer understand knowledge as

'standing for' a 'presence' that exists 'in itself' somewhere outside of knowledge.

Drawing on George Herbert Mead (1932) and Henri Bergson (1911) I then show that we can use insights from complexity to think of knowledge not as the acquisition of something already present, but as a *response* which 'calls forth' something radically new. With this understanding knowledge does not 'pin down' the meaning of something already there. Knowledge can no longer be brought to a close. Rather, knowledge must be understood as an 'opening' or 'invention' of meaning. It is in this regard that a complexity-inspired epistemology shows an affinity with deconstruction.

1.5.5 Chapter 6: Curriculum and emergence

In Chapter 6, I explore the implications of a complexity inspired epistemology for a practice of schooling that, for the main part, is based on a conventional, representational epistemology. In doing this I first address the question of opening or 'inventing' meaning in the school setting. This is a question about whether the practice of 'inventing' meaning in schools in fact escapes representational epistemology.

In this regard I provide three examples of 'pedagogies of invention' each of which attempts to facilitate (or has been *accused* of facilitating) the

'invention' of meaning in the classroom. In doing this I show that none of these 'pedagogies of invention' succeeds in doing away with the underlying representational logic of schooling. Even a pedagogy designed around an 'emergentist' conception of meaning making fails in this regard. I show that if we bear in mind that it is not only meaning that emerges from a pedagogical intervention but also the subjectivity of the one being educated then we have to concede that education *always shapes the subjectivity of the one being educated*. In this regard I point out that education is vulnerable to the representational problem of 'discipleship' which Ulmer describes as 'reproduction of the master's style' (Ulmer 1985, pp. 162-173). The knowledge that is being 'reproduced' in the student is knowledge of the master's style, and therefore knowledge of some pre-existing presence. Since the knowledge 'gained' is still knowledge *about* something which is outside itself (i.e., the master's style) education can still be found to rely on a representational epistemology

Next, I argue that 'the pedagogical effect of discipleship' (Ulmer 1985, p. 173) is produced only in curricula that are designed with an idea *already in mind* of what a human subject is. To avoid this pedagogical effect, and facilitate a form of education *not* premised on representational epistemology, it is therefore necessary to develop a curriculum around an understanding of human subjectivity that leaves *open* the question of what it

means to be a human subject. Here an understanding of subjectivity that is inspired by 'strong' emergence proves useful. This 'emergentist' understanding of subjectivity destroys the representational foundation upon which modern Western schooling is built and offers in its place a 'space of emergence' which cannot be understood in any foundational sense. However, since the 'space of emergence' is a *curricular space* it is still possible to theorise education.

Finally, I explain that when we theorise education in a non-representational mode, i.e., using the notion of an emergent 'curricular space' (which is a space of radical contingency) we see that the educator's responsibility is first of all not a responsibility to see to it that a certain form of knowledge is acquired by the one being educated. The educator's first responsibility, in other words, is not an epistemological or *representational* responsibility. Rather, the educator's first responsibility is to keep open a space in which the student can continue to emerge as a *singular and unique being*. This involves the educator in what Derrida has called a 'double duty' (Derrida 1992, p. 80).

Chapter 2

THE EPISTEMOLOGY OF SCHOOLING

Modern curricular thought and its representational foundations

2.1 PREAMBLE

In many ways, modern Western schooling can be understood as a *practice of representation*. The child – the subject of schooling – is, as Hannah Arendt has put it ‘new in a world that is strange to him’ (Arendt 1954a, p. 185).

Insofar as the child is not yet acquainted with the world, he must be gradually introduced to it; insofar as he is new, care must be taken that this new thing comes to fruition in relation to the world as it is. In any case, however, the educators here stand in relation to the young as representatives of a world for which they must assume responsibility although they themselves did not make it, and even though they may, secretly or openly, wish it were other than it is (Arendt 1954a, p. 189).

For Arendt, and many others, the task of Western schooling is, above all, to teach children ‘what the world is like’ (ibid., p. 195). ‘The teacher’s qualification consists in knowing the world and being able to instruct others

about it... pointing out the details and saying to the child: This is our world' (ibid., p. 189). What is 'pointed out' in schools is always something that is 'present' in and of itself, which pre-exists the curriculum, and which the curriculum must then 're-present.' But the curriculum cannot re-present everything, so it must select what to represent. Furthermore it must re-present it in a way that it actually gets transferred into the child. In other words the curriculum must ensure (or at least attempt to ensure) that the knowledge acquired by the child accurately reflects its object. It must be a good representation of the 'outside' world. In this way modern curricular thought is representational in a double sense. The curriculum *itself* 'stands for' or represents (signifies) the 'outside' world and moreover it does this in order to generate accurate representations (knowledge) of the outside world in the mind of the learner. Schooling is therefore a representational *practice*, which relies on a representational *epistemology*.

In this chapter I examine this double representationalism in modern Western schooling in some depth in order to see how it controls the kinds of questions curricularists can ask. I start with a general 'overview' of the representational logic of modern curricular thought to show how it is guided by two fundamental questions of *what* to present in the curriculum and *how* to present it. The first question is concerned with the *curriculum itself* as a representation (signifier). The content of the curriculum represents

(signifies) inside the classroom that which lies outside of it. The second question is concerned with *knowledge* as a representation (signifier). The method of the curriculum must ensure that the knowledge acquired by the learner accurately represents (signifies) its object. These questions therefore epitomise the 'double representationalism' in modern Western schooling practices. In doing this I also provide a brief overview of representational epistemology (the understanding that knowledge represents or signifies something that exists outside itself) showing how this epistemology is not primary (i.e., not 'first philosophy') but underpinned by a dualistic understanding of signification.

Following this I examine the concept of schooling from an historical perspective, to show how it was only *after* a dualistic understanding of the sign had emerged in Western culture that it became possible for the doubly representational logic of schooling to emerge in modern curricular thought.

Last I show how, with a dualistic understanding of the sign, curricular debate gets caught in a loop, with consecutive solutions to curricular problems eventually leading back to the original problem. The only way out of this loop is to unsettle the dualistic logic of signification upon which the various arguments are founded.

2.2 CURRICULUM AND REPRESENTATION

In this section I examine the representational logic that underpins modern curricular thought. This includes a discussion about the different ways in which the term 'curriculum' has been used (some more 'representational' than others), as well as the guiding questions and assumptions driving modern curricular thought and the theories of knowledge and signification that in turn drive these questions and assumptions.

2.2.1 *Different uses of the term 'curriculum'*

The term 'curriculum' has a variety of meanings and has been used differently in different times. Originally a Latin term for 'a course for a racing chariot' (*OED*), it had nothing to do with the idea of representation. Its more representational meaning only emerged in the seventeenth century when it started being used to designate a planned course of study at a school or university.¹⁶ The content of the curriculum *represented* those aspects of life that were to be studied. But this representational understanding of the term was then blurred in the twentieth century when it started being used to include out-of-school experiences, planned *and* unplanned experiences within schools, as well as experiences leading to 'unwanted outcomes of

¹⁶ The first recorded usage of the term as a 'course of study' dates back to 1633 where it was used in Latin texts of Scottish universities (*Online Etymology Dictionary* available at <http://www.etymonline.com/>)

schooling' (Jackson 1992, p. 8). These sorts of experiences could be understood as comprising the *'hidden curriculum'* this being the ideological and subliminal message presented within the overt curriculum and the *'unstudied'* or *'null curriculum'* which emphasises those topics not included in the overt curriculum. With such understandings of curriculum it becomes difficult to distinguish between the *content* of the planned course of study itself (i.e., the structure traditionally thought of as the curriculum in the seventeenth century use of the word) and the *method* of presenting this planned course of study (the way it is experienced by learners). *What* is taught and *how* it is taught are therefore equally caught up in the notion of curriculum. In short, the term curriculum can now be understood as embodying those *experiences* that are necessary to learn the things one is learning about. To some extent this increased focus on experience (as opposed to content) blurs the representational logic of curriculum, and this is something I want to 'unblur' to bring out more clearly the way in which the representational logic of schooling guides modern curricular questions.

2.2.2 *Modern curricular assumptions and questions*

There are three important assumptions connected to the idea that the curriculum embodies those experiences that are necessary to learn the things

one is learning. One is about learning, the second about education and the third about knowledge.

First, there is the assumption that we learn *about* whatever it is we are presented with. Since we are always being presented with something, learning therefore takes place all the time. In this way the curriculum – since it presents us with the experiences necessary to learn what we learn – *shapes* what we learn. Our learning therefore follows or represents what is presented in the curriculum.

Second there is the assumption that education (as opposed to ‘mere’ learning) is about *selectively* acquiring knowledge (only that which is ‘worth’ learning). Without this selection education would not be *educational*. The curriculum is educational precisely because it *directs* the learning of those being educated. In this way the curriculum shapes students in a particular way. Its educational end is *teleological*.

Third – and this is the epistemological point – there is the assumption that what is ‘worth’ learning *already* exists *independently* of those *who would learn about it*. After all, selection is only possible from a pre-existing range of possibilities. Moreover it is assumed that what is worth learning can somehow be transmitted (via the curriculum) to the one doing the learning.

In other words the curriculum is *necessary* to achieve a certain educational end.

When these three assumptions are put together this leads to the conclusion that in order to become educated one must engage with a curriculum. The idea of a curriculum – a course of experiences that leads to a particular educational outcome – is therefore *absolutely central* to the project of modern education. It is the vehicle by means of which education, in its modern form, is made possible. Questions about

- (i) *what* to present in the curriculum and
- (ii) *how* to present it

are therefore critically important educational questions and much (if not all) theorising about modern education is structured around these two questions.

The first question is a political question since it asks ‘whose knowledge is of most worth, and what constitutes official knowledge’ (Apple 1993, p. 316). To select one must, of course, have criteria about what counts as valuable or ‘worthy’ knowledge and what falls outside of this category. This has created deep rifts amongst curriculum theorists (Kliebard 2004) about how the world should be represented (signified) by the curriculum. The second

question is an epistemological and pedagogical question, which concerns issues of *presentation*. How should the curriculum present what it presents in order that accurate knowledge is generated in the learner? Different views on this have created another set of rifts amongst curriculum theorists. While the centrality of both these questions for modern curriculum theorising is unquestionable, in this thesis I am more concerned with the epistemological question about how to get what is presented *into* the learner. The methods chosen for getting knowledge into the learner will obviously vary depending on one's epistemological assumptions. But the very idea of getting knowledge into the learner, so I wish to argue, relies on a particular understanding of knowledge which holds that knowledge signifies or 'stands for' something which lies outside itself. This can therefore be called a representational theory of knowledge.

2.2.3 *Two representational theories of knowledge*

The idea that knowledge is representational in character implies that it embodies some sort of 'information' about the external world. To 'have knowledge' therefore usually means to 'have information' *that* something is the case and to know *that* something is the case implies there are grounds for believing this to be the case, i.e., believing it to be true. Knowledge, in this sense can be defined as justified true belief (Moser 1992b). The standard

analysis is that if one has justified true belief that *p*, then one knows that *p* (see Moser 1992a).¹⁷ Ryle (1945), however, disrupted this logic when he distinguished between knowing *that* (propositional or declarative knowledge) and knowing *how* (procedural knowledge). He argued that not all forms of knowing can be reduced to propositions. For example we can develop the skill of riding a bicycle (i.e., we can know how to ride a bicycle) without necessarily being able to describe exactly how we do it. Much of knowing how is unconscious knowing or practical skill, which could perhaps be called knowing with the body. This is in contrast to knowing that, which is about conscious knowing and theorising, about rational reflection and knowing with the mind. If Ryle's distinction is not given much attention, knowing *that* can be privileged over knowing *how* and all knowledge, including skills can be assumed to be reducible to propositions. Lehrer, for example, claims that having knowledge *of* the world is 'fundamental to human cognition and required both for theoretical speculation *and practical sagacity*' (Lehrer 1990, p. 4, emphasis added). However, when Ryle's distinction *is* taken seriously, knowing *how* must be privileged over knowing *that* because, as Ryle argued, it is only through our actions in the world that we are able to form conceptions about it, i.e.,

¹⁷ Although the 'Gettier Problem' poses counter examples to this standard formulation. (see Moser 1992).

know *that* it is a certain way. We are therefore left with the idea that all knowledge is caught up with the activity and situations in which it is produced, which means any knowledge acquired by the learner cannot be an undiluted or 'true' representation of an objective or universal reality. This reversal leads away from a 'picture' theory of knowledge and towards a 'use' theory of knowledge (Dewey and Bentley 1949), which of course has implications for how knowledge is to be brought across the divide between the mind and the world. Educators holding a 'picture' theory of knowledge maintain that the child can learn simply through observation. Educators holding a 'use' theory of knowledge maintain that it is only through childrens' actions in the world that knowledge is brought across this divide.

But here it is important to note that the distinction between knowing *how* and knowing *that*, and regardless of which is privileged over which, does not have an impact on the idea that knowledge (including facts and skills, and regardless of which comes first) is located *in* the knower. Even with such a distinction, it is still possible to maintain a Cartesian split between knowledge (which is in the knower) and the 'outside' world which is associated with the cause of our knowing. In this sense all 'knowing' can still have a dualistic relationship with the 'outside' world. It still 'stands for' the outside world, is still about something that exists outside of knowledge

itself. For this reason 'use' theories and 'picture' theories of knowledge are both *representational* theories of knowledge.

2.2.4 *A representational theory of signification*

Representational theories of knowledge can themselves be understood in terms of a representational theory of signification. This theory of signification holds that signs represent or stand for something which is present in and of itself. The very simplistic diagram below (Figure 2.1) illustrates this point.

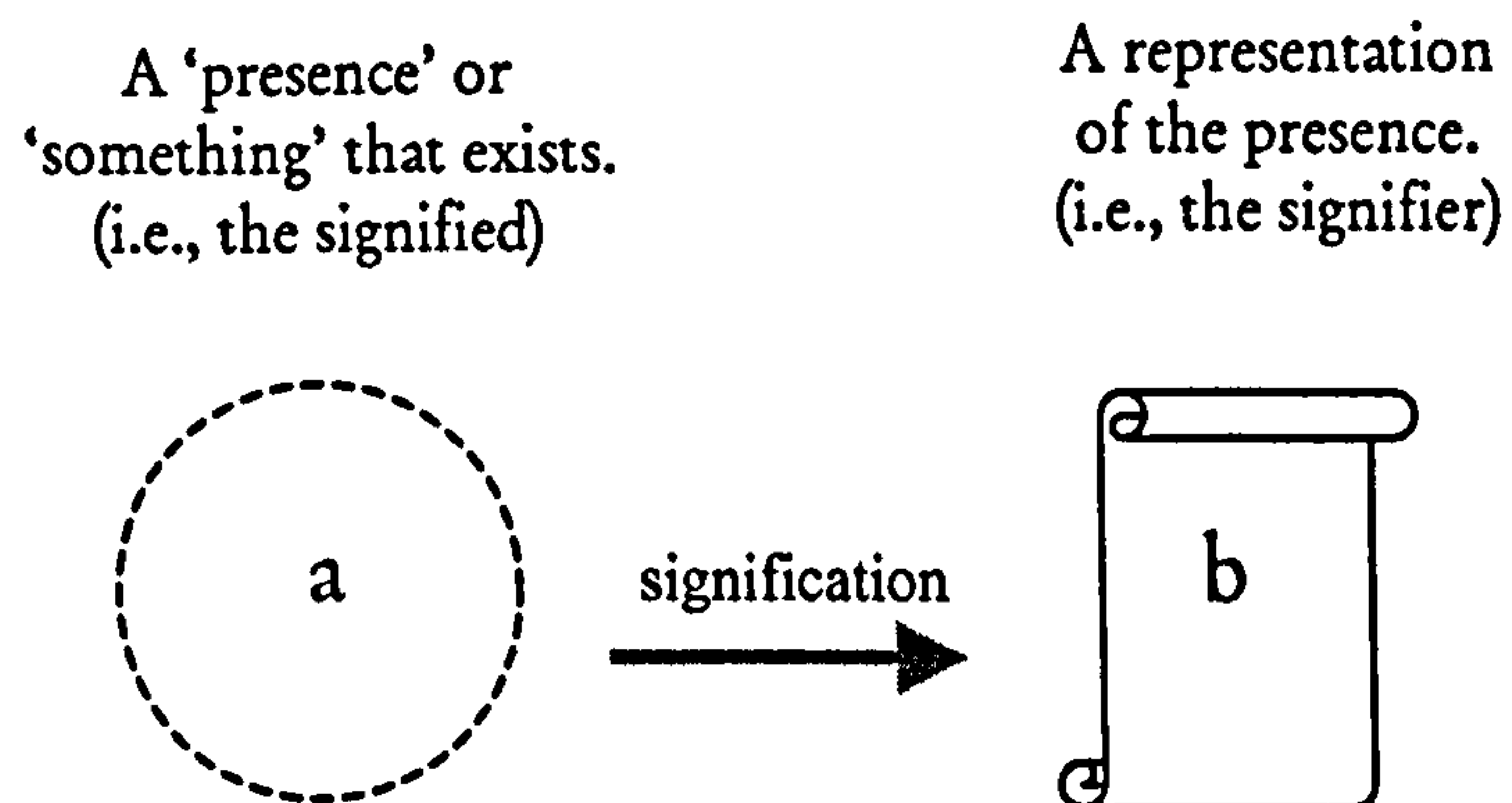


Figure 2.1

A dualistic or representational understanding of the sign

But the term 'sign' is not identical with the term 'representation.' For example lightning can be a *sign* of rain, but this does not mean that

lightning is a *representation* of rain. A representation is a *special case of the sign*. What is special about these sorts of signs is that *they have no content in and of themselves*. The content or 'meaning' of a representation comes entirely from a 'presence' which always exists prior to the representation itself and the representation simply 'stands for' this presence. A representation is always a sign that 'stands for' something else.

Since the task of representation is to *re-present* something that is *already present* without adding anything of its own, this means that (i) the quality of a representation can be assessed in terms of the accuracy with which it represents a presence and (ii) the idea of representation is entirely dependent on the idea of presence. This dualistic or *representational* understanding of the sign is the basis of what Charles Taylor calls 'modern representational epistemology' (Taylor 1995, p. 5) which he sums up as an understanding that knowledge is a 'correct representation of an independent reality' (*ibid.*, p. 3). In other words knowledge is supposed to signify something that is *present* and this something is 'independent reality.' Taylor calls this epistemology 'modern' because the Western philosophical tradition has not always understood knowledge in this dualistic or *representational* way. It was only at the end of the sixteenth century, that knowledge became understood in the dualistic sense, i.e., as standing for something present in itself, something 'real'. Foucault (2002/1970b) discusses this change in

understanding of the notion of knowledge in relation to changes in understanding of the notion of the sign. Prior to the seventeenth century, he argues, 'signs' were understood to be 'similitudes' between things. A sign was that which made it possible to see in one thing the mark of a second thing (e.g., lightning is a sign of rain). Foucault calls such signs *ternary*¹⁸ (rather than binary)(see Figure 2.2). The task of knowledge was to interpret the meaning of these signs, i.e., if it was possible to see in one thing the mark of a second, then this was understood to be meaningful (rather than simply coincidental) and this meaning then required interpretation. Signs, in other words, were understood to be *already* imbued with meaning. It was only in the seventeenth century, in Foucault's diagnosis, that the sign became completely empty of meaning and therefore became *simply* a representation. Foucault puts it like this:

¹⁸ Foucault describes these three distinct elements of the ternary sign as 'that which was marked, that which did the marking and that which made it possible to see in the first the mark of the second.' He adds that 'this last element [i.e., that which makes it possible to see in the first the mark of the second] was, of course, resemblance: the sign provided a mark exactly in so far as it was "almost the same thing" as that which it designated' (Foucault 2002, p. 70).

In fact, [the property of signs most fundamental to this period is that] the signifying element has no content, no function, and no determination other than what it represents: it is entirely ordered upon and transparent to it.... The binary arrangement of the sign, as it appears in the seventeenth century, replaces an organisation which, in different modes, had been ternary ever since the time of the Stoics, and even since the first Greek grammarians (Foucault 2002/1970b, p. 71).

The idea that signs are not ternary but dual or *representational* in character (see Figure 2.3) – i.e., reflecting *simply* what exists or what is ‘real’ in the world rather than having a meaning of their own, which requires interpretation – shifts the task of knowledge from the interpretative mode to the descriptive mode. Knowledge is about re-presenting something that is in itself, independently ‘present.’ It is here that modern education enters the picture.

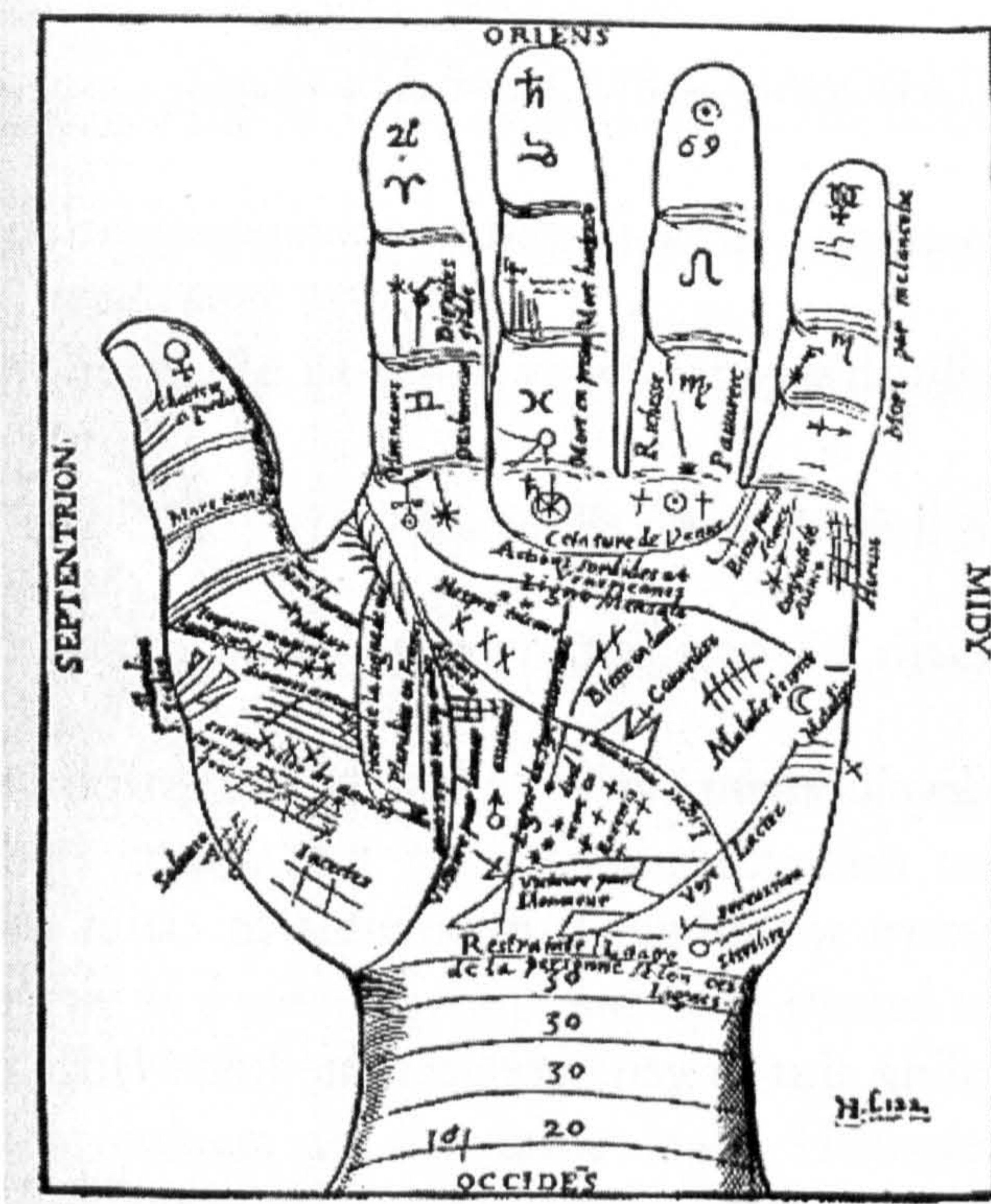


Fig. 244. POSITION OF THE SIGNS OF THE ZODIAC IN THE HAND
 Jean Baptiste Belot, *Glosses* (1640).

Figure 2.2

The ternary sign: A sign which makes it possible to see in one thing (e.g., a fingertip) the mark of a second thing (e.g., an astrological principle).

Image from *The Complete Works of Jean Baptiste Belot*, 1640
 (<http://www.fulltable.com/VTS/f/for/for.htm>)

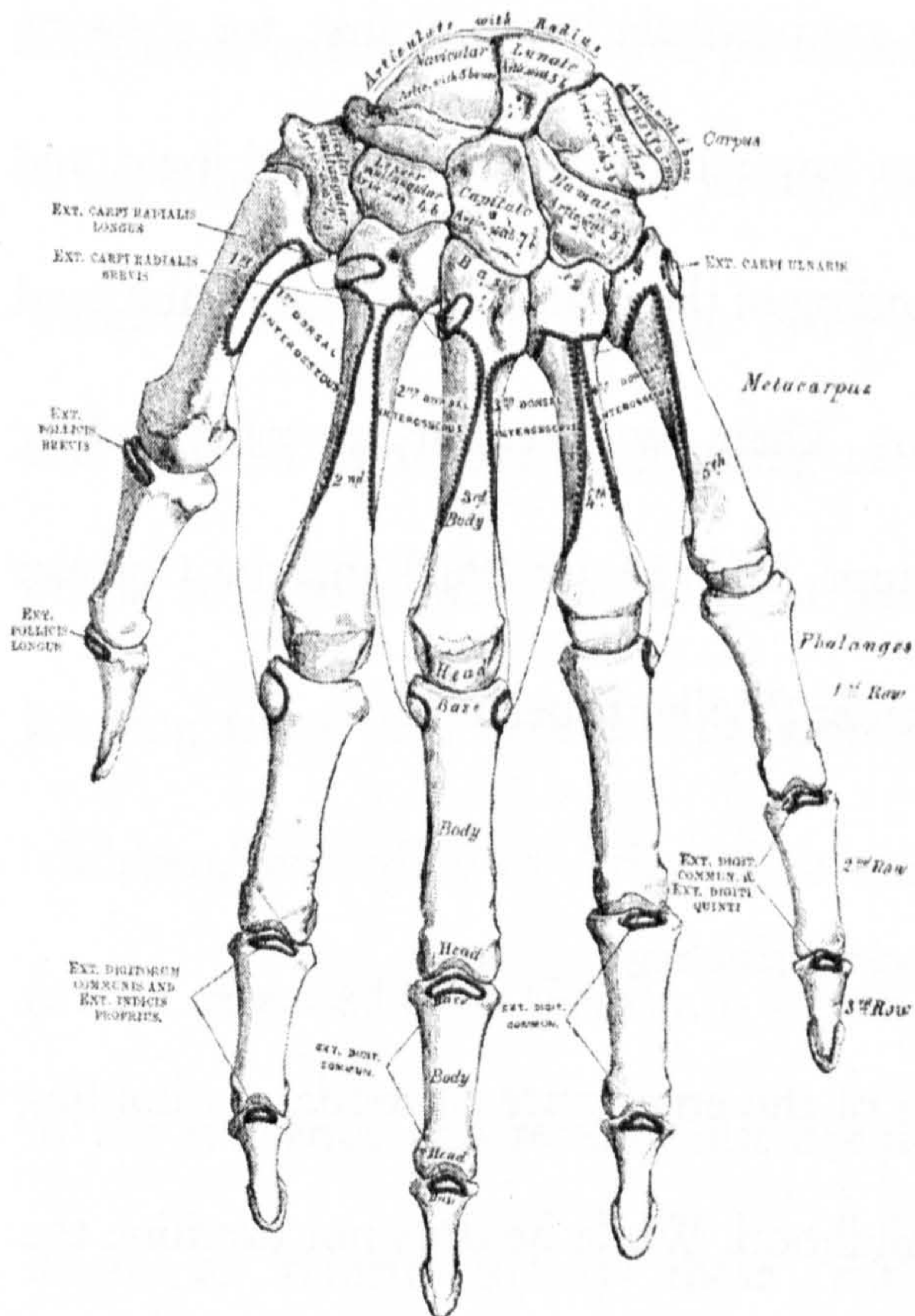


Figure 2.3

The binary or dualistic sign is a representation or reflection of what exists, as is the case in this biological drawing representing the bones in the hand.

Image from Henry Gray (1821-1865). *Anatomy of the Human Body*. 1918
 (<http://www.bartleby.com/107/illus220.html>)

2.3 THE ORIGINS OF REPRESENTATIONAL CURRICULAR THOUGHT

It can be argued that the emergence of a dualistic or representational understanding of the sign radically changed the way in which education was understood and organised, since it allowed for asking questions about how the 'real' world, the world present beyond our representations, could be presented to the student. This development can therefore be understood to mark the birth of modern Western schooling. It is possible to claim that since all modern forms of schooling aim to generate accurate knowledge of 'real' life, they are, in this sense, all reliant on a representational epistemology which itself is reliant on a dualistic understanding of the sign.

What I shall do in this section is introduce two accounts of the origin of modern schooling which I believe are particularly useful first, for showing how schooling has *not* always been inspired by representational logic, and second, for enriching our understanding of the centrality of representational logic in modern Western schooling. These two accounts are provided by the French cultural historian Philippe Ariès (Ariès 1962) and the German educational theorist Klaus Mollenhauer (Mollenhauer 1983).

2.3.1 *Ariès's account of the origin of modern schooling*

Ariès (1962) couches his discussion of the emergence of modern schooling in terms of the social history of childhood. While he does not examine the

epistemological roots of education, his discussion is useful in that it makes clear that the idea of schooling young people emerged initially for quite different reasons than to introduce young people to the world around them. Quite the contrary in fact. Ariès argument makes it clear that schooling was initially to *shield* young people from the world around them.

Ariès argues that prior to the fifteenth century, young people were not visible as a special group and were treated simply as 'undersized adults' and were subject to the same laws. However, from the fifteenth century onwards, according to Ariès, young people were increasingly perceived as a special group, in need of specialised treatment. One can think of this in terms of the social construction of childhood as a phase distinct from adulthood, and which required particular care and attention. According to Ariès, this re-description of young people and their categorisation as 'children' resulted in this group being increasingly separated from adults, and closeted in schools. According to Ariès this confinement of young people to schools was, for the most part, to exclude undesirable forms of learning from their world. The most avid proponents of education for 'children,' according to Ariès, were the 'early reformers' whose writings (which extended from Gerson to Port-Royal) became increasingly frequent in the sixteenth and seventeenth centuries (Ariès 1962, p. 412). In their desire to reform society these 'early reformers,' so Ariès reports,

disseminated a form of propaganda which encouraged parents to send their children to school by suggesting that parents were *individually* responsible for giving their children 'not only life but a good and holy life' (ibid., p. 413) and by suggesting that those who send their children to school 'are more worthy of respect than those who just bring them into the world' (ibid., p. 413). Ariès claims that the 'extraordinary development of the school in the seventeenth century' (ibid., p. 413) was a consequence of the new interest taken by parents in their children's education, which in turn was strongly influenced by the 'propaganda' spread by the reformers of the fifteenth, sixteenth and seventeenth centuries.

Ariès does not discuss the epistemological changes that took place in the seventeenth century, but other educational historians have commented that it was only with the advent of 'realism'¹⁹ in the seventeenth century that 'educational theorists ... began to introduce science and a knowledge of real things into the curriculum' (Graves 1914, p. 262). This can be linked with the emergence, in the seventeenth century, of a dualistic understanding of the sign and the idea of knowledge as a representation of the 'real' world. I wish to suggest that it was only once a dualistic understanding of the sign was in place that the attention of educators could become focused on the

¹⁹ Graves defines the 'realist movement' of the seventeenth century as 'a search for a method by which *real things* may be known (Graves 1914, p. 240).

idea of teaching young people about the 'real' world. Prior to this – and Ariès account supports this conclusion – educators had been concerned mostly with the moral welfare of children. This switch in focus presented educators with a completely different set of pedagogical questions. After this time, educators became increasingly concerned with the question of how to get the student acquainted with the 'real' world that existed *outside* the boundaries of the school. It is here that Mollenhauer's work is useful (but also problematic). Mollenhauer discusses this new set of pedagogical questions in terms of presentation and representation.

2.3.2 *Mollenhauer's account of the origin of modern schooling*

Mollenhauer (1983) argues that historically educational practices were initially practices of *presentation*, where the next generation or newcomers learned about existing ways of life consciously or unconsciously, willingly or unwillingly (Mollenhauer 1983, p. 20) by being immersed in those ways of life, by mingling, competing and working in the 'real' world. Using Wittgenstein, Mollenhauer argues that this presentation is a presentation of structures, i.e., in Wittgensteinian terms: a presentation of 'forms of life' (ibid., p. 28). Although Mollenhauer does not use this term, this can be thought of as a process of enculturation or socialisation, this being a practice which is largely uncritical. The vast majority of young people learned about

the world first hand through their participation in, and experience of, the world and from the adults they interacted with on a daily basis. In other words, they learned about 'forms of life' through direct and immediate participation in the existing ways of life and knew no other way. Any intentional education carried out by adults was simply a 'pointing out' of structures rooted in specific ways of life (and it should perhaps be added that there are still countries where 'enculturation' is still the only way in which the next generation learns about life).

Mollenhauer argues, however, that starting in the fifteenth century, as the position of young people in Western society started to change, what gradually disappeared was the situation in which young people were direct participants in 'real' life. What emerged instead was an educational sphere or 'realm' (ibid., p. 68), that is, a separate world for young people. Mollenhauer's main claim is that this confinement of young people in schools brought about a switch in focus from a *presentational* mode of education to a *representational* mode. After all, so Mollenhauer argues, once we take young people out of 'real' life but still want to teach them about 'real' life we need to somehow represent 'real' life within the confines of the world of the school. This, so he claims, necessitates decisions about *which* of all the things in life that there are to learn, are the ones that are truly important (the political curricular question) and decisions about how the

important matters can be conveyed with the requisite clarity (the epistemological curricular question). These questions, of course, are precisely the curricular questions with which modern education is concerned.

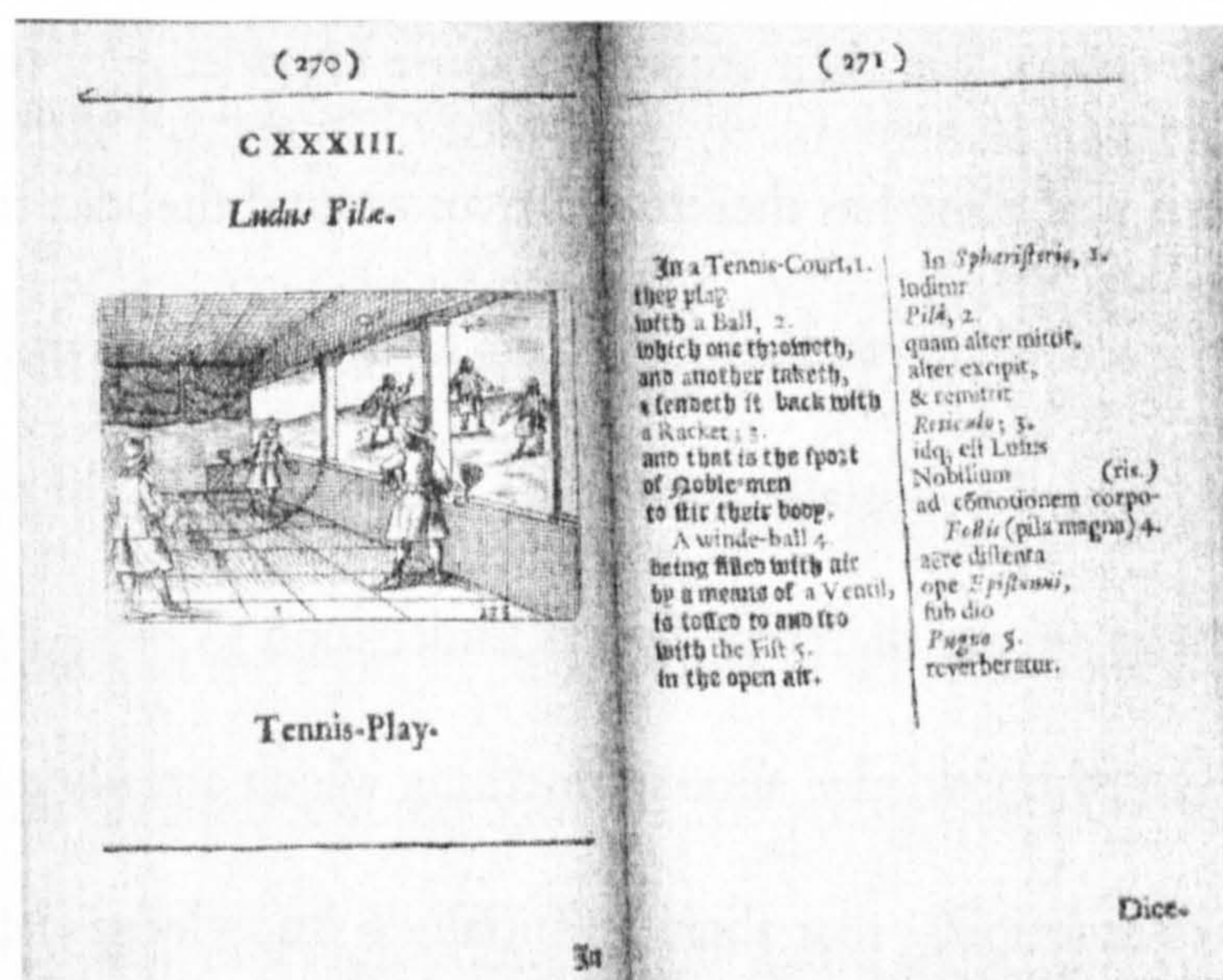
I would like to suggest, however, that while the construction of a separate educational sphere was certainly *necessary* to provoke modern curricular questions it was, in itself, not *sufficient* to provoke such questions. After all, the idea that schools should say anything at all about a world that lies outside their boundaries, it would seem, is entirely dependent on the idea that the 'outside' world is *worth* knowing about. And this was certainly *not* the sentiment of the educators Ariès was talking about. Ariès makes clear that young people were initially confined in schools to *prevent* them from learning about the world outside the school. In this sense, while I agree with Mollenhauer that the representational approach inaugurated modern curricular thought, I believe the confinement of young people in schools was *not* instrumental in bringing about the representational approach to schooling. Rather, the confinement of young people in schools meant that schools were 'pre-adapted' or 'ready' for representational logic, ready for the idea that it was possible to re-present *inside* the school the world that lay *outside* the school.

I would contend that it was only possible to ask modern curricular questions about how to represent the 'real' world in the school because of the emergence of a dualistic understanding of the sign and the ensuing popularity of 'realism' which sought 'a method by which "real" things may be known' (Graves 1914, p. 240). Such a world view had been 'brewing' for many centuries. Graves (1914) for example, suggests

[It] was not until the latter half of the fourteenth century that... [t]here appeared a general intellectual and cultural progress that began to free men from their bondage to ecclesiasticism and *induce them to look at the world about them*. The absolute adherence to an 'otherworldly' ideal that was characteristic of early Christianity and monasticism... [was] by this time rapidly disappearing. Such tendencies were clearly being replaced by a genuine joy in the life of this world, a broader field of knowledge and thought (Graves 1914, pp. 106-107, my emphasis).

The appearance of 'realism' in the seventeenth century (which, from Foucault's account, appears to be connected with the emergence of a dualistic understanding of the sign) could therefore have provided considerable impetus to 'the extraordinary development of the school in the seventeenth century' (Ariès 1962, p. 413). As Mollenhauer himself makes clear, it was only in the seventeenth century, two centuries *after* the idea of schooling young people emerged that *representational* curricular thinking (with its underlying questions of *which* aspects of the 'real' world to include

in the curriculum and *how*) began to emerge. Mollenhauer suggests that Comenius's *Orbis sensualium pictus* (The Visible World in Pictures) a text book for children published in the seventeenth century which makes extensive use of 'images and representations which are not "the thing itself" but instead "point out" things and phenomena (Mollenhauer 1983, pp. 52-53) exemplifies representational curricular thought because it was precisely concerned with the questions of how to represent the world to young people most adequately (See Figure 2.4).



(source: <http://www.uned.es/manesvirtual/Historia/Comenius/OPictus/OPictusAA.htm>).

Figure 2.4

A lesson from Comenius's *Orbis sensualium pictus*. The book simplified the 'real world' in such a way that children could gain an 'adequate' understanding of it

Having linked the 'start point' of representational curricular thought to the emergence of a dualistic understanding of the sign and the opening of the question of how to acquaint the student with 'real' life, I would now like to open the discussion further and examine the methods that have been designed to ensure that children actually acquire knowledge of the 'real' world.

2.4 REPRESENTATIONAL VS. PRESENTATIONAL PEDAGOGIES

With representational epistemology the primary responsibility of modern educators is to ensure that their students acquire knowledge of the 'outside' world. Modern schooling has therefore grown around the idea that the job of educators is to develop methods of getting knowledge (knowing how and knowing that) which is initially *outside* the learner (i.e., in the world) *into* the learner. Learners are therefore always understood to be in the position of being *in need* of knowledge about something which already exists in the world. This assumption – that there is initially a knowledge deficit in the learner which must somehow be bridged by schooling – has played a crucial role in the development of modern schooling and inspired a number of educational techniques which are designed to bridge this gap most effectively and efficiently.

In this section what I hope to make clear is that pedagogical methods of getting knowledge of the world into the minds and bodies of children seem to be based on only two strategies: representational (or 'traditional') pedagogy which is premised on a 'picture' theory of knowledge and presentational (or 'progressive') pedagogy which is premised on a 'use' theory of knowledge. Both strategies rely upon the idea that it is possible to have knowledge of a world or way of life that is present in and of itself. In this respect, both these pedagogical strategies are informed by a set of epistemological assumptions that draws on a dualistic understanding of the sign. Let me start with Comenius.

2.4.1 Comenius and representational pedagogy

Comenius was adamant that schooling was an absolute necessity and that all young people had the right to be educated in schools. This was because he believed that life itself was too complex for young people to learn from and that the only way in which young people could adequately be taught about 'real' life was if a realm of schooling were 'created' for the younger generation, in which they could be presented with life in simplified form, through carefully selected and ordered instructional materials, which were designed specifically to appeal to the young person. *Without* such

educational intervention, Comenius expected the young person would acquire a 'chaotic' understanding of life (Mollenhauer 1983, p. 67).

Comenius regarded both pictorial representations of the world and the sequencing of these representations as indispensable. His approach thus marks a break with other forms of education because he emphasised the importance of drawing on *images* of worldly objects rather than pointing to the *objects themselves*. 'For Comenius, the image was a pivotal didactic tool because it bridged the gap between direct sense impressions (perceptions) and the classification system from which these perceptions initially derive their meaning' (Mollenhauer 1983, p. 59). His pedagogy, in other words, is *representational*. Children learn from representations of the world rather than from the world itself.

While Comenius presented important reasons for using a representational approach for educating children, representational pedagogy has been strongly criticised in the last century for relying on a 'picture' theory of knowledge as inert, decontextualised, formal concepts – that is, 'static representations of an independent reality' – that can simply be transmitted, transferred or otherwise reproduced in the minds of learners who are assumed to have no educational intentions of their own. Up until the end of the nineteenth century children, for the most part, were understood as

'blank-slates' waiting to be inscribed with knowledge, or 'empty vessels' that needed to be filled (Cuban 1984). The most effective way of getting knowledge into the learner was therefore to make sure there was as little interference as possible during the 'transfer' of knowledge. Children were required to passively absorb the knowledge that was being verbally and visually transmitted to them by the teacher (Cuban 1984). For the past century, at least, this representational pedagogical style has been strongly criticised, the most well known of these critics being John Dewey.

Dewey, whose work in education has been highly influential, developed a form of 'progressive' education – which drew on a 'use' theory of knowledge rather than a 'picture' theory of knowledge – in direct opposition to the 'traditional' pedagogical methods that were practiced in his time.

2.4.2 *Dewey's progressivism. A 'presentational' pedagogy*

Like Comenius, Dewey also believed that schools are needed to simplify existing life or 'reduce it to an embryonic form' because, '[e]xisting life is so complex that the young person cannot be brought into contact with it without either confusion or distraction' (Dewey 1897, p. 80). Unlike Comenius, however, he did not believe that the only route to simplifying existing life was to *represent* it. Dewey argued that the representations

young people were presented with in schools had no basis of 'reality' in their experience. Such abstract and decontextualised representations, he argued are 'condemned to be hieroglyphs' which 'remain an idle curiosity, to fret and obstruct the mind, a dead weight to burden it' (Dewey 1990/1902, p. 203).

Furthermore, Dewey argued that prescriptive curricula with set 'start-to-finish' sequences of instruction leave no room for children to exercise their natural curiosity and hence deprive children of the pleasure learning (Dewey 1990/1956). Instead learning becomes a tiresome or even hated chore imposed from without. Further, the lessons taught have 'only an abstract and remote reference to some possible living to be done in the future' (ibid., p. 18) and so have no basis in the actual experience of the child. Lessons that are devoid of any real significant meaning to the child cannot appeal. In order to get children to acquire such 'dead and barren' subject matter – so Dewey argued – schools had to resort to 'adventitious leverage to push it in, to factitious drill to drive it in, to artificial bribe to lure it in' (ibid., p. 205). This, according to Dewey, was a 'waste of human life' (ibid., p. 64). It wasted the lives of the children while they were at school and it was also a waste afterwards because of 'inadequate and perverted preparation' (ibid., p. 64).

The way out, according to Dewey was not so much to improve the link between representation and 'reality,' but rather to do away with the 're' and make schools into places where the world itself was *presented*. In this regard, Dewey proposed a curriculum in which the child was put directly in touch with the 'real' world. His solution was to bring the world *into* the school, i.e., to make schools into places where children could learn directly by experiment and discovery. He insisted that to learn, young people need to actively participate in something that is 'real' for them. Schools were therefore 'to become the child's habitat, where he learns through directed living, instead of being only a place to learn lessons [abstracted from] living' (Dewey 1990/1956, p. 18). With such schools, he argued, the job of the curriculum was to provide the conditions under which children, *by their own activities*, come to their own 'discovery of truth' (ibid., p. 202). With this model, the teacher, rather than being a transmitter of 'dead and barren' representations instead *guides* learning through 'real life' experiences that are educative. This, of course, necessitates the child having certain kinds of experiences.

Dewey was therefore very much concerned with the same representational questions that concerned Comenius. *Which* aspects of the world need to be addressed in the curriculum and *how* this can be done most adequately (i.e., in a way that connects to the child's experience). While acknowledging that

knowledge is intimately connected with what people do – which relies on a ‘use’ rather than a ‘picture’ theory of knowledge – Dewey’s progressive pedagogical approach still relies on the idea that the child must develop knowledge of a world that exists in and of itself, somewhere outside of the child.

2.4.3 *Situated Learning and ‘presentational’ pedagogy*

The progressivist notion of an ‘experience based’ education ties in with ‘participatory’ learning theory (see for example Brown, Collins and Duguid 1989, Lave and Wenger 1991, and Rogoff 1990) which emphasises that the only way in which people can learn *about* the world is when they have the opportunity to participate *in* ‘real’ world practices, and so the idea of young people passively absorbing decontextualised representations of the world in order to use this knowledge in their *later* activities makes no sense. Young people need to be directly *presented* with ‘real’ world practices because ‘all knowledge is ... inextricably a product of the activity and situations in which [it] is produced’ (Brown, Collins and Duguid 1989, p. 33). According to Lave and Wenger (1991), *all learning* is situated in ‘communities of practice’ and cannot be analysed in isolation from either the practice or the community.

While situated learning theory has similarities with Dewey's progressive ideas, situated learning theorists argue that the idea of bringing 'real' life into the school is problematic when the purpose of this is to teach the young person about 'real' world *practices* or *ways of life* (which it often is, e.g., young people are taught about scientific *practice*, i.e., what it means to 'do' science). This is because many of the activities that young people undertake in schools are simply not the activities of practitioners in the 'real' world. Situated learning theorists (e.g., Brown, Collins and Duguid 1989, Lave 1991) have argued that when authentic activities of practitioners are transferred to the classroom, their context is altered to the extent that they 'would not make sense or be endorsed by the cultures to which they are attributed.' (Brown, Collins and Duguid 1989, p. 33). Lave suggests that schools engage in the 'narrowing, trivialization, and decomposition of full participation', and 'decomposition of activity to the point of meaninglessness' (Lave 1991, p. 77-78). Classroom tasks, in other words, can completely fail to provide the contextual features that allow 'authentic activity.' To learn how to use knowledge like a practitioner Brown *et al.* argue that 'a student, like an apprentice, must enter that ['real' life] community and its culture' (ibid., p. 33).

Situated learning theory suggests that, like apprentices in the 'real' world, when young people enter a school culture, they learn *that* culture i.e., they

learn 'school culture'. Schools are communities of practice with their own formal and informal codes of behavior. As Brown *et al.* point out, learning 'school culture' can be very effective within the practices of schooling, but outside of schools, 'where problems do not come in textbooks, a dependency on such school-based cues makes the learning extremely fragile' (Brown, Collins and Duguid 1989, p. 36).

Thus for situated learning theorists, 'authentic activity' is a central component of learning. If this is the case, and if we further assume that the purpose of education is prepare young people for 'real' world practices (ways of life) by teaching them about these practices or ways of life then participatory learning theory must be read as suggesting that young people would be better off being encultured into 'real' world communities of practice right from the start rather than learning about these practices or ways of life in schools (which are communities of practice in their own right, with their own unique social structure). Unlike Dewey, whose solution to representational curricula was to *bring 'real' life into the school*, contemporary participatory learning theories – when understood in the context of schooling as preparation for later life – seem to be suggesting that the solution to representational curricula is to place the young person *directly back into the 'real' world*, i.e., back into 'real' life, and hence do away with formal schooling altogether.

The 'participatory' understanding of learning has been contrasted with the idea of learning as 'acquisition' (Sfard 1998). According to Sfard, the 'acquisition metaphor' – which implies gaining ownership over some kind of self-sustained entity (i.e., knowledge or concepts) which may be acquired through passive reception or active construction – is usually more prominent in older writings on learning while more recent studies on the topic are often dominated by the 'participation metaphor' which, rather than focussing on the individual mind and the knowledge objects that go into it, shifts the focus to the process of 'taking part' or 'being a part' of a greater whole (Sfard 1998, p.6). From the situative perspective, successful 'transfer' of knowledge means improved participation. However, it can still be argued that participation is necessary for the very purpose of *acquiring* knowledge *in order* to participate more fully. As such, participation cannot be opposed to acquisition in the sense Sfard suggests. Participatory learning theories, like the other pedagogies discussed in this chapter, still rely on the idea that people acquire knowledge *of* something that initially exists 'outside' of themselves and which can somehow be brought 'within' through observation, experience, or participation. As such, participatory theories are still reliant on a representational epistemology.

The situated approach is also highly problematic for pedagogical reasons. It has been argued first, from a conservative viewpoint, that a 'decent'

education is not merely an apprenticeship – a form of vocational training – but one in which children get access to all the great works of a particular cultural tradition (see Silberman 2002). Second, from a humanistic perspective, it is argued that children who become apprenticed at an early age will not be exposed to a variety of different subjects and so in this sense their choice of vocation is, at best, severely restricted, at worst, entirely predetermined by others. Third, from a more critical perspective, it is argued that participatory or presentational forms of learning end up in socialisation and adaptation and therefore result in one-dimensional ways of learning.

2.4.4 The representational-presentational binary

The argument so far is that with the emergence of a dualistic understanding of the sign in the seventeenth century the objective of schooling became how to familiarise the young person with the ‘real’ world. It was thought that since the ‘real’ world was too complex for the young person to understand, it had to be presented in simplified form. This necessitated teaching young people about ‘real’ life in schools. The first way in which ‘real’ life was simplified in schools was to present it in the form of carefully ordered *representations* of things rather than the things themselves. This representational pedagogy proved problematic, however, because the

representations had no basis of 'reality' in the experience of the young person. The solution to this was to bring 'real' life into the school, i.e., to present life directly rather than representing it. But this is also problematic because 'real' life cannot be transferred into the school without altering the context of 'real' life to the extent that what is brought into the school no longer bears any resemblance to the 'real' life practice it is supposed to simulate. The solution to this is to place the young person directly back into the world, i.e., to learn from the world itself, rather than in schools. This however, is also problematic, as it means the young person can only learn about the local world, i.e., the world they are immersed in. Although their knowledge may be robust, such 'local' knowledge is also uncritical and narrow. Furthermore, by doing away with the 'educational realm' – as a special realm for children – we are returned to the medieval situation in which children are treated in the same way as everyone else. It would appear therefore that since the emergence of mass schooling which, according to Ariès, started in the fifteenth century, schooling practices have come full circle.

Within this circle both presentational and representational pedagogies are seen to be problematic although they are still the two main approaches to education and becoming increasingly intertwined. To a certain extent they can be used to offset each other's deficiencies. Nevertheless, because they

rely on different theories of knowledge (a 'use' theory and a 'picture' theory of knowledge) this 'co-existence' is an uneasy one. On the one hand, while representational practices produce a critical distance, the 'picture' theory of knowledge upon which it depends is now mostly regarded as obsolete. On the other hand, while the presentational practices rely on a more contemporary 'use' theory of knowledge, the pedagogical practices which result from this theory of knowledge must sacrifice critical distance. The question therefore arises as to whether there is another way forward for education.

I would like to suggest that there is and it lies with tackling representation not at the epistemological level, but at the level of the sign. While both representational and presentational pedagogies use different epistemologies to answer the question of how to familiarise the young person with the world, they are both concerned with closing a gap in knowledge between the young person's understanding of the world and the world itself. One pedagogy attempts to close this gap by presenting the young person with representations of the world, the other attempts to close the gap by presenting the world itself for children to 'reconstruct' or 'participate' in. My point is that regardless of whether this is done through providing accurate representations or by presenting the student with the world 'itself' the underlying assumption that there is a world 'out there' which can either

be represented or presented and which the student needs to learn about. Both 'representational' and 'presentational' pedagogies still rely on the idea of a world that the learner somehow has to be brought in touch with. This understanding, ultimately, rests on a dualistic understanding of the sign. As such, presentational and representational perspectives on curriculum are polarised on a binary *made possible* by a dualistic understanding of the sign. This amounts to a representational worldview, the idea that there is a 'real' world which can be represented in knowledge, language, art and so on. Representations always refer to something that is more 'real' than the representation itself, something that pre-exists the representation. In this regard presentational curricula do not challenge the representational *foundation* of modern schooling. Rather they are themselves a product of the same dualistic logic that drives 'traditional' representational pedagogies. As long as a dualistic understanding of the sign structures curricular thinking educators are stuck with understandings of knowledge – a range of epistemologies – that are fundamentally representational. To escape the presentational-representational binary, and thus put an end to the circling of representational epistemologies around each other in the pedagogical arena, it is necessary to address the problem of representation at the level of the sign. Before 'rethinking' the epistemology of schooling it is therefore necessary to 'rethink' the logic of signification.

2.5 SUMMARY AND CLOSING REMARKS

In this chapter I have argued that the pedagogical practices that characterise modern Western schooling are, for the most part, underpinned by representational theories of knowledge which in turn are underpinned by a representational or dualistic understanding of the sign. The emergence of modern schooling practices can be linked to the emergence of the binary sign in the seventeenth century. This notion structures the kinds of curricular questions that can be asked. I also discussed some of the ways in which problems with 'traditional' representational schooling practices have been addressed. In this regard I argued that problems with representation have been tackled at the level of epistemology, rather than at the more foundational level of the sign. Since a dualistic or representational understanding of the sign facilitated the emergence of modern schooling in the first place all curricular arguments are underpinned by this dualistic logic. This has resulted in a trajectory of curricular theorising which returns to the place it started. To escape this loop, I suggest it is necessary to address representation at the level of the sign. This is particularly pertinent for contemporary educational theorising as dualistic or representational understandings of the sign have themselves been brought into question in the last century, a move which has initiated what is popularly labelled the

'crisis of representation.' It is to the crisis of representation that I turn in the next chapter.

Chapter 3

THE CRISIS OF REPRESENTATION

Representation, semiology, Cartesian epistemology and beyond

3.1 PREAMBLE

In the last few decades there has been a steadily increasing interest in, and debate about, what has become known as the ‘crisis of representation’. To give an idea of the complexity and extent of the debate about representation, it is worth quoting at length the pre-announcement for the ‘Crisis of Representation’ semiotic colloquium that was held at the University of Kassel in Germany on the 18-19 February 2000 (reproduced in a special issue of *Semiotica*).

At the transition from the second to the third millennium, postmodern philosophers, cultural critics, media theorists and poststructuralist semioticians are discussing the crisis of representation [...]. The crisis of representation is the apprehension of a world in which the signs have lost their power

to represent anything. Words become deprived of their referent, images are no longer anchored in reality, the media become more and more self-referential, and the result is a world of virtual or hyperrealities. Texts begin to lose their structural autonomy and ramify in a network of hypertextualities. Closely related to these semiotic processes is the debate about the 'decentering' of the semiotic subject [...]. At the same time, however, the idea of a crisis of representation is gaining support from research in the 'exact' sciences: In physics, quantum theory has demonstrated the impossibility of an unbiased, 'objective' observation and hence representative of the world. In mathematics, catastrophe theory has drawn our attention to ruptures in dynamical and apparently continuous processes. Finally, chaos theory has testified to the existence of identities and self-similarities in apparently chaotic processes and has thus given further evidence to support the idea of self-referentiality in nature (Noth and Ljungberg 2003, pp. 3-4).

In this chapter I shall review only three aspects of the extensive critique of representation. I review the critique (i) in relation to personal knowledge, (ii) in relation to scientific or 'public' knowledge and (iii) in relation to language and writing (semiotics).

The first two lines of argument take place at the *epistemological* level. They are framed in terms in terms of 'Cartesian dualism' (Descartes' mind-world scheme) which splits the 'real' world from our knowledge of it (Cottingham 1992) and therefore take place *within* the logical framework of Cartesian or representational epistemology. Within the Cartesian epistemological

framework the 'crisis of representation' appears as a crisis of indeterminism. The question arises as to which theory of knowledge/representation is the best. Competing epistemologies (which are all representational epistemologies of one sort or another) include 'subjectivist,' 'objectivist' and 'relativist' versions amongst others. In this sense the 'crisis of representation' is not a crisis of the logic of representation *as such* but a crisis of the 'representation of representation' (Jorna and van Heusden 2003, p. 125). The idea that significations 'stand for' something else is taken for granted, treated as a given 'phenomenon'. What is questioned is the epistemological *status* of the representation/signification. For this reason this particular 'crisis of representation' takes place at the epistemological level.

The third line of argument takes place at the level of signification itself. As I argued in the previous chapter, the idea of a sign as something which stands for something else is implicit in Cartesian epistemology. This means a critique of representation at the level of the sign takes place at a more foundational level than the critique of representation that takes place at the epistemological level. This line of argument questions the so called 'phenomenon' of representation, i.e., it puts into question the whole idea that a signification 'stands for' some entity that exists or is 'present' *before* the signification. Here a different logic is developed - the logic of

deconstruction – which challenges the idea that something can be ‘present’ and therefore also challenges the idea that something can be ‘re-presented’ (that which is itself not present it cannot be re-presented). Because this critique of representation takes place at the more foundational level of the sign, it puts into question all epistemological arguments framed in terms of a Cartesian or representational epistemological style. This deeper ‘crisis of representation,’ because it puts into question the foundations of Cartesian epistemology (‘first philosophy’) therefore opens a way of theorising which is fundamentally different from the thinking styles that Cartesianism has spawned. It suggests the need for a different kind of understanding of knowledge, which is not *representational* in either the ‘use’ or ‘picture’ sense.

While the crisis of representation that takes place at the epistemological level has received a great deal of attention by educational theorists (as attested to by the debate amongst curricularists about how and whether pedagogy can be rearranged around a ‘use’ theory of knowledge, as explicated in the previous chapter) the implications of the deeper ‘crisis of representation’ are only just starting to be explored in a systematic way in educational discourse (see Biesta and Egea-Kuehne 2001, Pinar and Reynolds 1992, and Trifonas and Peters 2004 for three collections of works on

deconstruction and education). Let me start by examining the crisis as it applies to the notion of personal knowledge.

3.2 REPRESENTATION AND PERSONAL KNOWLEDGE

The epistemological critique of representation as it applies to personal knowledge generally goes by the names of 'subjectivism,' 'constructivism' or, more broadly, 'idealism.' Historically this is an extremely long-standing argument with versions going back to Plato (Slezak 2000) but all contemporary versions are concerned with the idea that the concept of an 'external world' is a *creation of the mind* and as such personal knowledge cannot *accurately* or 'absolutely' represent 'reality' as it 'really' is. Mental representations, in other words, do not have a correspondence with 'reality' 'out there.' The idea that knowledge accurately or 'absolutely' represents the facts *as they are* is sometimes referred to as 'absolutism.' Knowledge is 'absolute,' in the sense that it is impossible for a person to have *better*, or to have *worse*, knowledge of a fact (Hetherington 2001, p. 3).

In this section I shall provide a brief account of *one* contemporary epistemological argument against representationalism that is framed in subjectivist terms, this being the 'radical constructivism' of Ernst von Glasersfeld (1984, 1995, 1999). This argument captures many of the features of the subjectivist argument as well as being quite well known amongst

educationalists, having been influential in the field of learning theory. For von Glasersfeld, mental 'representations' are not passive reflections of an outer 'reality,' but actively built, subjective *constructions*.

3.2.1 *Von Glasersfeld's 'radical constructivism'*

According to von Glasersfeld (1999) the intuitively obvious view that mental representations represent or 'correspond' to real things in the external world is insupportable because there is no way of checking any such relation to 'real' things. He suggests that this has been a central problem that has occupied philosophers for many centuries and expresses incredulity at the fact that correspondence theories of cognition are still entertained in any form by anyone. In his words

The main argument... is simple and irrefutable. To know whether anything we derive from experience corresponds to or 'represents' an aspect of an external world, we should have to be able to compare it to the real thing. But this we cannot do, because we can compare experiences only to more experiences (von Glasersfeld 1999, p. 284).

Von Glasersfeld's main point is that there is an unbridgeable gap between the objective and subjective worlds. When we try to compare our experience with the 'real' world, we find the 'real' world is not available to us. All that is available is our experience of it and so it is therefore illicit to

claim a one-to-one representational relationship between our experience of the world and any independent external reality. It is important to note, however, that von Glasersfeld is not suggesting that an external 'reality' *does not exist* – in fact his arguments presuppose its existence and in this sense he is a realist – just that *we can know nothing about it*. For von Glasersfeld, the subjective world is the primary production and paramount and any ontological assumptions about an observer-independent 'reality' are 'simply irrelevant'²⁰ (von Glasersfeld 1999).

To make sense of the notion of representation without invoking a mental mirroring of external 'reality,' von Glasersfeld distinguishes quite sharply between what he calls 're-presentations' (with a hyphen) and 'experiences' believing 're-presentation' to be 'reflection upon experience' which is not at all the same thing as 'having an experience' (von Glasersfeld 1995, p. 90). For von Glasersfeld, 're-presentations' are not 'pieces of external reality', but rather

pieces of *experience* that we have combined in order to form more and less complex structures, in our attempt to order and systematise the world in which we find ourselves living. It is the only world we know – and it's a world that only we ourselves perceive and conceive (von Glasersfeld 1999, p. 285, italics added).

²⁰ Although I would argue that such an ontological assumption is *far from irrelevant* because it facilitates his schema.

The first sentence of the above quote makes it clear that von Glasersfeld understands 're-presentation' as *active construction*. In this way he departs radically from the idea that mental representations can passively correspond to the external world. Cognition, for von Glasersfeld, does not have anything to do with *reflecting* an external world. Rather, it serves the subject's *active organisation* of the experiential world and this organisation (or 're-presenting') of the experiential world has an *adaptive* (not mirroring) function – it enables the organism to survive (von Glasersfeld 1989, p. 162).

Von Glasersfeld calls the organisation we construct for ourselves an 'experiential reality' or 'web of beliefs' (von Glasersfeld 1995, p. 116). This 'web of beliefs' is developed as we figure out which of the meanings we attribute to our concepts fit in with the constraints of our experiential 'reality' (von Glasersfeld 1999, p. 287), i.e., any new additions to our web of beliefs have to cohere with our already existing web of beliefs. In this way re-presentation (the active construction of a web of beliefs) is entirely self-referential, i.e., it is based on the web of beliefs already in existence and *not on an external reality*. The constraints of our already existing 'web of beliefs,' so von Glasersfeld argues, prevents our webs of belief from growing in ways that are completely arbitrary. The 'web of beliefs' is thus *self-correcting*, it does not have to rely on the concept of an *external truth* to

legitimate itself. All that any new addition to our web of beliefs requires to legitimate itself is coherence with other already existing beliefs.

According to von Glasersfeld (1999), this sort of 'self-correcting' position is often interpreted as adaptation bringing our mental constructions closer to an observer-independent ontological 'reality,' i.e., it is thought that our representations *reflect* something of the structure of an observer-independent reality. This, however, is *not* how von Glasersfeld wishes his position to be understood. He insists that our 'webs of belief' *say nothing about the external world* because they are not passive reflections of it, but active constructions. There is no reason to think that the world sets limits on the ways in which it might be understood. 'Reality,' for von Glasersfeld, is always 'bigger' than any idea or re-presentation of it that we can possibly construct.

[V]iability [of a web of beliefs] entails neither 'information' about the environment nor correspondence with it. The fact that certain [actively constructed] concepts and certain theories 'work' for us, in that they do what we expect them to do, means no more than that they are compatible with the constraints we experience. In other words, 'reality' leaves sufficient room for them to work in our experiential world. This has the important corollary that our successful concepts and theories can never be claimed to be the only ones that work and therefore they cannot be claimed to be ontologically 'true' (von Glasersfeld 1999, p. 286).

Because von Glasersfeld sets up a relationship between *subjective experiences* and *reflections upon these experiences* his position is sometimes referred to as a 'monist' position. However, calling this position 'monist,' implies that von Glasersfeld has somehow *avoided* the Cartesian mind-world dualism. I would argue that this is not the case. The fact that von Glasersfeld reduces the meaning of the world to a projection or byproduct of an individual observer *does not* free him from dualism for it is the Cartesian world view, in which a strong distinction is made between the knowing subject and the knowable world that enables his epistemology in the first place. The very concept of subjectivity *already* grants the distinction.

3.2.2 *Difficulties with the subjectivist position*

An insurmountable difficulty with von Glasersfeld's position (and other forms of subjectivism) is that if one starts with mind, one finds one cannot get outside of it. In effect, the 'real' world disappears and the account lapses into solipsism. If we cannot 'get outside' our subjectively constructed set of beliefs and compare our experiences to an objective 'reality,' then any model constructed by a subject is as good as any other and there is no way to distinguish adequate or 'true' knowledge from inadequate or 'false' knowledge. Although von Glasersfeld argues that individually constructed knowledge is not arbitrary *for the individual concerned* (for any additions to

a 'web of beliefs' must cohere with what is already there) it is difficult to see how, without any reference to an external 'reality,' this web of beliefs could cohere with the webs of belief of other individuals. Furthermore, there is no way of accounting for the existence of shared realities.

Influential as von Glasersfeld's work has been in challenging understandings of mental representation as the passive mirroring of an external world, subjectivism must ultimately be found to be lacking as an epistemology due a number of problems which Kenneth Gergen lists as including, solipsism, mind-material separation, individualism, political conservatism and moral flaccidity amongst others (Gergen 1994, pp. 117-142). As Bernstein has remarked, subjectivism, in all its forms is 'no longer a live option' (Bernstein 1983, p. 12). Even if it was a 'live option,' von Glasersfeld still understands knowledge as 'standing for' something outside of itself (i.e., 'experience') and, for this reason, his epistemology is still representational in the Cartesian sense. I turn now to another epistemological debate which has taken place around the idea of scientific or 'public' knowledge. Here what has been brought into question is not only the accuracy of scientific representations of an objective 'reality' but also the objectivity of these representations.

3.3 REPRESENTATION AND SCIENTIFIC (PUBLIC) KNOWLEDGE

In this section I wish to show how epistemological arguments taking place mostly in the philosophy of science have opened a debate about how, if we cannot have 'true' knowledge of the world, we can have any knowledge at all. What is *not* questioned is the idea of representation itself, the idea that a representation (such as knowledge) can stand for something outside of itself. The debate takes for granted that knowledge stands for something else, and questions, rather, the epistemological status of the knowledge-representation. However, before exploring this argument, it is perhaps useful to present a view of the epistemological background from which this critique of representation emerged. Although a detailed analysis of this background can be found in any text covering the history of science or contemporary analytic philosophy (see for example Munitz 1981) I include a brief introduction to these developments in this chapter including only sufficient detail to show how the problematic nature of representation came into view. Two alternative theories of knowledge – objectivism and relativism – that emerged from this epistemological climate are then dealt with more comprehensively. I conclude the section with the observation that while both objectivism and relativism offer different theories of knowledge both perspectives nevertheless assume the Cartesian perspective that knowledge must 'stand for' something which is not itself. The

postempiricist critique therefore does not pose any direct challenge to the logic of representation *as such*.

3.3.1 From 'positivism' to 'post-empiricism.'

As I have already mentioned in Chapter 2, the dualistic logic of representational epistemology is said to have emerged in the seventeenth century (Foucault 2002/1970b). For empiricists (or 'realists') of this time, the object of science was to get accurate knowledge of the 'real' world by *describing* and *measuring* it. By concentrating attention on the empirically determinable aspects of nature, early empiricists hoped to achieve the elimination of the subjective (i.e., interpretive) elements of knowledge, thereby achieving *true* knowledge. Because these early empiricists held that the sole 'reality' was 'positive data' obtained through the senses (i.e., 'sense data') they became known as 'positivists,' a term popularised by Comte (1798-1857). In contrast to early forms, later forms of empiricism recognised that the object of science was not simply *to describe* and *measure* the universe but also *to establish connections* between the regularities of nature – i.e., develop universal laws – which are analysable, well founded and constant and which hold at all times and places (Salmon 1992) in order to make predictions. With the addition of a strong *logical* or 'rational'

component to scientific knowledge building endeavours, later versions of empiricism came to be known as *logical* positivism (Munitz 1981).

The logical positivists insisted that to make *scientific predictions*, experiences must be formulated into hypotheses or 'knowledge claims' which can be empirically tested or 'verified' to determine their truth status – i.e., every knowledge claim must be capable of undergoing some sort of empirical analysis which proves it true or false with absolute certainty. This verification procedure was generally understood as *the scientific method*. However, the *principle of verification* – the key to the scientific method – depended wholly on inductive inference (the general is inferred from the particular). This was extremely problematic for logical positivists, for Hume (1711-1776) had long since shown that there is no justification for believing that what we have not experienced will be the same as what we have experienced (Stroud 1992). This problem with the principle of verification presented an insurmountable difficulty for logical positivism for it meant scientific knowledge could *not* be grounded in empirical certainty. Whatever scientific knowledge was, it was not an *accurate* or 'absolute' representation of 'reality' as it really is. And so – at least according to Bernstein – 'absolutism' is now also (i.e., together with subjectivism) 'no longer a live option' for epistemology (Bernstein 1983, p.12).

The philosophy of science, by most accounts, has entered a 'post-empiricist' or 'fallibilist' phase and it is this which appears to have ushered in a 'crisis' or 'anxiety' (Bernstein 1983) around the nature of scientific knowledge. This is because the post-empiricist movement is divided over the issue of what kind of representational structure scientific knowledge is if it is not absolutely true. On the one hand there are those who claim scientific knowledge is grounded in a universal 'rational' conceptual scheme that stands outside of and above all other conceptual schemes (the 'objectivists')(e.g., Popper 1959, Lakatos 1970). On the other hand there are those who claim that scientific knowledge is relative to *specific* conceptual schemes, 'forms of life,' or culture (the 'relativists')(e.g., Kuhn 1962; Quine 1953 1960). The objectivists have a *methodological* theory of scientific knowledge (the scientific method is the universal overarching framework against which all knowledge claims are assessed), while the relativists have a *social* theory of scientific knowledge such that all knowledge claims are seen as particular to the social and historical contexts from which they emerge.

To give an idea of the flavour of these two versions of post-empiricist thought I have, in the following two sections, provided an account of the methodologically orientated 'objectivist' views of Popper (1959) sometimes referred to as 'evolutionary epistemology' (see Stein 1992) and the socially

orientated 'relativist' views of Duhem (1953), Quine (1953) and Kuhn (1962) sometimes also referred to as 'social epistemology' (see Goldman 2001).

3.3.2 *The objectivist view (Popper's 'evolutionary' theory of knowledge)*

In his best known work *The Logic of Scientific Discovery*, first published in German in 1934 and only translated into English in 1959, Popper 'solved' the verificationist's problem of the irrationality of inductive logic by exploiting the fact that a universal statement can be refuted by a single negative instance. Using this logic, Popper claimed that while it is rational to *reject* beliefs, there is no rational way we can *accept* any belief. In the light of this, he suggested that the only theories that count as 'scientific' are those that are *falsifiable*, and the aim of scientific research should be to 'falsify' (or refute) truth claims not find reasons to accept (verify) them. He proposed a methodology of 'falsificationism' or 'critical rationalism' whereby all truth claims are to be rigorously tested in an attempt to falsify them. Those that survive falsification are *tentatively* accepted, while those that do not are rejected. This seems to imply that truth claims that fail this test (i.e., truth claims that can be falsified) can be *permanently eliminated* and knowledge can therefore progress towards 'truth' in a straightforward manner. This understanding of falsificationism has been called naïve falsificationism (see Lakatos 1970). But Popper's scheme was far more sophisticated than this.

Popper (1959) was well aware that a logic which insists that it is irrational to accept truth claims also undermines itself. If it is irrational to accept truth claims this means it is also irrational to accept as conclusive the (truth) claim that a particular theory is false. Everything (including the apparent 'falsification' of a theory) must be subject, again and again, to the logic of refutation, *ad infinitum*. Thus, for Popper, it is the *logic* of falsification (i.e., the *method*) not its *conclusiveness* that is of consequence for scientific knowledge. This is extremely important in Popper's philosophy. This 'falsificationist' credo leads to the inevitable conclusion that *we can never find out what is true*. Indeed we cannot even know what is 'truly' false.

Nevertheless, although Popper firmly maintained that we can never *conclusively* discover what is true (or false) he did not succumb to the conclusion that scientific knowledge is unable to progress. Quite the contrary. To explain the progression of scientific knowledge Popper (1972, 1980) evokes the notion of 'conjecture' (an opinion without proof). He maintains that in order for knowledge to grow, the logic of falsification must be applied to 'conjectures' which are tentative hypotheses (Popper 1962). For Popper scientific knowledge grows by means of 'conjectures and refutations.' (Popper 1962, p. 46).

On this account, the logic of falsification is analogous to biological natural selection (survival of the fittest) and in this sense the growth of scientific knowledge is 'evolutionary' (Stein 1992). New conjectures (opinions without proof) confront selective pressures, they meet the competition of alternative theories, critical arguments and experimental testing, and only the 'fittest' (given the empirical tools and understandings of the time) 'survive.' In this interpretation the most sophisticated scientific theories are simply the end products of 'epistemic natural selection' (Popper 1980).

What Popper has done is impose a set of 'universal' methodological rules that embody the choices or decisions scientists can make, and furthermore he sees only *one* set of rules (the logic of falsification applied to conjectures), against which *all systems of thought* are to be judged. It is, for Popper, the existence of a privileged or 'universal' *method* for science that supposedly guarantees the *objectivity* of the product. However, Popper's claim that scientific knowledge is 'objective knowledge' (i.e., uncontaminated by subjective social bias) holds only if one assumes that the growth of scientific knowledge *is* in fact free of social bias. In the next section I will show that this assumption has itself been brought into question.

3.3.3 *The relativist view (social theories of knowledge)*

The work of Duhem (1953), Quine (1953) and Kuhn (1962) has contributed greatly to the idea that methodology does not furnish a transcendent or context-free standard that lies somehow outside of and above competing alternatives. These authors have all shown that historical and social influences cannot be ignored or excluded from any theory of knowledge.

This move towards a social theory of knowledge in fact starts with Popper himself, with his view that that neither verification *nor* falsification is unequivocal (Popper 1959). Elaborating on this view of falsificationism Duhem (1953) drew attention to the complex interconnectivity of scientific practice and showed that any empirical outcome can be protected indefinitely by *ad hoc* modifications that alter the background assumptions. More specifically, he showed how a knowledge claim can never be conclusively refuted for there could always be something else in the test situation that caused the result. However Duhem's more explicit formulation of the problem with falsification still does not help us to see that Popper's falsificationist methodology leads straight to a social theory of knowledge. This was achieved by Quine (1953), who developed Duhem's ideas into what is generally referred to as the 'Quine-Duhem thesis'.

Using a metaphor, Quine (1953) suggested that scientific beliefs could be understood as a fabric stretched taught, like the skin of a drum. As new scientific observations are added to the system, the fabric adjusts to accommodate this. In this way theoretical developments can be understood as a reorganisation of the whole fabric. The point of the metaphor is to show that no *single* scientific observation will have a *determinate* effect on the web or 'fabric' of beliefs. Observations will have an impact, but are moderated by the state of the fabric *as a whole*. Thus, in practice, an empirical observation cannot be separated from the framework of activities, practices and beliefs in which it is embedded. Since it is moderated by all the other elements in the web it can only be evaluated *in terms of this whole web of issues*, or fabric of beliefs.

The crucial point here is that the Quine-Duhem thesis makes it clear that individual theories or observations cannot be individually assessed against an objective state of affairs in the 'real' world but can only be assessed in the light of *the theoretical climate of the day* – i.e., the particular beliefs, values, standards, methods and aims of its practitioners. The truth or falsity of a theory is judged according to whether it makes sense *within a particular framework*. Even though we may use the logic of falsification to assess our scientific theories, to judge a theory to be 'false' is a 'theory-laden' undertaking, i.e., to say that 'x is false' requires an extensive knowledge

about factors which would make x false. These factors themselves are contingent on other knowledges making up the web of beliefs. In the light of this it is difficult to escape the conclusion that scientific theories are contextually embedded. This means they are socially and historically located. Fully extended, the Quine-Duhem thesis suggests that all knowledge is an expression of social relations. By showing that scientific knowledge is not free of social bias and in this sense it is not objective the Quine-Duhem thesis seriously compromises Popper's claim to the 'objectivity' of scientific knowledge. Closely related to this critique is the historical work of Thomas Kuhn (1996/1962).

Kuhn (1996/1962) argued that the actual history of scientific progress is rarely in agreement with Popperian assumptions. He claimed that the historical record shows that most major scientific theories have advanced or been maintained for long periods *in spite of apparent refutations by empirical data*. This conclusion suggests that Popper's falsificationist methodology is therefore not the only device for adjudicating among competing scientific accounts. Other rules are also at play.

According to Kuhn, 'real' scientific progress occurs only when there is a 'paradigm shift' or 'scientific revolution' (which is a comparatively rare occurrence). For Kuhn, a 'paradigm shift' is not the gradual, cumulative

result of *falsifications*, but more like a gestalt shift in perception, resulting from the accumulation of 'anomalies', until a new theory (or paradigm) emerges which can account for them. According to Kuhn, the switch to a new paradigm *is not a rational undertaking*, but a 'leap of faith'. It is a leap of faith because paradigms separated by a scientific revolution are *incommensurable* with one another, the new intelligibility cannot be understood in terms of the old. Kuhn suggests that for a new paradigm to be accepted (on faith) by some members of the scientific community it has to meet only two important requirements, (i) it must resolve a recognised problem that can be resolved in no other way, and (ii) it must preserve a concrete part of past problem-solving achievements, although many old problems will have to be banished (Kuhn 1996/1962, p. 169). Once the new paradigm has been accepted by some members of the scientific community, the paradigm is strengthened and entrenched and it is only a matter of time before it becomes the dominant paradigm.

In view of these critiques of the objectivist view of scientific knowledge there are those who claim that a 'relativist' view of knowledge is in fact the only logical alternative (see, for example, Feyerabend 1975). That all knowledge *can only* be grounded in the conceptual framework from which it emerges and that there is no overarching framework or 'meta-logic' that can be used to adjudicate between competing conceptual schemes. However

despite the intractable problems with objectivism that the relativist view exposes, the relativist view is itself highly problematic. The main argument that is brought to bear against the relativist view of knowledge is that

[R]elativism, whenever it is clearly stated, is self-referentially inconsistent and paradoxical. For implicitly or explicitly, the relativist claims that his or her position is true, yet the relativist also insists that since truth is relative, what is taken as true may also be false. Consequently, relativism itself may be true *and* false. One cannot consistently state the case for relativism without undermining it (Bernstein 1983, p. 9).

The relativist framework puts forward a view of what is ‘really’ going on. In this sense it seeks to *represent* the situation – and in doing this it takes up the very stance it attacks. In view of problems with both objectivism and relativism, Richard Bernstein argues that the objectivist-relativist argument about the status of scientific knowledge has reached an impasse of indeterminacy.

3.3.4 Beyond objectivism and relativism

In his book *Beyond Objectivism and Relativism* Bernstein draws attention to the fact that the opposition between objectivism and relativism is only possible ‘if we implicitly accept some version of Cartesianism’ (Bernstein 1983, p. 19). According to Bernstein, the dualistic scheme, which splits

knowledge from 'reality' facilitates only one kind of epistemological debate: the debate about the nature of the relationship between knowledge and what it stands for. Largely, this is a debate about how closely (or not) our knowledge corresponds with reality. In this regard, so Bernstein argues, we appear to be faced with only one choice, a choice between objectivism and relativism (because subjectivism is already ruled out). Furthermore, there is a good deal of anxiety associated with this choice – which he calls the 'Cartesian Anxiety' (ibid., p. 16) – because of the fear that if we give up objectivism we are left with incoherence. As Bernstein puts it, there is a fear that

Either there is some support for our being, a fixed foundation for knowledge, or we cannot escape the forces of darkness that envelop us with madness, with intellectual and moral chaos (Bernstein 1983, p.18, emphasis original).

This 'Cartesian Anxiety' can be equated with the 'crisis of representation' at the epistemological level. The idea of a *crisis* of representation suggests the anxiety associated with impasse now reached between objectivism and relativism. The realisation that neither truth values *nor criteria of rationality* exist outside of time and place – i.e., outside of social relations – ushers in a crisis around the fear that the loss of the possibility of *true* representation, leads ultimately to chaos. Bernstein suggests, however, that there is another

way of looking at this debate. Rather than getting caught up in assessing the various strengths and weaknesses of objectivism and relativism, it is possible to look at the impasse between objectivism and relativism as putting into question the whole framework of thinking which facilitates the impasse, i.e., the framework of Cartesian dualism, in which knowledge and the world are split from each other.

Using Bernstein's argument it is possible to say that both sides of the objectivism-relativism debate are concerned with the *accuracy* of our knowledge. Both assume that knowledge is a representation of something that lies outside of itself and so both sides of the debate argue over the nature of these representations. On the one hand the objectivists argue that scientific representations are grounded in 'universal' criteria of rationality which exist 'in themselves' (i.e., as 'truth'). On the other hand the relativists argue that the standards of rationality of scientific knowledge are culturally and contextually situated (such that there is no ultimate truth, no ultimate standard against which everything can be judged). Nevertheless, while they argue over whether the standard *against which* knowledge is judged is universally or contextually based, both assume that knowledge represents or stands for something that is not itself. The idea of representation is therefore implicit in the assumptions on both sides of the debate. This suggests that the way out of the objectivist-relativist impasse, which is also a

way out of the epistemological 'crisis of representation' is to make use of an alternative form of logic, one *not* premised on the idea of representing the world. But what could take the place of representational epistemologies in all their variants? To address this question it is necessary to address the critique of representation at the level of the sign. It is necessary to go deeper, into semiology²¹ and the philosophy of language for no Cartesian theory of knowledge is independent of a representational theory of signification as described in Section 2.2.4.

3.4 REPRESENTATION, SEMIOLOGY AND WRITING

In this section I am concerned with arguments against the idea that the signs we use to communicate have a simple representational relationship with reality. Although there are a number of perspectives that bring into question the idea that the signs we use in language have a 'straightforward' representational character (e.g., the work of Frege, Peirce, and Wittgenstein) I will, in this section, draw only on the work of Ferdinand de Saussure and Jacques Derrida as I believe it only in Derrida's work that there is a fundamental break with a dualistic conception of representation. De Saussure is included because Derrida's logic follows de Saussure's logic exceptionally closely and therefore to understand Derrida's perspective on

²¹ The word 'semiology' comes from de Saussure, but it is more commonly known as

this issue is also to understand de Saussure's perspective. In what follows I shall provide a brief account of de Saussure's semiology to present the basic semiological framework. Following this I present Derrida's critique of de Saussure's semiology and in so doing introduce the logic of deconstruction.

3.4.1 De Saussure's 'semiology'

To understand de Saussure's linguistics, which he calls 'semiology', it is necessary to understand his terminology, and in particular his understanding of the terms 'sign,' 'signified,' 'signifier,' 'meaning' and 'value'. It is also necessary to understand that his system is based on the privileging of speech – 'the social product stored in the brain, the language itself' (de Saussure 1983/1916, p. 24) – over writing, and this is primarily what Derrida takes issue with. De Saussure insisted that

A language and its written form constitute two separate systems of signs. The sole reason for the existence of the latter is to represent the former. The object of study in linguistics is not a combination of the written word and the spoken word. The spoken word alone constitutes that object (de Saussure 1983/1916, pp. 24-25).

For de Saussure, a linguistic sign is not a link between a word and a thing in the external world (i.e., a 'referent') but rather a link between a psychological concept and a 'sound-pattern,' which 'is the hearer's

'semiotics' in English-speaking countries.

psychological impression of the sound' (de Saussure 1983/1916, p. 66). In his words, a sign is 'a two-sided psychological entity' (ibid.) and the 'two sides' of this entity are as inseparable as two sides of a sheet of paper. 'Just as it is impossible to take a pair of scissors and cut one side of paper without at the same time cutting the other, so it is impossible in a language to isolate sound from thought, or thought from sound' (ibid., p. 111). De Saussure also calls these two psychological aspects of the sign – concept and sound-pattern – the 'signified' and the 'signifier' respectively (de Saussure 1983/1916)²² although the word 'signifier' is also used more generally to refer to any material symbol (sound, written word, image) to which a concept is linked. Figure 3.1 shows how de Saussure represents his 'sign.'

Furthermore, de Saussure stresses the *arbitrary* nature of this inseparable link between the two components of the sign. This can be understood in terms of the way in which a sign comes into being, or emerges from thought and sound. In this regard, de Saussure speaks of thought and sound as, initially, being 'two amorphous masses' in which 'no shape is intrinsically determined', as shown by 'A' and 'B' in Figure 3.2. Signs emerge from these two 'amorphous masses' by a process of 'segmentation'

²² Actually in this (more recent) translation of de Saussure, the terms 'signification' and 'signal' are used to denote 'signified' and 'signifier' respectively. Wherever these terms have occurred in the book, I have replaced them with the older terms 'signified' and 'signifier' as these are the terms Derrida uses.

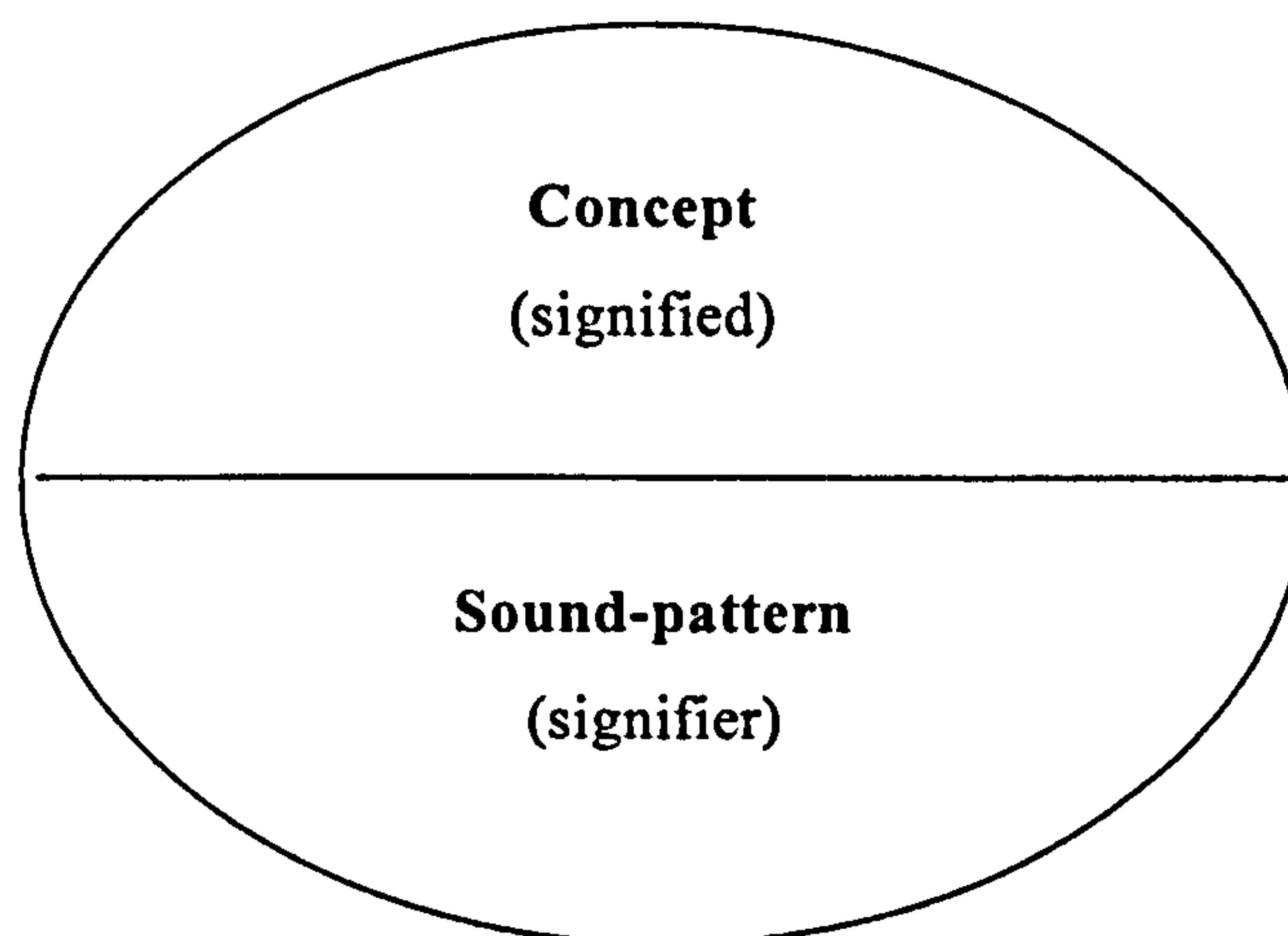


Figure 3.1

de Saussure's diagrammatic representation of the 'sign' as a two-sided psychological entity (adapted from de Saussure 1983/1916, p. 67)

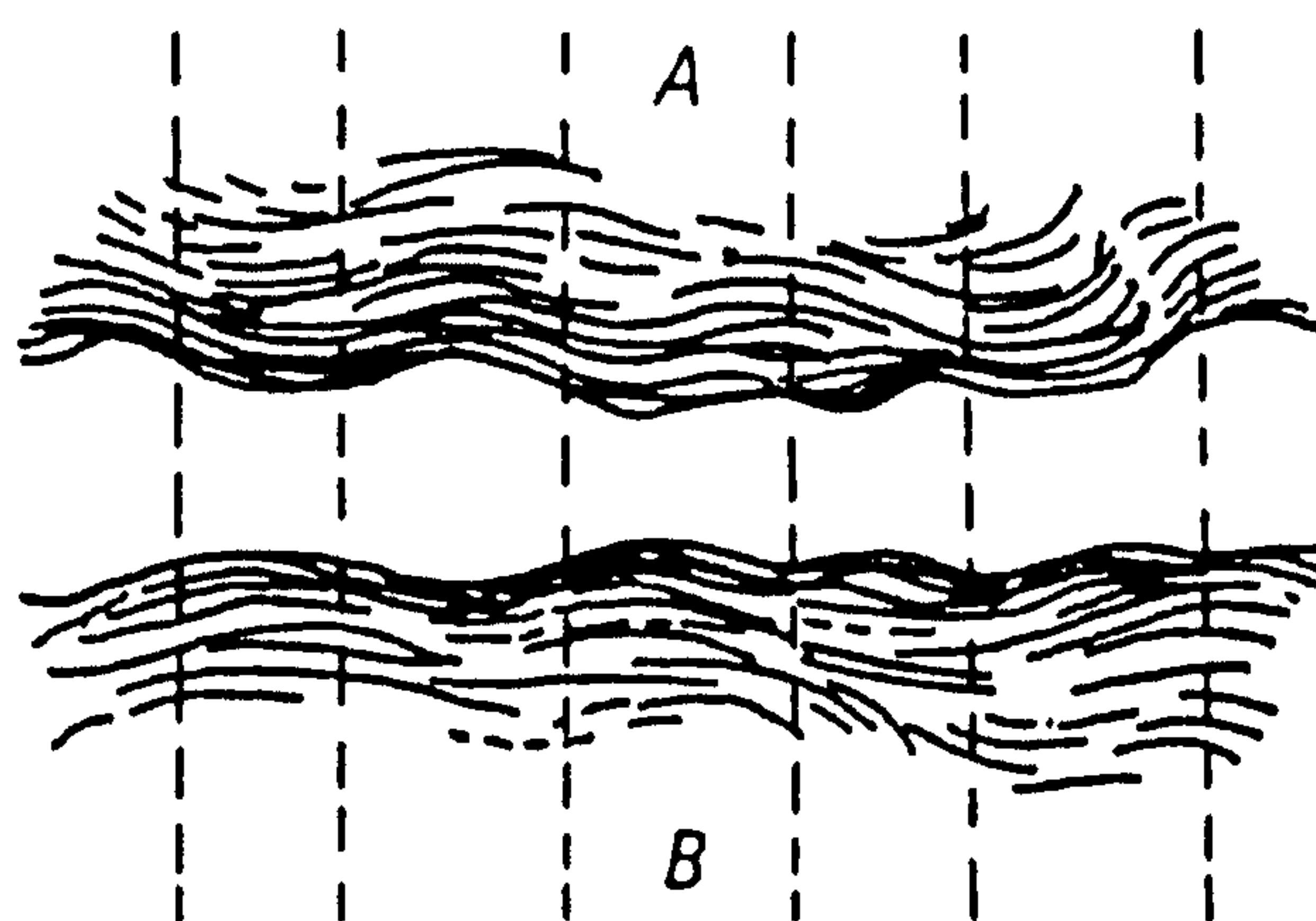


Figure 3.2

de Saussure's illustration of the shifting 'nothingness' of (A) thought and (B) sound (reproduced from de Saussure 1983/1916, p. 111, with permission of Duckworth Publishers, London).

in which segments of thought become associated with segments of sound (ibid., pp. 110-111).

According to de Saussure, neither thought nor sound are able to offer ready-made moulds for each other (ibid., p. 110). Because there are no ready-made moulds, 'with shapes that thought must inevitably conform to' (ibid., p. 110), a thought *arbitrarily* becomes linked with a 'segment' of sound, and this *arbitrary linkage* is what produces his two-sided psychological entity or unit: the sign. De Saussure explains this as follows:

What takes place, is a somewhat mysterious process by which 'thought-sound' evolves divisions, and a language takes shape with its linguistic units between those two amorphous masses.... Every linguistic sign is a part or member, an articulus, where an idea is fixed in a sound, and a sound becomes the sign of an idea (de Saussure 1983/1916, pp. 110-111, emphasis original).

A sign can therefore be described as a correlation between a signifier which is an arbitrary material symbol (e.g., a sound-pattern) and a concept or thought - the 'signified.' Were it not for this process of segmentation, where signs differentiate from the 'nebulous world of thought' (ibid., p. 110)

we should be incapable of differentiating any two ideas in a clear and constant way. In itself, thought is like a swirling cloud, where no shape is intrinsically determinate. No ideas are established in advance, and nothing is distinct, before the introduction of linguistic structure ... Thought, chaotic by nature, is made precise by this process of segmentation (de Saussure 1916, p. 110).

Unsegmented, given no acoustic difference between the signifiers of two ideas, de Saussure argues that the ideas themselves will not be differentiated. However, although the arbitrary linking of thought with segments of sound to form 'signs' explains how ideas may become differentiated 'in a clear and constant way' (ibid., p. 110), the question still remains as to how these self-contained units – signs – *acquire their meanings*, because, for de Saussure, a 'thought-sound unit' cannot be understood as the counterpart of an independently existing referent, already in the world. To explain how a sign (or word) acquires its meaning in the absence of a direct reference to a 'reality' outside of itself, de Saussure draws on the notion of 'value'.

Using as an example the 'value' of a five-franc coin (see ibid., p. 113), de Saussure distinguishes two elements comprising the term 'value'. First, he suggests the value of a thing (even in non-linguistic cases) can be understood in terms of dissimilar things that it can be exchanged for. For example a five-franc coin could be exchanged for a loaf of bread – this can be called its '*exchangeable value*.' Second, he suggests value can be understood in terms of

similar things that can be compared. For example the value of a five-franc coin is ascertained by comparing it to a one-franc coin, or a twenty-franc coin, or a coins of a similar value belonging to another system, such as an English penny. This can be called its '*comparable value*.' It is the latter meaning of the term 'value' that is of the most importance to de Saussure, for he claims that although words have exchangeable value, their meaning can never be determined only by this exchangeable value.

Its value is ... not determined merely by the concept or meaning for which it is a token. It must also be assessed against comparable values, by contrast with other words. The content of a word is determined in the final analysis not by what it contains but by what exists outside it. As an element in a system, the word has not only meaning but also – above all – a value. And that is something quite different (de Saussure 1916, p. 114).

For de Saussure, while the linkage of concept and sound creates an *exchangeable value* (i.e., the sound and concept are exchangeable), this value is dependent for its meaning on the surrounding signs making up the system. Put differently, the exchangeable value of the sign can only be understood in terms of what exists around it, i.e., it can only be evaluated in terms of that which it is not but against which it can be compared and which will restrict its meaning. It can only emerge 'from relations with other values of a similar kind. If those other values disappeared, this

meaning too would vanish' (de Saussure 1916, pp. 115-116). In the end it is only through the values created by the *differences* between signs that it is possible to ascertain their meaning (see Figure 3.3). The sign, in other words, has a negative value – *there are no positive ideas*. In de Saussure own words 'in a language there are only differences, and no positive terms' (de Saussure 1916, p. 118).

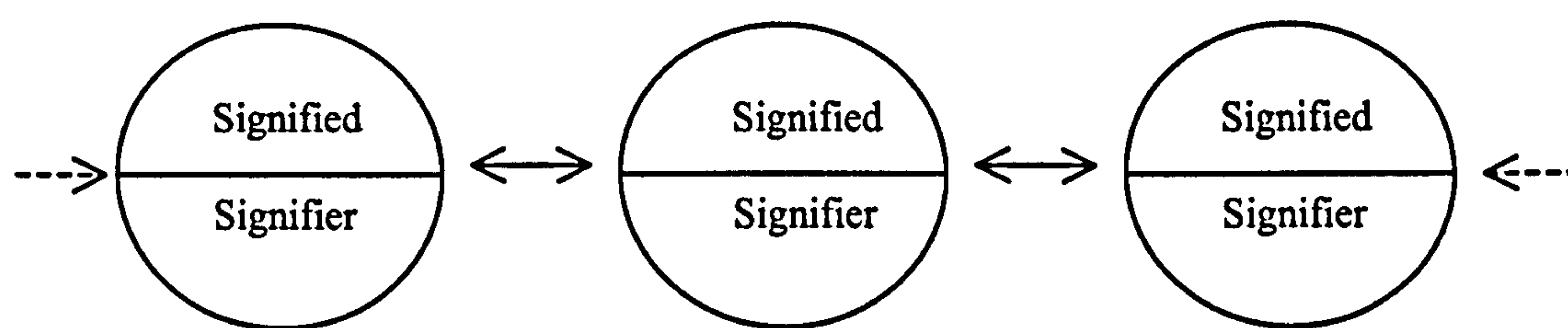


Figure 3.3

The individual meaning of the signified emerges from
the play of difference between signifiers
(illustration adapted from, de Saussure 1983/1916, p. 113)

What de Saussure's semiotics makes evident is that the meaning of a sign does not lie in some independently existing 'reality' that exists somewhere outside of language itself. Rather meaning is instead the product of a vast web of interdependencies and usages – it is the result of *relational action*.

This is a radical shift in thinking and de Saussure was not unaware of the

importance of these ideas which he predicted would form the basis of a new science.

We shall call it semiology (from the Greek *sēmeîon*, 'sign'). It would investigate the nature of signs and the laws governing them. Since it does not yet exist, one cannot say for certain that it will exist. But it has a right to exist, a place ready for it in advance (de Saussure 1983/1916, pp. 15-16).

While 'semiology' – the science of signs – did in fact develop exactly as de Saussure predicted it would, Culler (1986) suggests that de Saussure's 'relational approach' is in itself is not something radically new. He claims it embraces a world view which has generally been labeled 'process philosophy' – as articulated by Alfred North Whitehead (1985) and his followers (Culler 1986, p. 128). This view has been around at least since the ancient Greeks (Rescher 2002) although Western metaphysics has mostly been biased in favour of things or substances – what Whitehead calls the 'materialism' which grants ontological primacy to objects. However, as Culler comments, in the twentieth century there have been shifts in techniques in various fields and disciplines – including art, philosophy and science – which have led to a concentration on systems of relation rather than independently existing objects and things. With this focus it is relations

and systems of relations that are given ontological primacy, *relationships create and define objects not the other way around*.

According to Culler, de Saussure's work articulates the themes of process philosophy particularly clearly 'not as aspects of some diffuse world view but as methodological postulates' (Culler 1986, p. 129). However, there is a problem in equating de Saussure's work with a process philosophy, in that he specifically downplayed diachronic or temporal aspects which, according to Rescher (2002) are *fundamental* to process philosophy. With regard to linguistics, de Saussure maintained that 'if [one] takes a diachronic point of view, [one] is no longer examining the language, but a series of events which modify it' (de Saussure 1983/1916, p. 89). The clear separation of synchronic and diachronic studies of language, de Saussure maintained, was entirely necessary to understand the actual *structure* of language for

no synchronic phenomenon has anything in common with any diachronic phenomenon. One is a relationship between simultaneous elements, the other a substitution of one element for another in time, that is to say an event (de Saussure 1983/1916, p. 90).

Furthermore, de Saussure insisted that the diachronic aspects of a language were *secondary* to synchronic aspects 'for a language is a system of pure values, determined by nothing else apart from the temporary state of its

constituent elements' (ibid., p. 80). What is evident here is that de Saussure wanted to pin down the structure of language as a system, and his focus on the synchronic aspects of language – on the *state* of a language at a particular moment in time – makes it hard to reconcile de Saussure's semiology with a process philosophy. Even though the state of a language at a particular moment in time may be the result of the relationality of the system of signs at a particular moment, this leaves no room for movement within the system. In other words, there is only *one possibility* for the system at a particular moment in time, one possible way in which the system may be coordinated. In effect, de Saussure is looking at language as an *object* not a *process*.

One does not need to look too closely at de Saussure's argument to see that he provides a representation of language (i.e., he tries to describe the way language 'really' is) which suggests that language *cannot produce such representations* (signs, for de Saussure, exist primarily in relation to *each other* before they exist in relation to a concept, they are therefore not representational). In other words de Saussure assumes a perspective outside language to describe language and in this sense he makes use of the very representational logic that his theory of language undermines.

It is here that Derrida's work becomes important. Derrida provides an alternative reading of de Saussure, emphasising the diachronic aspects which de Saussure deliberately excluded or made secondary, showing also that these very aspects of language are in fact *the general mechanisms of language*. They are the mechanisms which make language possible, and without which we could not have/use language. In doing this Derrida takes de Saussure's scheme beyond representational logic, into the logic of deconstruction.

3.4.2 Derrida's 'deconstruction'

Derrida does not simply replace de Saussure's logic with an alternative. Rather he follows de Saussure's logic through to a different conclusion, or, more accurately a different 'non-conclusion.' The alternative '(non)conclusion' – which is deconstruction – takes issue with the notion of presence, and hence with the idea that knowledge can 're-present' that which is already there.

To recap, de Saussure's main thesis was that the 'value' or 'meaning' of a particular sign could only be determined by comparison with the values of other signs that surrounded it in acts of speech. In other words, the terms internal to a linguistic system define each other uniquely, by contrast and comparison (i.e., by use), without regard to a referent that is *external* to the

system. However, as mentioned, de Saussure focusses on the *synchronic* state of the system (de Saussure 1987, p. 99) as if it can be frozen. This can be likened to a snapshot of the structure of the linguistic system as it is in a moment in time. Harland describes this as a 'simultaneous system.' It is 'simultaneous in that the system only balances if words push against each other at exactly the same time' (Harland 1987, p. 136). To do this everything in the system must be present at once, everything must be 'there' at a particular moment in time. De Saussure insists that it is only through the study of synchronic linguistics that we are able to 'establish the fundamental principles of any idiosyncratic system, the facts which constitute any linguistic state' (de Saussure 1983/1916, p. 99). Diachronic linguistics, he claims, is not helpful in this regard since it is 'concerned with connections between sequences of items... which replace one another *without themselves constituting a system*' (de Saussure 1983/1916 p. 98, my emphasis). It is this point that Derrida picks up on (he suggests that diachronic elements *do* constitute the system) and I will return to this later. But let me first explain what happens to meaning when the synchronic aspects of language are privileged.

With de Saussure's synchronic scheme meaning can be understood to be contingent on the state of the linguistic system at a particular moment in time. Because meaning, at any moment, is determined by the state of the

system *in its totality* and because the system is constantly changing, the meaning of a concept is not static but can nevertheless be *fully* present to a speaker at a particular moment in time. To put this differently, when the whole system is 'frozen' in a moment in time, meaning can be understood to be fully present to a speaker. It is this idea – that meaning can be fully present to a speaker – that Derrida takes objection to in his critique of de Saussure (Derrida, 1976). He makes this argument in two main steps.

First he shows that contrary to de Saussure's claim that writing is only a 'sign of a sign' while speech is a 'real' sign, that as a system of signs writing is *no different from speech*. This means that if writing is a 'sign of a sign' *then so is speech*. In other words all signs are a form of writing. He then closely follows the 'logic of writing' – which he calls 'grammatology' in contrast to de Saussure's 'semiology' – and in doing so shows that at no point in time are all the elements of a grammatological system 'there' at the same time. For this reason meaning can never be 'fully' present. Further, it is this very 'non-presence' of meaning that makes communication possible. In what follows I trace this argument in more detail.

For Derrida, the 'presentationalism' (my word) in de Saussure's thought begins with his (mistaken) claim that the sign is an 'articulated *unity* of sound and sense' (Derrida 1976, p. 29, my emphasis). This articulated unity

(i.e., the signifier-signified, in its relation with other signifier-signifieds) is, for de Saussure, the 'real' sign while writing is secondary, being merely a 'sign of a sign' or a 'pure signifier' (see *ibid.*, p. 43). For Derrida, de Saussure's claims about the 'unity' of sound and sense are incoherent for the very reason that the link between the signified and the signifier is always *arbitrary*. If the bond between signified and signifier is 'arbitrary' – as de Saussure claims it is – this means it can only be an *unmotivated* or *instituted* bond, i.e., a bond that must be *formally established*, having no 'natural attachment' to the signified within reality. To say this differently, if the relationship between signifier and signified is *instituted*, this means the signifier can never be understood to *naturally* mirror the signified – 'the property of the sign is not to be an image' (*ibid.*, p. 45) – there is no natural connection, rather the signifier must be something that is *put in place* as a mark or inscription: i.e., *a form of writing*. In fact, as Derrida points out, de Saussure *himself* uses writing as an example to explain the arbitrariness of the link between signifier and signified of the 'real' sign. He suggests that

an identical state of affairs is to be found in that other system of signs, writing. Writing offers a useful comparison, which throws light upon the whole question... The letter *t* for instance has no natural connection with the sound it signifies... (de Saussure 1983, pp. 117-118).

What Derrida makes clear is that *all* signifiers, even phonic ones (i.e., ‘sound images’) are ‘written’ (graphic) in the narrow sense of being *instituted* rather than ‘naturally’ mirroring something. The very idea of the arbitrariness of the sign, for Derrida, is therefore ‘unthinkable before the possibility of writing’ (Derrida 1976, p. 44). Derrida gives the name ‘arche-writing’ to this *generalised writing* (ibid., p. 60) and maintains that ‘writing in general covers the entire field of linguistic signs’ (ibid., p. 44). If this is the case then there is no reason to make a distinction between a ‘real’ sign (i.e., de Saussure’s ‘unity’ of sound-image and concept) and a ‘sign of a sign’ (i.e., writing, which de Saussure demotes to being a ‘pure’ signifier). For Derrida ‘writing is not a sign of a sign, except if one says it of all signs, which would be more profoundly true’ (ibid., p. 43). As Derrida puts it,

...the thesis of the arbitrariness of the sign ... must forbid a radical distinction between the linguistic and graphic sign... [F]rom the moment one considers the totality of determined signs, spoken, and a fortiori written, *as unmotivated institutions*, one must exclude any relationship of natural subordination, any natural hierarchy among signifiers or orders of signifiers (Derrida 1976, p. 44, italics added).

Derrida’s next step is to show that the arbitrary or ‘instituted’ connection between the two elements of the sign means signified and signifier must

necessarily always remain totally different or 'other' from each other. This means the sign, for Derrida, is a place

where the completely other is announced as such – without any simplicity, any identity, any resemblance or continuity – in that which is not it (Derrida 1976, p. 47).

Thus, while de Saussure makes of the heterogeneous sign a *unity* inseparable as 'two sides of a sheet of paper' such that the signifier simply 'brings out' the signified which is *already present* (but unable to present itself without the help of the signifier), Derrida maintains that nothing is 'brought forth' by the signifier, it simply marks a space 'where difference appears *as such*' (Derrida 1976, pp. 46-47, original emphasis). Let me put this another way. While de Saussure thinks of the unity of 'sound-image' and concept as *revealing a presence* and hence bringing about the closing of the play of difference between signs (ibid., p. 57), for Derrida there is *only* the play of difference between signifiers. The signifier marks a space where difference appears as difference. It does not 'reveal' a self contained presence. One of the terms Derrida uses for this space where difference appears is 'trace.'²³ Because the trace is not a self contained presence, Derrida goes so far as to say that 'no concept of metaphysics can describe it' (ibid., p. 65). It is

²³ Another better known term that Derrida uses for this is 'différance.'

necessary, nevertheless, to attempt a description of Derrida's 'trace,' even if only a temporary one, in order to show how this '(non)concept' presents a radical challenge to the idea of presence for, as Derrida puts it, 'difference cannot be thought without the *trace*' (Derrida 1976, p. 57, italics original).

Derrida uses the word 'trace' to refer to an absence. But this is not a 'pure' or 'simple' absence. It is an absence which is *marked* by something that is not present. It is imprinted by something which is itself not there. But that which is not there has not left the scene, having been present at some time in the past. The trace is an absence marked by that which was never there, which was always already absent, not the result of some presence or originary *non-trace*. In Derrida's words:

The trace is not only the disappearance of origin... it means that the origin did not even disappear, that it was never constituted except reciprocally by a non-origin, the trace, which thus becomes the origin of the origin (Derrida 1976, p. 61).

Derrida suggests that to think the notion of the trace it is necessary to speak of an 'originary trace' or 'arche-trace' while knowing

that that concept destroys its name and that, if all begins with the trace, there is above all no originary trace (Derrida 1976, p. 61).

The significance of the concept of the trace is that any meaning that is said to be 'present' is caught up with something that is *not* present. Meaning cannot present itself 'by itself, in its own words, in its own voice, in its logos' (Derrida 1981, p. 31). It is present only in so far as it is *also* absent. The trace is therefore *neither* present *nor* absent. And at the same time it is *both* present *and* absent, or perhaps one could speak of its 'presence-as-absence' as Michael Dillon does (Dillon 2000, p. 15). Meaning cannot be captured in a 'snapshot' in time, not even a snapshot which is the always 'now.' The trace entails that all thought is in fact inhabited and constituted by the 'non-now,' by that which is not present 'now.' Derrida remarks that 'in the last analysis, what is at stake is... the privilege of the actual present, the now' (Derrida 1973, pp. 62-63). Derrida strategically utilises a conception of time that emphasises *deferral*.

What Derrida has done is follow de Saussure's argument extremely closely to the point where the representational logic de Saussure was using to understand his own argument fails and replaces itself with (or metamorphoses into) an alternative to itself. Against de Saussure's insistence that language can only be understood synchronically, as a frozen moment in time, Derrida shows that de Saussure's scheme follows a logic of *radical* temporality. It is not temporal in the 'simple' sense that one event follows another, as in a sequence of snapshots in time, laid out one after the other.

Such a 'temporalisation' would amount to little more than the linear arrangement of a series of synchronic schemes in an order called 'the past,' 'the present' and 'the future.' The temporalisation Derrida offers is *radical* in that it insists on the inclusion of elements which cannot ever be brought within the framework of presence. They are radically outside presence and at the same time constitutive of what 'presents' itself. In this sense Derrida's temporalisation disrupts linear notions of temporality. What presents itself is radically contingent on what is *not there*, what is *not present* and so it relates no less to what is called 'the future' than to what is called 'the past' and 'the future' and 'the past' can no longer be thought *as separated from the present*. If what presents itself is 'present,' it is a 'presence' which is always deferred and can therefore no longer be considered present in the usual sense of the word. It is not absent either. Derrida explicitly highlights the trace as being 'originary' (Derrida 1976, p. 61) but at the same time 'unpresent' (my word) and therefore 'unrepresentable.' It is with Derrida's challenge to the 'metaphysics of presence' – the classical notion of an absolute and self-contained presence – that we enter a different 'non-representational' form of logic. If meaning is not present then it cannot be represented.

Derrida's critique of de Saussure challenges representation in an entirely different way than the critiques mentioned previously. As I pointed out in

previous sections, other critiques of representation have argued that our representations cannot be perfect, or cannot be objective, or can only be contextual, or that we can never know whether our knowledge corresponds to 'reality,' all of which take for granted that knowledge is *split* from a 'reality' which is 'there' and which we therefore can have knowledge of. If something is present, this raises questions about whether it can be represented as knowledge. Derrida's argument is a quite different for he is not concerned with whether what is present can or cannot be represented as knowledge. For Derrida representation is questionable *not* because we cannot get everything that is present into the frame at the same time, which is the relativist point of view, and *not* because we can never know whether what presents itself to our subjectivity corresponds to what is present in the real world, which is the subjectivist argument. He is not concerned with such representational questions for he questions instead the notion of presence. For Derrida we cannot have knowledge of something that is 'there' because, as Krell has put it, 'there never was any *there* there for us' (Krell 2000, p. 18). Derrida questions the idea that 'reality' is ever 'present.' This negates all questions concerning whether or not 'reality' can be represented.

With this sort of critique of representation, the 'crisis of representation' is something entirely other than a crisis of indeterminacy about which theory

of knowledge is the best. The idea of which theory is best assumes there is some measure against which the various theories can be tested. It assumes in other words a real 'reality' that exists independently of knowledge. When we consider the 'crisis of representation' at the level of the sign – from the perspective of deconstruction – we see that the bringing into question of the notion of presence opens a different world of theorising which has nothing to do with Cartesian questions about what constitutes knowledge of 'reality,' knowledge of what is *present*. Deconstruction suggests that it is possible to think with the logic of 'deferred presence.' When we begin to speak and think in this way, with this logic, we find ourselves in a different theoretical space entirely. We enter a space which is incomprehensible from the perspective of a representational or Cartesian world view.

3.5 SUMMARY AND CLOSING REMARKS

In this chapter I have argued that the crisis of representation takes place on two levels, an epistemological level and a semiotic level, with the latter being the more foundational level. I outlined two important critiques of representation that takes place at the epistemological level, these being the subjectivist or constructivist critique and the postempiricist critique. In doing this I explained that the constructivist critique, while useful for learning theory, is not valid as an epistemology. I then explained that while

it is now generally agreed that science has entered a 'post-empiricist' (or 'fallibilist') stage (Thomas 1979), those interested in the status of scientific knowledge are divided over the issue of relativism. At this juncture the semiotic critique proves useful as this is a critique of representation that takes place at the level of the sign, that is, at the level of representation itself. This critique – deconstruction – puts in question the whole framework which facilitates the other critiques of representation and hence puts into question the whole objectivist-relativist debate/impasse. The implications of this deeper level critique have scarcely been touched on in educational theory.

Although deconstruction presents an interesting and important way forward for theorising education along more contemporary epistemological lines, Derrida's conceptual schemes are notoriously difficult to negotiate. An alternative scheme which has sparked considerable interest in the last two decades and which has also been charged with providing a critique of representation at the level of the sign is that of 'complexity theory' (see for example Cilliers 1998). In addition to this a number of authors have explicitly drawn connections between complexity and 'poststructuralism' (Cilliers 1998, Dillon 2000, Popolo 2003). In view of this, a question that arises is whether 'complexity theory' can provide any assistance with the task of 're-thinking' the epistemology of schooling, which, as I have shown

in Chapter 2, is currently driven by representational or Cartesian logic. The remainder of this thesis is therefore taken up with an exploration of the potential of complexity theory for facilitating the theorisation of education along non-representational lines. Because 'complexity theory' emerges from science, whereas deconstruction emerges from philosophy and literary studies, complexity has the potential to offer useful alternative metaphors and conceptual tools for dealing with the difficult task of conceptualising schooling along non-representational lines.



Chapter 4

INTRODUCING COMPLEXITY

A brief review of various attempts to represent the unrepresentable

4.1 PREAMBLE

The purpose of this chapter is to introduce some of the conceptual structures of the multidisciplinary area of investigation that has come to be known as ‘complexity studies’ (Richardson and Cilliers 2001). My intention is to build a ‘platform’ of understanding to use as a base from which to understand complexity’s critique of representation which I shall then discuss in Chapter 5.

In trying to describe the ‘field’, a useful way forward is provided by Richardson and Cilliers (2001). In their editorial to a special issue of *Emergence*, focussing on the question ‘What is complexity science?’ they respond by providing ‘a view from different directions,’ suggesting that one (simple) way of thinking about the field is in terms of three broad ‘schools of thought’, these being

- ‘hard’ or ‘reductionistic’ complexity science – an approach that is concerned with understanding the mechanics of complexity. In other words it is concerned with *the nature of reality*.
- ‘soft’ complexity science – an approach that uses insights from hard complexity science as metaphors to describe complex social interactions. One could say this approach uses complexity as *a way of seeing the world*.
- ‘complexity thinking’ – an approach that is concerned with the epistemological implications of assuming a complex universe. It represents *a way of thinking and acting*.

Richardson and Cilliers do, however, admit this classification ‘conveys a neatness that is really rather illusory’ (ibid., p. 8) as these three ‘schools of thought’ are highly intertwined. Changes in perspective always come with different ways of acting, thinking, seeing, relating and working and so any attempt to separate these into clearly separate ‘schools of thought’ is unrealistic. Moreover any attempt to define the ‘boundaries’ of these ‘schools of thought’ creates caricatures that cannot do justice to the ‘school of thought’ in question. Nevertheless, regardless of the shortcomings of such a classification, it does provide a useful device for an initial positioning of my own work in this chapter and the chapters that follow.

Since the 'hard' approach is generally considered the established orthodoxy, and since other approaches to a large extent draw on the findings of this approach, this current chapter is concerned mostly with the insights generated by the 'hard' approach. In Chapter 5, I shall draw on the background presented in this current chapter to outline what I believe to be the semiotic and epistemological implications of complexity (and thereby add to the domain of 'complexity thinking') and Chapter 6 will extend this epistemology to educational theory. From this it should be clear that at no time is this work concerned with the 'soft' approach which 'applies' the insights generated by the hard approach to social situations (such as education). Chapter 6 is concerned, *not* with understanding education and schooling as a complex system – i.e., it is *not* using complexity *as a metaphor* to understand education differently (see, for example Doll 1993, Davis, Sumara and Thomas 1996, Badenhorst 1998, Fullan 1999, Davis, Sumara and Luce-Kapler 2000) – but with retheorising education *from a different epistemological and semiotic base*, one inspired by complexity. This leads to an epistemology which does not conform to the Cartesian framework. With this distinction my work introduces a radical shift in focus for research that is concerned with the implications of complexity for educational theory. Until now this genre of research has been driven mostly by the 'soft' or metaphorical approach in various modes.

The remainder of the chapter is divided into three main sections. The first is concerned with *defining* complexity, the second with *describing* it and the third with *explaining* it (explaining the logic behind it). This, I hope, will provide a base from which to launch the epistemological, semiotic and educational discussion that follows in Chapter 5 and Chapter 6.

4.2 DEFINING COMPLEXITY

'Defining' complexity is a notoriously difficult task (see Waldrop 1994). Despite a large number of popular books on the subject which bring together many ideas under the popular labels of 'complexity science' or 'complexity theory' there is no 'field,' 'theory' or 'science' of complexity.

4.2.1 *Why 'defining' complexity is difficult*

One of the reasons why a 'definition' of complexity is elusive is because complexity research spans a wide diversity disciplines including theoretical physics, cell-biology, ecology, evolutionary biology, chemistry, non-linear mathematics, artificial intelligence, game theory, computer studies and neuroscience, amongst others, each with its own perspectives. For this reason, among complexity scientists, complex systems are variously known as 'many bodied systems' (Auyang 1998), 'complex adaptive systems' (Gell-Mann 1994, Holland 1998, Kauffman 1993), 'complex dynamical systems'

(Mandelbrot 1982), 'dissipative structures' (Goodwin 1995, Prigogine and Stengers 1984) and 'autopoietic systems' (Maturana and Varela 1987) and so on. These different names reflect different foci of attention and go with fairly precise technical meanings in the different disciplines. This means there is a diverse collection of ideas associated with the notion of complexity, a non-uniform terminology for discussing these ideas, and therefore no agreement on what, exactly, constitutes 'complexity.' Nevertheless, this does not mean nothing can be said about complexity. For a start, a distinction can be drawn between chaos and complexity.

4.2.2 *The distinction between chaos and complexity*

While both complexity and chaos theory are concerned with *dynamical* systems – i.e., systems which grow and so become *more* complex over time – the former is concerned only with systems that grow in response to the iteration of a pattern of activity governed by a few fixed rules *and the iterated formula remains constant*. This pattern of activity invariably gives rise to extraordinarily intricate structure or behaviour such as that found in mathematical objects such as the Mandelbrot set²⁴ and crystalline structures

²⁴ The Mandelbrot set, named after Benoit Mandelbrot, is said to be the most geometrically intricate image in all of mathematics. It is a fractal – an object that displays self-similarity at various scales. Magnifying a fractal reveals small-scale details similar to the large-scale characteristics. Although the Mandelbrot set is self-similar at magnified scales, the small-scale details are not *identical* to the whole. In fact, the Mandelbrot set is infinitely complex. Yet the process of generating it is based on an extremely simple equation.

such as snowflakes which are generally associated with fractal mathematics. In contrast to this 'passive' form of complexity (Cilliers 1993, p. 7), there is an 'active' form which cannot be described simply by the multiple iterations of an *unchanging* rule or algorithm.

Actively complex systems *evolve* over time – i.e., they are historical systems – and this entails changing the rules, or operating according to 'higher level' rules. Furthermore, these systems are capable of adapting to a changing environment. For this reason they are sometimes referred to as 'complex *adaptive* systems' (CAS). The interesting thing about historical systems is that their history is written into their structure. Such systems cannot be understood simply in terms of their parts, because their parts do not contain all the information necessary to understand the system. Some of the information is in the history of the system and so the history of the system must always be taken into account.

It is this active form of complexity that is the domain of complexity science proper. Systems that are actively complex (and so historical) include all manner of *living systems*, such as individual organisms, ant colonies, ecosystems, economic systems, social systems, the human mind and so forth and also some artificial systems, such as cellular automata (as will be described in Sections 4.3.2). Although the distinction between 'passive' and

'active' types of complexity is not clear-cut (Cilliers 1993), it is only systems that exhibit an active type of complexity – i.e., *historical* systems – that are of concern to this particular study. This is because it is only *historical systems* that present a problem for representational epistemology, a point I shall return to later in the chapter and again in Chapter 5.

4.2.3 *The 'generic' features of complexity*

Some tentative attempts have been made to identify the 'generic' features of active (or *historical*) complex systems (see for example Cilliers 1998). Such features are those that are deemed to persist regardless of the specific details of the system's construction. These have been described in terms of the physical properties of the system itself (e.g., Kauffman 1995, p. 17) and the rules or laws that *generate* such systems or govern their behaviour (e.g., Holland 1998, p. 5). Cilliers (1998) provides a useful and comprehensive list of ten generic features pertaining to the models of complex systems and a quick search of the internet yields a further rich supply. From these descriptions a rather sparse working definition can be distilled:

A complex system consists of (i) a collective of interacting agents, which are (ii) richly and recurrently interconnected (in a web-like, non-linear arrangement). The product of all the interactions between the agents is (iii) unpredictable (non-linear) and manifests as (iv) emergent features and (v) self organising behaviour. The self-organisation is (vi) a dynamic process, in that it is continuously changing (evolving or developing) which can only occur in (vii) a system that is *open* in that it is exchanging information with its environment.

Although this 'definition' of complexity is simplistic in the extreme it nevertheless manages to capture certain features that are deemed to persist regardless of the specific details of the system's construction. For example all the above mentioned features are characteristics of complex systems as different as human brains, economic systems, ant colonies, board games, cellular automata, ecosystems, climate, human language, single-celled organisms and the World Wide Web, to name but a few.

4.2.4 *A 'sketch' of a complex system*

This sparse definition above can be fleshed out a little more by providing a concrete but familiar example of a complex system. The example of an economic system serves us well as it is familiar to most. The account below draws on a description provided by Paul Cilliers (Cilliers, 1998, p. 6) and describes each of the generic features listed in the 'definition' above.

- (i) In an economic system the economically active people in a country certainly comprise a collective of interacting agents. They interact by lending, borrowing, investing and exchanging money for goods.
- (ii) Each agent is richly interconnected in that it interacts with many other agents – shop and bank tellers, investment advisors, relatives, and so on. Furthermore the activity of each agent may be fed back on itself, a phenomenon known as recurrency. For example, a good investment can produce good returns and overspending can result in a shortage of money.
- (iii) The actions of a single agent are unpredictable. For example a small investment could produce very large returns while a large investment could have no significant impact.
- (iv) The actions of a single investor can cause complex ripple effects throughout the entire stock market, and sometimes even cause an emergent effect such as a stock market crash.
- (v) These non-linear interactions are self-organising in that patterns emerge that are not centrally controlled. The complexities of inflation are a good example.

- (vi) The economic system is dynamical in that it is continually driven by supply and demand. It is never stable, never stands still, not even in a recession.
- (vii) The economic system is also an open system. It is virtually impossible to draw its borders. It is continuously influenced by the political system, agriculture (and therefore climatic conditions), science and technology, international relationships and so on.

Having provided an initial 'definition' of the type of complexity with which this chapter will be concerned (albeit a rather sketchy one), it is now possible to describe the 'structure' of complexity in more detail.

4.3 DESCRIBING COMPLEXITY – INSIGHTS FROM COMPUTER MODELLING

Amongst 'hard' complexity scientists, those most interested in understanding the 'structure' of complexity are those working in the field of computer modelling. Insights emerging from the Santa Fe Institute – a research institute dedicated to complexity as a field of study in its own right and which has been instrumental in promoting the ideas of 'complexity theory' to the broader public (Thrift 1999) – are particularly helpful in this regard. This research community is concerned with *simulating* complexity in order to work out the general laws or rules that govern complex systems.

The work of John Holland (Holland 1998) provides a good example of the type of understanding that has emerged from this research community. Holland attempts to model complexity by ‘shearing away the detail’ to get at the ‘essence’ of complexity (Holland 1998, p. 24). This approach has provided many compelling accounts of what a ‘complex system’ could be. An example is provided below.

4.3.1 A computer model of a complex system

Cellular automata are computer models that are frequently used to mimic complexity. These models are also frequently used to make the point that

There are simple sets of mathematical rules that when followed by a computer give rise to extremely complicated patterns. The world also contains many extremely complicated patterns. Conclusion: Simple rules underlie many extremely complicated phenomena in the world. With the help of powerful computers, scientists can root those rules out (Horgan 1995, p. 107).

I shall therefore use a simple two-dimensional cellular automaton to elaborate upon the features of complex systems described in the sparse definition provided in the previous section in order to build up an understanding of complexity. Cellular automata are described in detail by Wolfram (1984) and what follows is based on his descriptions.

A two-dimensional cellular automaton is a collection of identically programmed 'cells' (imagine a checkerboard) that interact with one another (see Figure 4.1). These cells are the interacting agents. Each cell (agent) in the system has a 'state' (e.g., black or white) and a 'neighbourhood' made up of its eight adjacent cells (see Figure 4.2). The cells in the system interact with one another in that the state of any particular cell depends on the state of its neighbouring cells. Since each cell is affected by eight others, the automaton can be said to be richly and recurrently interconnected.

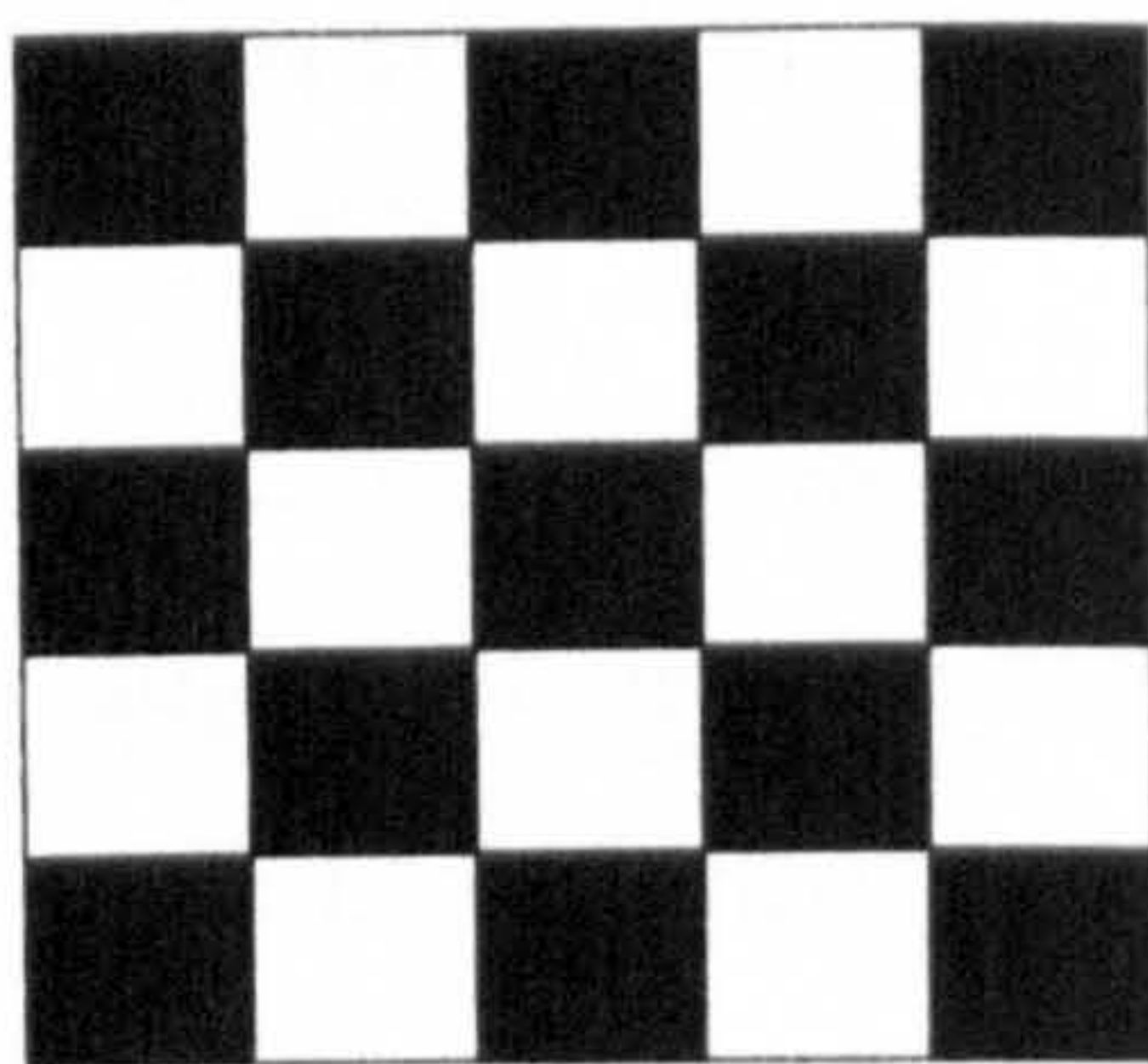


Figure 4.1

A checkerboard

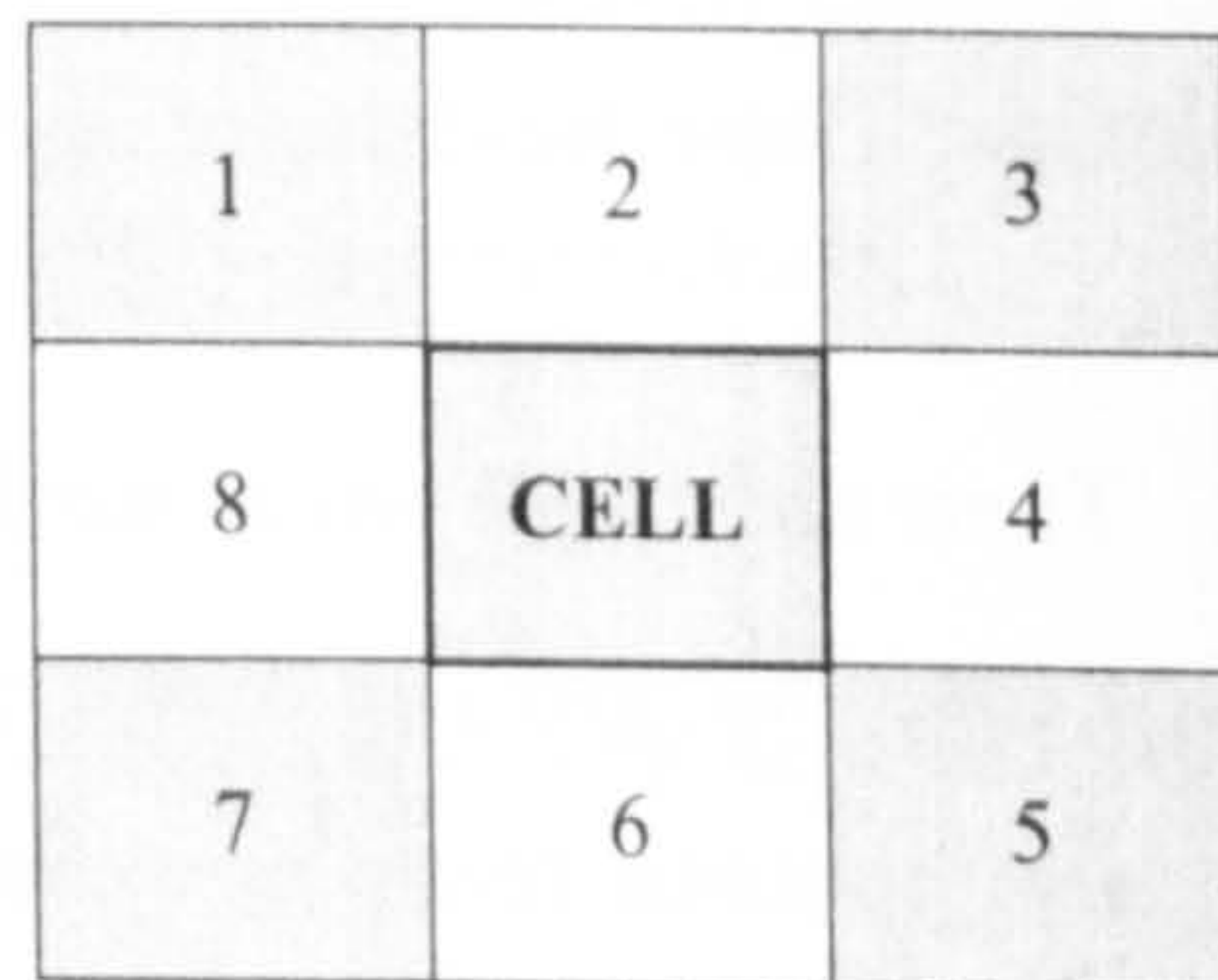


Figure 4.2

A cell surrounded by its 'neighbourhood' of eight adjacent cells

The cells change their state relative to each other following a simple set of rules. For example if 2 neighbours are white a cell stays in its current state - which can be either black or white. If 3 neighbours are white, a cell will go

white regardless of what it was before. Under all other conditions it is black (see Figure 4.3). At given moments in time, the states of all the cells in the cellular automaton are scanned and then adjusted according to the set of rules.

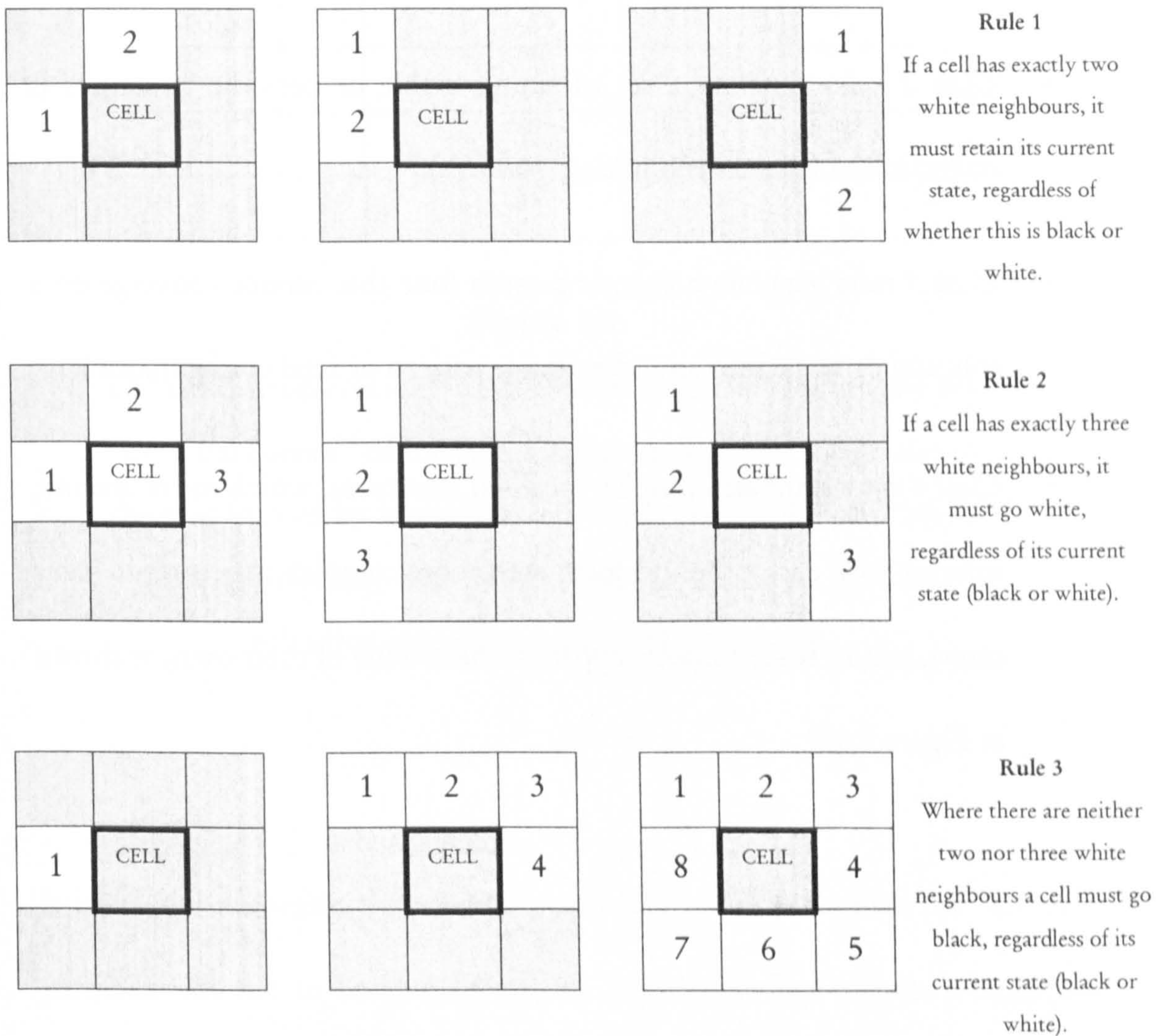


Figure 4.3

Some possible neighbourhood configurations that would lead to state changes of an initially black cell, in a cellular automaton operating according to 3 rules of interaction.

Regardless of the initial configuration, the rules quickly produce a characteristic pattern. Wolfram (1984) classifies these rules into four 'Classes':

- *Class 1 rules* generate a homogeneous pattern (all cells black, or all cells white, or a checkerboard pattern as in Figure 4.1).
- *Class 2 rules* generate a set of simple stable or periodic structures (a collection of frozen or 'blinking' patterns).
- *Class 3 rules* generate a chaotic pattern (one that cannot converge on a solution or settle into any identifiable pattern or final configuration).
- *Class 4 rules* generate complex localised structures, which move around, interact with each other (to form even more complex structures in some cases), and in some respects appear to have a life of their own, as shown in Figure 4.4.²⁵

²⁵ John Conway's famous game of *Life* is a good example of a cellular automaton operating according to Class 4 rules. It is difficult to appreciate the nature of Class 4 rules without interacting with a cellular automaton such as the game of *Life*. Several interactive examples of cellular automata (including *Life*) can be found on the internet.

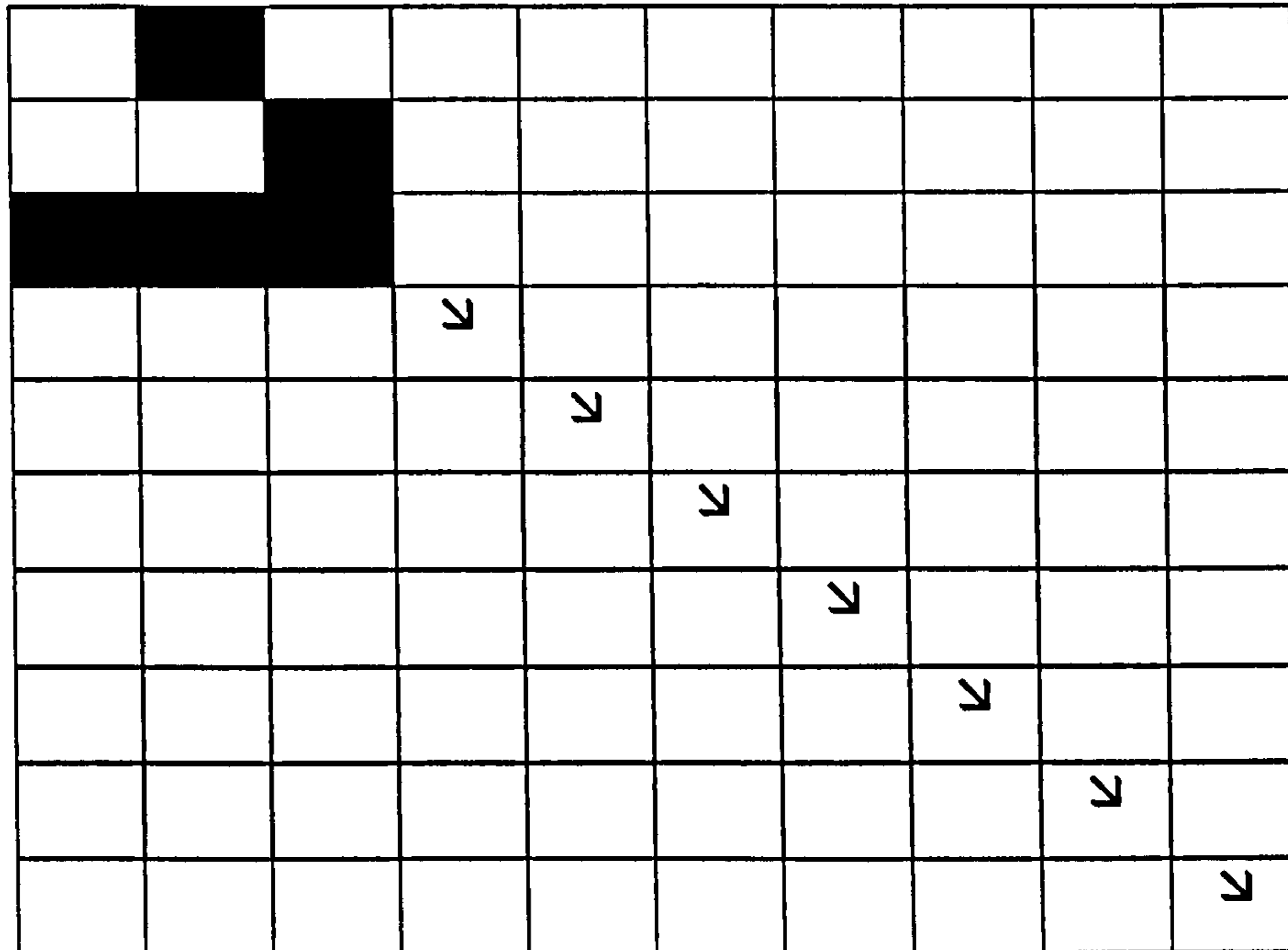


Figure 4.4

Localised structures such as the one made of five cells in the top left hand corner²⁶ of the grid above, 'emerge' and 'glide' across the grid (shown by arrows) as individual cells in the grid 'blink' on or off (black or white) following the simple set of Class 4 rules that guide the automaton's behaviour.

It is cellular automata that operate according to Class 4 rules that are of particular interest to complexity science because, unlike cellular automata that operate according to Class 1, Class 2 and Class 3 rules, these systems *evolve* through time as patches of pattern interact with each other according

²⁶ This particular structure is called a 'glider' in Conway's game of 'Life'. The game of 'Life' also generates many other patterns.

to their own (second or higher order) rules, to form even more complex patterns. This can continue indefinitely or until extremely complex levels of organisation are reached. Indeed Conway, the inventor of the cellular automaton known as the game of *Life* 'showed that the "Life" universe ... is not fundamentally less rich than our own' (Poundstone 1985, p. 24). Computer models such as these highlight two extremely important features of complex systems, their non-linear arrangement and the process of emergence. These two features are elaborated upon in Section 5.3.2 and 5.3.3.

4.3.2 Non-linearity and determinism

Before discussing non-linearity it is necessary to be clear about the notion of linearity. Very briefly, a linear system is one where each component has a discrete and predictable effect on some other component, as is the case with a clock. If we add up all these little effects we can *determine* how the system works: the whole system is completely predictable (see Figure 4.5). This doesn't mean, however, that these systems are always simple. They can be extremely complicated (like a computer, or a jet aircraft) but a specialist can still understand them fully. Linear systems enable what is sometimes referred to as a 'Newtonian' understanding of the universe, which suggests that since everything has a discrete and predictable effect on everything else,

the entire universe can be understood in terms of the effects things have on each other. Everything, in other words, can be understood by looking at the parts and their rules of interaction. We must bear in mind however that this logic *assumes* linearity. It assumes linear cause and effect relationships. But when relationships between things are not linear, i.e., when they are *nonlinear*, this logic fails. When we start trying to understand complex systems – such as human brains, and ecosystems, and ant colonies, which are uncompromisingly *non-linear* in terms of their rules of interaction, we can no longer understand them simply in terms of their parts and their rules of interaction.

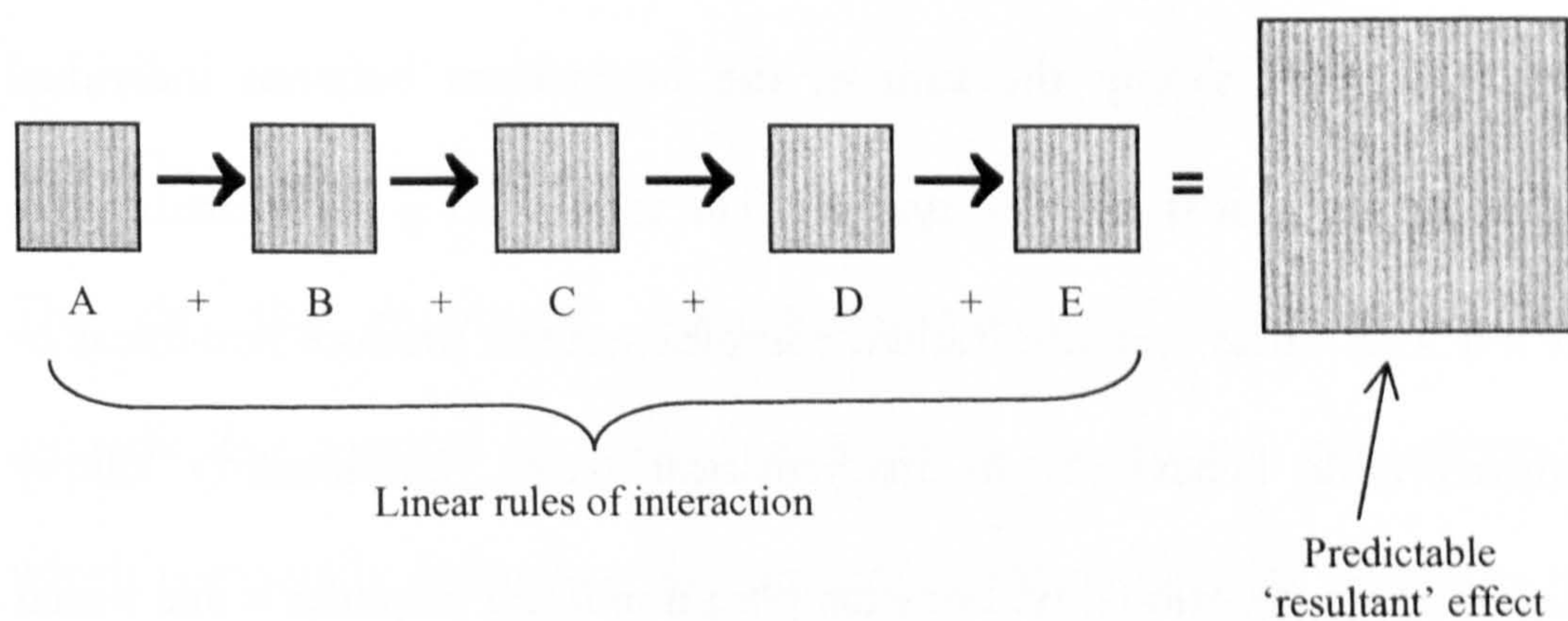


Figure 4.5

A linear cause-and-effect sequence results in a predictable 'final' state that is the sum of the effects of the component parts.

The parts making up a complex system (e.g., the cells of the automaton) are not connected in a linear sequence with a beginning and an end, but are rather interconnected in a web-like or non-linear fashion (see Figure 4.6). This web-like arrangement means that information can be fed back on itself. Any perturbation to the system therefore produces a complex ripple effect in the system as responses are fed back and forth through the system. Since no one element in the system has a discrete effect on any other element in the system, linear cause-and-effect type relationships between the individual components are masked. A response can therefore be greatly magnified or cancelled out altogether.

Because responses can be magnified or cancelled out this means the total effect is never simply the sum of the interactions between individual components, as it is in linear systems. The total effect is never predictable, as it is with linear systems. Rather, complex systems produce non-linear or unpredictable behaviour. In mathematical terms, non-linearity simply means non-proportionality. For example a non-linear response is one which is disproportional to the input that produced it. A small stimulus won't necessarily cause a proportionally small response and vice versa. It is web-like interconnectivity that results in non-linear behaviour. With complex systems, we are unable to pre-determine what effects will be produced by the interacting components.

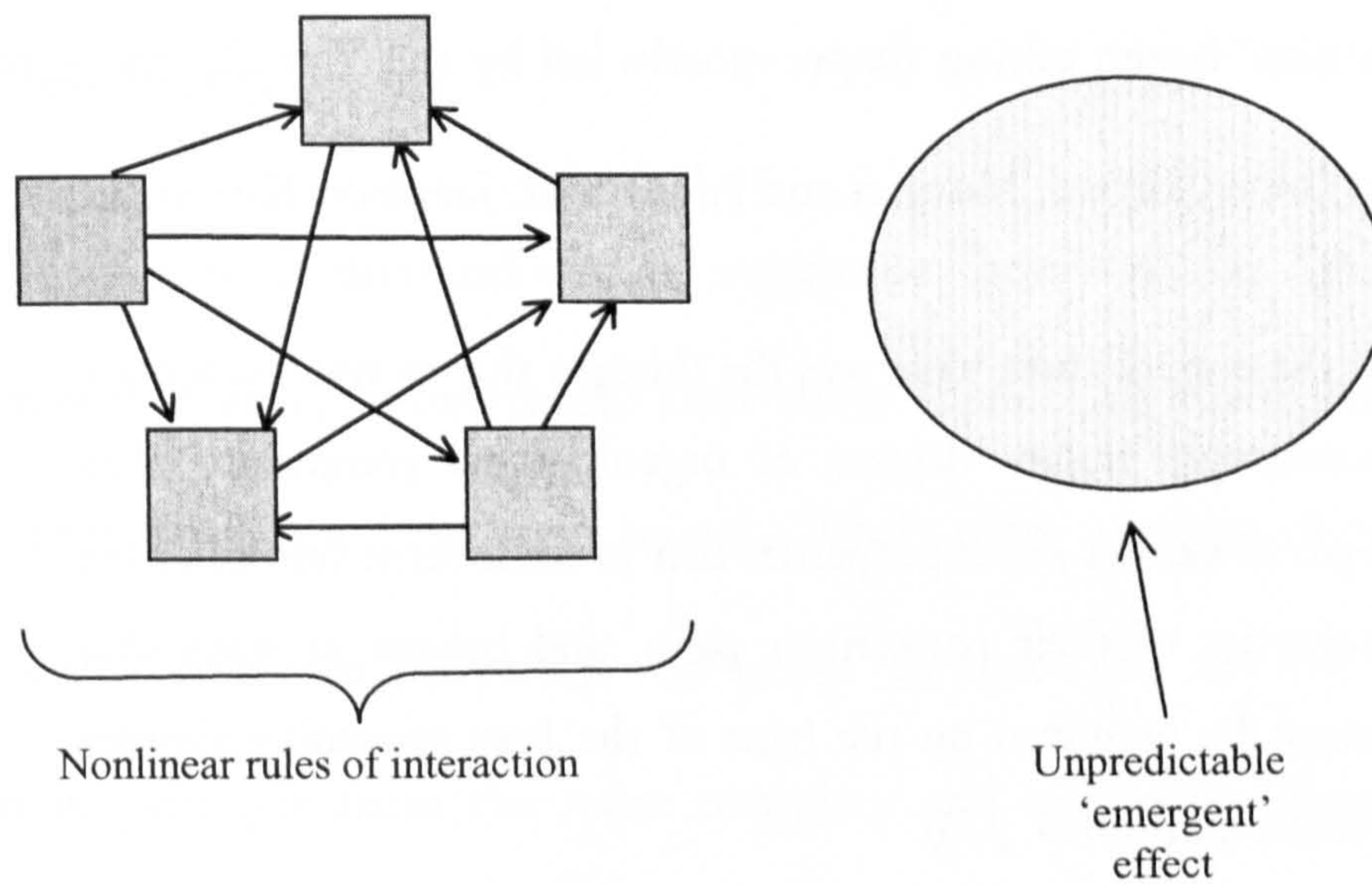


Figure 4.6

Complex, non-linearly connected systems produce unpredictable 'emergent' effects

4.3.3 *The notion of emergence*

The idea that interacting components produce 'effects' which are unpredictable a priori is closely connected to the concept of emergence which is generally defined as 'the creation of new properties.' The idea of emergence is, however, not unique to complexity. It has a long and checkered past. By most standard accounts (e.g., Stanford Encyclopedia of Philosophy) the term is said to have been coined by G.H. Lewes (see Lewes 1875) to differentiate between chemical products that could be derived from their constituents and those that could not. He called the former 'resultants'

and the latter 'emergents'. Following this formulation the philosophy of 'emergentism' began taking shape, mostly led by the 'British emergentists' including Lewes, Broad, Morgan and Alexander. Jaegwon Kim suggests that

At the core of these ideas was the thought that as systems acquire increasingly higher degrees of organisational complexity they begin to exhibit novel properties that in some sense transcend the properties of their constituent parts, and behave in ways that cannot be predicted on the basis of the laws governing simpler systems (Kim 1999, p. 3).

Emergence therefore came to be defined, first and foremost, as 'the creation of new properties.' More specifically, it came to be understood as a process whereby properties that have never existed before and, more importantly, are *inconceivable* from what has come before, are created or somehow come into being for the first time (Kim 1999).

In the early part of the twentieth century the idea of emergence was highly problematic because it brought into question the idea of determinism during a time when scientific reductionism was on the rise (ibid.) This, and an apparent link with 'vitalism,' according to Kim, contributed to the emergentist movement failing to become a visible part of mainstream philosophy of science early in the twentieth century. Nevertheless, the rise of non-linear mathematics and complexity science in the past three decades,

together with the decline of reductionism, have resulted in a resurgence of emergentism (Kim 1999).

Contemporary understandings of emergence, however, are unlike their nineteenth century counterpart. They differ from their predecessor in the way they understand the term 'novel.' While older versions of emergence stress that emergent properties are 'novel' in that they are not deducible even in principle from the most complete and exhaustive knowledge of their emergence bases (ibid.) the contemporary version understands that emergent features are 'novel' in that they are merely *unexpected* given the principles governing the lower-level domain. Such unexpected properties (no matter how 'inconceivable' or 'unimaginable') can emerge *deterministically* from non-linear rules of interaction, as is the case with the evolving 'patches of pattern' of a Class 4 cellular automaton. Although the future of these patterns cannot be predicted a priori, their emergence is nevertheless completely explainable in terms of the lower level. Chalmers (2002) therefore notes that with the rise of complexity science and non-linear mathematics we now have two understandings of emergence – a 'strong' and a 'weak' version – the first (older) version being incompatible with determinism, the second (contemporary) version being compatible with determinism. In introducing a 'weak' version of emergence complexity science appears to have reconciled emergence and determinism.

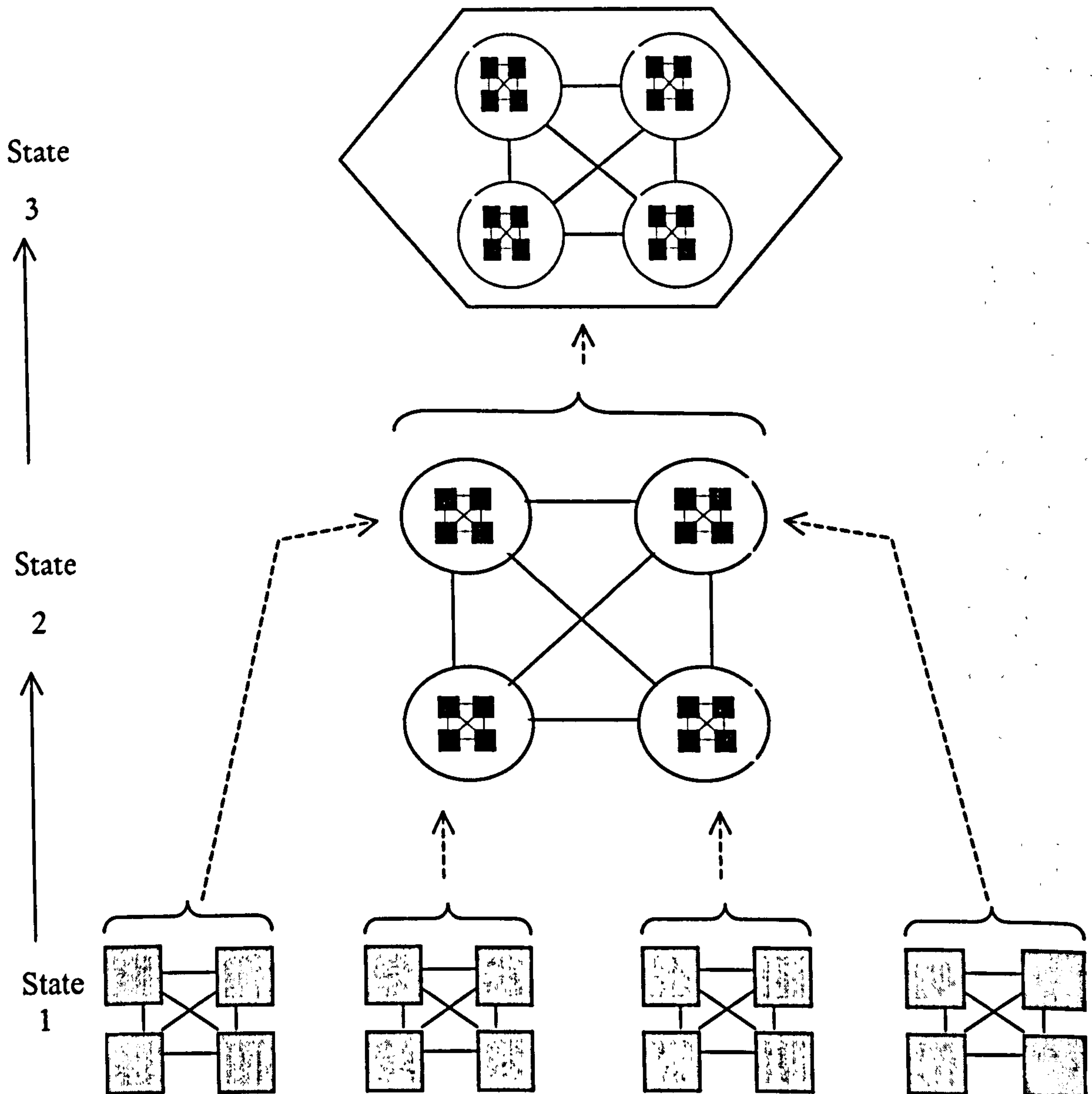


Figure 4.7

A hierarchical model of emergence. As non-linear interactions produce emergent features at new hierarchical levels, these in turn interact to produce yet another emergent hierarchical level of order. In this diagram, different shapes represent different hierarchical levels of order (i.e., 'State 1', 'State 2' and 'State 3'). However note that each of the three 'states' can exist simultaneously and, although not shown in this diagram, there can be interactions which cut across different hierarchical levels.

Holland (1998) provides a useful discussion about the way in which constraints at lower levels *determine* the nature of emergences at higher levels while being unable to *predict* them. In this regard he emphasises first the decoupling of determinism from predictability and second the hierarchical and hence *historical* nature of the process (see Figure 4.7). Holland focuses largely on cellular automata and board games such as chess and checkers to get this point across. We can therefore return to our cellular automaton example to illustrate these aspects of emergence.

First, Holland stresses that although the order that emerges in cellular automata is *strictly* determined by an initial handful of operating rules, the precise nature of the order that emerges from a cellular automaton operating according to Class 4 rules is not predictable a priori. This is because the non-linear interactions between the agents make for an infinitude of potentially different combinations. This does not mean that every time the programme is run a different outcome will be achieved. Because cellular automata are closed systems with well-defined boundaries when a rule is applied there is only a *single trajectory* the system can follow and it will follow this same trajectory time and again. This means, provided the initial conditions are the same, the system will achieve exactly the same end point time and again, without fail. We cannot predict this outcome however, without running through the programme itself. The only way to

determine the emergent properties is to run the programme. In this way an emergent process is quite unlike a more mechanical process where the outcome can be determined *before* it is achieved.

Second, he stresses that because Class 4 automata evolve, much of the information about the current state of the system is caught up in its *history of interactions* not in its individual components. This is the case because the rules of the lower hierarchical levels of the system which emerge first, *constrain the features that can emerge* at later stages in the system's development (Holland 1998, pp. 126, 246). With each new level of order new constraints are introduced. In working with each new level of constraint further order of a particular nature, emerges. Constraints not only *establish* the direction that can be taken by the system in the future, they are also *pre-requisites* for the future order that emerges. Thus the system cannot be understood independently of its history. In this sense history is written into the structure of the system itself. Holland describes it like this

Persistent patterns at one level of observation can become building blocks for persistent patterns at still more complex levels. [...]. At each level of observation the persistent combinations of the previous level *constrain what emerges at the next level*. This [represents a] kind of *interlocking hierarchy* (Holland 1998, p. 7, my emphasis).

With evolving systems such as these, history or 'time' is a structural component of complex systems, not something that is applied to the system from without. This, in turn, means that such emerging systems – or perhaps I should say emergent processes – are *fundamentally* historical. The system is an historical object in the sense that its subsequent evolution depends on its prior evolution. In this sense the trajectory of the system can also be described as 'irreversible': a complex system cannot develop backwards, even in theory (i.e., it can only develop in one direction, the 'logic' doesn't work in the other direction). For this reason the trajectory can be described as 'asymmetrical'. A closed or linear system, on the other hand, can develop in either direction (backwards or forwards – it can be taken apart and put back together again, and the logic works both ways) and in this sense it is 'symmetrical.' Murray Gell-Mann talks about this 'irreversibility' or asymmetry of complex systems in terms of the 'arrow of time,' which he describes as an *effect* or *illusion* produced by the 'irreversibility' of complex processes (Gell-Mann 1994, p. 129, cf. Prigogine's view on this, as described in in Section 4.4.1).

In this way a complex (emergent) process is unlike a more mechanical process which is a-historical (or 'reversible' in the sense that they can be understood both forwards and backwards). Mechanical processes are permanent, static and unchanging (except in the sense of falling apart).

Their history is not caught up in their structure. Complex systems, on the other hand, are *dynamic systems*. They are constantly changing as their components interact, exchange information with each other and new order emerges.

4.3.4 *Problems with the computer modelling approach: boundary issues*

For a system to continually evolve or grow, there has to be an input from outside the system. Something has to be fed in. If nothing is fed into the system, it will remain static (inert) or, alternatively, will fall apart. It *cannot* grow. This means complex systems must be open systems. Which means their boundaries cannot be clearly defined. The issue of boundaries is not something that the computer modelling community models very well. Evolving Class 4 cellular automata, for example, are 'open' *only* in the sense that they receive an input from a power supply. In all other senses they are closed. They have well defined boundaries, and receive specific inputs. The rules that drive the programme operate against a known set of initial (boundary) conditions. This is not the case with 'real' world complex systems such as ecosystems and communities which do not only receive but also exchange information with their environment. When neither the boundaries nor the inputs can be defined the logic of cellular automata fails. While the scientific and philosophical (epistemological) prospects for the

insights generated by the computer modelling community are undoubtedly useful (see Bedau 1997 for a discussion about this), the main problem with this approach from the perspective of my own work, is that it attempts to represent open systems with ill defined boundaries and which are *exchanging* information with their 'environment' with closed systems with well defined boundaries that are simply receiving an input. This raises the question as to whether such models are modelling *complexity*. I shall return to this question in Chapter 5 where I discuss the epistemological implications of complexity. First I wish to elaborate on the issue of boundaries in complex systems and the use of the term 'environment.'

When dealing with open systems, the term 'environment' must be used with care as it can imply the presence of a non-arbitrary physical boundary (i.e., between a system and its 'environment'). This is problematic for open systems that exchange information with the environment as it is not possible to determine with certainty which components belong to the system (or are 'inside') and which belong to the environment (or are 'outside'). The closer one gets to the boundary of any complex/open system, the less distinct containment becomes. Even self-produced boundaries (such as those of cells and organisms) become fuzzy when approached. For example, at a molecular level it is not clear which molecules in the membrane bounding a cell are part of the cell and which

are part of the 'environment'. Furthermore, the question of when a particular particle that has been taken in by the cell, actually becomes incorporated into the physical structure of that cell, also involves a fuzzy boundary. Specifying clearly where a boundary should be is not obvious, not something that can be described objectively.

Because the boundaries of complex systems are so difficult to define, yet we *must* define boundaries in order to make sense of the world (Cilliers 2001), it is useful to make the conceptual distinction between (whatever it is we deem to be) an 'entity', and its 'environment' while understanding that there is no *actual* or objective, hard (physical) boundary between the two. This does, however, have implications for what we can say about how an 'entity' behaves in relation to its 'environment'. If an entity is not clearly separate from its environment, we cannot accurately speak of it responding or adapting *to* a distinct (separate) environment. Rather, we have to 'zoom out' to encompass a broader level of organisation. We then have to understand that this greater system is in turn part of an even greater one, and this can continue to infinity. In this regard Van Uden, Richardson and Cilliers (2001) suggest it makes more sense to refer to 'complex systems' as 'partial complex systems' since we are never able to extricate them from other interacting components. With this sort of understanding, we must acknowledge that a so-called 'entity' and its so-called 'environment' are part

of a greater, complex system, composed of non-linearly interacting components. From such a perspective each agent in this larger system acts on and is in turn acted upon by other agents in the larger system. Looked at in this way, interactions between 'a system' and 'its environment' can no longer be understood in a linear (cause and effect) sense. Since everything is caught up in a greater non-linearity it becomes difficult to talk about *anything* in terms of the logic of cause and effect. *An entirely different logic is required of us.*

In this regard I now wish to discuss a line of theorising that can be understood to be concerned with developing a kind of logic which is suitable for a world in which everything is interrelated, a world in which *boundaries are not assumed*. Since this body of research takes non-linearity and connectedness seriously, one could say this line of work is concerned with *explaining* complexity rather than *describing* or modelling it (although obviously the two activities are closely interwoven). This line of theorising has been developed by Ilya Prigogine. I shall be using Prigogine's logic when I discuss the epistemological and semiological implications of complexity in Chapter 5.

4.4 EXPLAINING COMPLEXITY – INSIGHTS FROM THERMODYNAMICS

In many respects Ilya Prigogine's work can be seen as *incompatible* with the theories generated by the computer modelling community of the Santa Fe Institute. Nevertheless the importance of his work to 'complexity theory' is profound. In this section I shall try to introduce some of the more important themes of his work through the notion of emergence.

Although the word 'emergence' seldom appears in his writings, Prigogine was nevertheless very much concerned with those kinds of processes that give rise to increasingly higher levels of organisational complexity. As such, one could say his work has been intimately concerned with emergence. More specifically, one could say his work explores the notion of emergence through a meticulous examination of the passage between the micro and the macro level. In explaining the dynamics of this passage he provides a convincing argument for the idea that emergent phenomena are in principle *not* reducible to or calculable from the lower levels from which they emerged. It is for this reason that I suggest that Prigogine's work can be understood as being *incompatible* with that of the computer modelling community, who conclude that emergent properties, while being unpredictable a priori, are nevertheless *completely explainable* in terms of the lower level. Prigogine's work presents a *challenge* to the idea of

determinism, while the conclusions of the computer modelling community *support* the idea of determinism. If Prigogine's work is understood in terms of emergence this leads one to conclude that complexity science *is not wholly concerned with 'weak' emergence*. I believe Prigogine's work in thermodynamics supports a theory of 'strong' emergence in the sense that the British emergentists had in mind.

4.4.1 Background to Prigogine's work

It is worth mentioning before starting that what *I* call Prigogine's theory of 'strong' emergence *he* himself refers to as his 'microscopic theory of irreversible processes' (Prigogine and Stengers 1984, p. 310). I translate his theory into the language of emergence because this is useful for my discussion in the next chapter. I mention the name he uses because it relates to the focus of his work, which is largely concerned with time irreversibility. In particular, Prigogine's theory of irreversible processes makes clear that the crux of what separates 'emergents' from 'resultants' is a distinction between the kind of processes that take place in 'closed' systems (those that do not interact or exchange information with their environment) and those that take place in 'open' systems' (those that interact with or exchange information with their environment). The former are, in principle, '*reversible*' processes (i.e., the logic of their mechanics is the

same in either direction) while the latter, he claims, are strictly '*irreversible*' (i.e., the logic of their 'mechanics' only works in one direction: forwards). If this distinction between reversible and irreversible processes is not made we have no means to understand *why* emergents should be different from resultants, so in this sense Prigogine's work can be seen as having provided a crucial layer of understanding to the emergentist debate. At this point, some background to Prigogine's work might be helpful.

Prigogine's main aim was to better understand irreversible processes and hence the role of time in the physical sciences and in this regard he was awarded the Nobel Prize in chemistry in 1977 for his contributions to thermodynamics. Prior to this work, irreversibility, or the 'arrow of time' (which is the distinction between past and future) was associated only with gradual and fully deterministic thermodynamic change towards disorder. In other words the 'arrow of time' was understood to manifest because things inevitably run down. More specifically, it was thought that the 'arrow of time' appears only because there are simply more ways for a system to be disordered than ordered (so the chances of the universe becoming disordered are higher than the chances of it becoming ordered). With this logic irreversibility (or the arrow of time) appears a side effect of *timeless* physical processes. The arrow of time, in other words, is an illusion (Gell-Mann 1994 provides an example of this understanding of irreversibility).

With this understanding of irreversibility (which is also the understanding of the computer modelling community, Holland included) the system is 'irreversible' *in practice* (because we can never have all the information required to delineate the initial conditions), but not *in principle*. Emmeche et al., put it like this

Emergent phenomena ... are unpredictable until the moment when they are described. Then they are in a certain sense not unpredictable anymore. After the relations between the preceding conditions and the phenomena produced are described for the first time, one can claim that the event hereafter can be predicted and therefore is causally described (Emmeche, Køppe and Stjernfelt 1997, p. 100).

Prigogine showed, however, that this logic applies only to closed systems. When we are dealing with open systems – which are systems that interact with their environment – *there are irreversible changes towards states that are more ordered*. Furthermore, these irreversible changes are not deterministic but probabilistic. This irreversibility is therefore not only an irreversibility in practice (i.e., not only an apparent irreversibility) but an irreversibility in principle. A genuine irreversibility not an 'effect' or 'illusion' as Gell-Mann would have it (see Section 4.3.3). This, according to Prigogine – this probabilistic element – puts the 'arrow of time' in a different position altogether. The 'arrow of time,' or irreversibility appears as an operator in

physical processes not an 'effect' or 'illusion.' The 'arrow of time,' in other words, takes on *ontological* status and this is the crux of Prigogine's theory of 'strong' emergence, the crux of what separates 'emergents' from 'resultants.' The former are *strictly* irreversible, the latter only *apparently* irreversible. To appreciate how Prigogine's re-interpretation of irreversibility (the arrow of time) affects determinism, it is necessary to introduce three other concepts that Prigogine uses. These are, (i) non-equilibrium, (ii) self-organisation and (iii) bifurcation.

4.4.2 *Non-equilibrium and self-organisation*

Non-equilibrium is a state that characterises open systems. The most obvious examples of such systems are boiling water, tornadoes, lightning and all living systems. These are systems that are exchanging energy and matter with their environment and which exist only because they are open. If an open system is cut off from its environment it dies or simply fades away. It cannot be separated from the fluxes that sustain it. In contrast to this, equilibrium systems are closed to their environment. They are essentially static, inert systems that, once formed, can be maintained indefinitely without further interaction with their environment. An example of a system at equilibrium is a container of cold water. If we started to apply heat from below we would be starting to push the system away

from equilibrium. Heat would be 'coming in' to the system and the system would move into a 'non-equilibrium' state. When the system has been pushed sufficiently far from equilibrium the water responds by organising itself into a macro-level pattern, i.e., it erupts into turbulence (it boils).²⁷ The system 'jumps' to a new level of order. This response is produced by the non-equilibrium situation and is a response that will be maintained as long as the non-equilibrium situation producing it is maintained. Furthermore, the spontaneous appearance of the macro-level pattern – a process which Prigogine calls 'self-organisation' – is entirely in accord with known physical laws. The micro-level entities are simply obeying known physical laws and in doing so the macro-level pattern spontaneously emerges. There are many examples of such spontaneous patterning in nature, such as tornadoes, turbulence and the flocking behaviour of birds to name but a few.²⁸ Prigogine calls these self-organised patterns 'dissipative structures' and claims that the emergence of such structures is a characteristic of non-equilibrium. For Prigogine, non-equilibrium is at the source of order and by this he means it is at the source of *all* order. He insists that within the universe equilibrium is 'a rare and precarious state'

²⁷ Turbulence is a complex pattern of order, not a disordered or chaotic state.

²⁸ A well-used, micro-level example is the case of the 'Rayleigh-Bénard instability.' If we apply heat from below to a thin layer of water, the water responds by organising itself into tiny convection currents called Bénard cells. In other words a macro-level pattern emerges which transcends and subsumes the micro-level components.

and that most of 'reality' is not orderly, stable and equilibrated, but seething and bubbling with change and process and dissipative structures.

We come to one of our main conclusions: At all levels, be it the level of macroscopic physics, the level of fluctuations, or the microscopic level, *nonequilibrium is the source of order. Nonequilibrium brings 'order out of chaos.'* (Prigogine and Stengers 1984, pp. 286-287, emphasis original).

But it is necessary to look a bit more closely at the concept of self-organisation because I have said that the lower level entities form themselves or 'self-organise' into macro-level patterns *entirely in accordance with known physical laws*. This seems to imply that the macro-level structure that emerges at the higher level is entirely explainable in terms of known physical laws. If this were the case Prigogine's theory might be a theory of emergence, but it would not be a theory of 'strong' emergence. It would mean that the universe is 'unfolding' in an entirely deterministic fashion, like a Class 4 cellular automaton, according to a set of operating rules or laws. It is here that the concept of bifurcation is required. It is bifurcation – not self-organisation – that brings determinism into question.

4.4.3 Bifurcation and the role of chance: the roots of 'strong' emergence

According to Prigogine, while everything that is taking place at non-equilibrium takes place under necessary conditions these conditions, while necessary, do not determine in its full 'reality' that which emerges in non-equilibrium conditions. This, he maintains, is because when a system responds to an external 'flux' by 'jumping' to a new level of order, there are always a number of structural possibilities for a higher level of order that would be equally satisfactory in terms of the known physical laws. This means that the single actualised version – the 'solution' that is 'chosen' by the emerging system – is always one among a number of plausible alternatives that happened not to occur.

Prigogine calls the point at which these possibilities appear a bifurcation point.²⁹ This is a point that corresponds to a symmetry break (which means additional degrees of freedom have been provided in a particular dimension as a result of the system being pushed out of equilibrium) so at bifurcation the system must choose between several equally satisfactory symmetry options. Prigogine has shown that as a system is pushed further and further from equilibrium, additional bifurcations (symmetry breaks) will appear. 'By stabilising the system becomes an historical object in the sense that its

²⁹ The name is misleading, however, as it means separation in two, when in fact there may be several possibilities.

subsequent evolution depends on this critical choice' (Nicolas and Prigogine 1989, p. 72).

So the question is how the system selects its options and this is where Prigogine's work becomes contentious. Prigogine insists that the choice that is made is *purely the result of chance* (Pomian 1990 has collected some of the most important contributions to the determinism debate surrounding Prigogine's work). In Prigogine's words:

The system 'chooses' one of the possible branches available when far from equilibrium. But *nothing in the macroscopic equations justifies the preference for any one solution.* (Prigogine 1997, p. 68, emphasis added).

The difficulty with this – and this is the difficulty that brings determinism into question – is that 'chance' according to Prigogine³⁰ 'can neither be defined nor understood' (Prigogine 1997, p. 5). Chance is something that is in itself not present or, at least, always missing. This means we cannot use it to create a complete description of an emergent system's past or future trajectory (all we can have are probabilities). It is in principle impossible to provide a complete description of the 'emergent' level from its the 'submergent' level 'components.' Such systems, in other words are

³⁰ Here Prigogine draws on Abraham De Moivre, one of the founders of the classical theory of probability.

'strongly' emergent because what happens at the micro-level is in principle insufficient to provide a complete description of what emerges at the macro-level. But the probabilistic nature of processes taking place 'far from equilibrium' has a deeper significance than simply that we can't accurately describe a system in terms of its lower level components. It also leads to Prigogine's re-interpretation of 'irreversibility' (see, e.g., Gell-Mann 1994 for a detailed account of the conventional interpretation of irreversibility) which – I believe – is the crux of what forces us to rethink our ideas about representation *at the level of the sign*. This, of course, also has implications for Cartesian or representational epistemology. I will return to this point in Chapter 5.

4.4.4 Probability and irreversibility

If chance is involved at each bifurcation and since it takes only a very few bifurcations to produce an inordinate number of options (Figure 4.8), the trajectory of the system is radically indeterminate. What we have, therefore, is a system that is indeterminate or strongly emergent despite the fact that it is operating according to known physical laws. Because probability is built into the system at every bifurcation, we must understand it as an operator in what emerges. It is not just that we have insufficient information about the system to know what will emerge, we cannot determine what will

emerge even in principle (all we have are probabilities). Probability therefore introduces an irreducible element into our description of nature which is quite foreign to strictly deterministic systems with trajectories that can be fully determined and therefore 'read' forwards or backwards in time. Deterministic systems are, *in principle*, reversible systems, even if this reversibility cannot be achieved in practice. Their 'irreversibility' is the result of ignorance (we cannot know everything we need to know to delineate the initial conditions) rather than being a structural feature of the system itself.

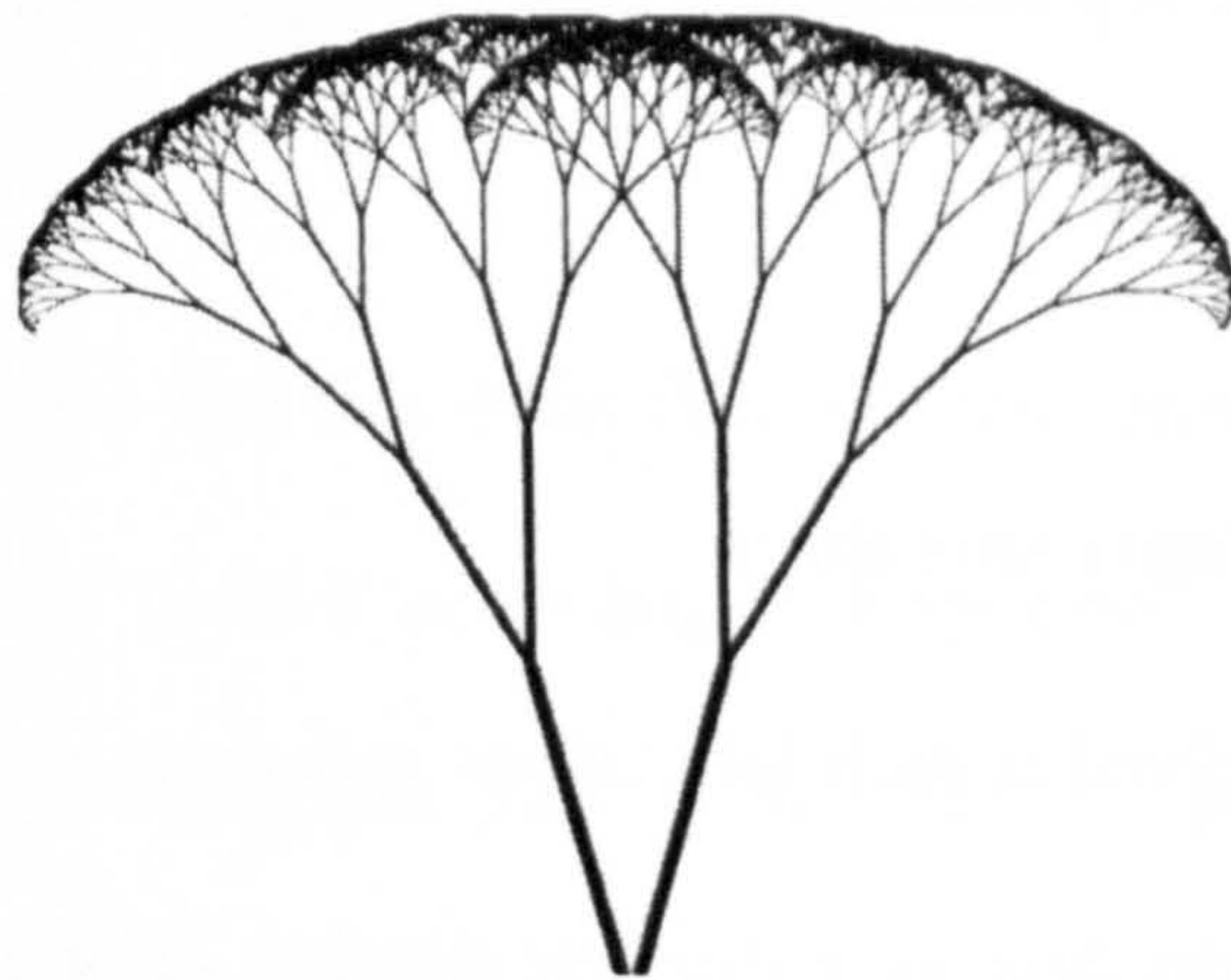


Figure 4.8

Fractal tree showing how simple binary branching can quickly lead to an inordinate number of outcomes.

Once irreducible statistical features are introduced into our description then irreversibility or the 'arrow of time' takes on ontological status. It is no longer an illusion product of ignorance. If the present is not contained in

the past, and the future is not contained in the present then irreversibility must exist. Probability therefore *presupposes* an irreversible direction of time (Prigogine and Stengers 1984, p. 259). In Prigogine's words

Indeed, what could an arrow of time mean in a deterministic world in which both future and past are contained in the present? It is because the future is not contained in the present and that we go from the present to the future that the arrow of time is associated with the transition from present to future (Prigogine and Stengers 1984, p. 277).

Irreversibility is therefore Prigogine's deepest level of explanation for the emergentist ontology he invokes. He cautions however that while (his interpretation of) irreversibility is a source of order at all levels, it 'can be fully understood only in terms of a microscopic description' (Prigogine 1997, p. 183).

Far from being an 'illusion' [irreversibility] expresses a broken time-symmetry on the microscopic level. Irreversibility is either true on all levels or on none (Prigogine and Stengers 1984, p. 285).

The universe, for Prigogine is emergent because of microscopic irreversibility, because of the arrow of time. He postulates that irreversibility itself – i.e., the 'arrow of time' – *precedes existence* (Prigogine 1997, p. 163).

Questions concerning the origins of time will probably always be with us. But the idea that time has no beginning – that indeed *time precedes the existence of our universe* – is becoming more and more plausible (Prigogine 1997, p. 182, emphasis added).

It is irreversibility that puts us in an ever-emerging present. Furthermore, whatever emerges or comes into presence, because it is at the same time conditioning a rising future, necessarily *calls forth* that which is unimaginable or incalculable from the present. This is because the future evolution of the system is made possible not only by that which has already emerged *but also* by the arrow of time, which can never be ‘present’ in that it is not something that can itself emerge. What emerges is therefore never the complete thing. The arrow of time is always missing from what is ‘present’ but necessary for what is present to present itself.

Because the universe is irreversible it cannot unfold like an automaton for which we must simply discover the rules which are ‘present’ but hidden from view. Irreversibility, Prigogine insists, requires a reformulation of the fundamental laws of physics in terms of (irreversible) probability distributions, rather than the (reversible) trajectories used since the time of Newton. Probability or ‘chance,’ in other words, must play a fundamental role in our descriptions of nature. The basic laws must be reformulated to acknowledge that there is an unalterable temporal direction functioning as

an operator in what is taking place. It is this reformulation of irreversibility that serves as complexity's critique of representation at the level of the sign. I will elaborate on this point in the next chapter.

4.7 SUMMARY AND CLOSING REMARKS

In the preceding sections I have made an attempt to describe complexity not as an individual theory, but in terms of two opposing understandings which attempt to explain the world in terms of its interconnectivity (but of course the 'field' if such exists, could be 'cut' in other ways too). With both styles of theorising, the world is understood as a *relational entity* and, moreover, this relationality is of a *nonlinear nature*. For both styles of theorising, the non-linear nature of the relationality means that 'time' is a structural component of complex systems, not something that is applied to the system from without. This, in turn, means that complex systems – or perhaps I should say complex *processes* – are, for both understandings, fundamentally *irreversible* and *historical* which in turn means that complex systems/processes cannot be understood by taking them apart. They cannot be understood in terms of the traditional reductionist methods of 'ordinary' science, which attempt to understand the universe linearly, in terms of 'parts' that are acted upon by processes or 'rules' that are external to the parts themselves, such that $A + B + C$ is always (predictably) equal to

ABC. With complexity, $A + B + C$ may not only 'add up' to something *quite unpredictable*, like \emptyset , for example, but it is also the case that \emptyset cannot be understood as separate from $A + B + C$. In other words, 'components', 'product' and 'process' are all caught up in the complex entity or phenomenon, and inseparable from each other. These features, common to both approaches, so I shall argue in the next section, have some profound implications for our understanding of what we can know. As such, complexity's challenge to representation has been taken up the the epistemological level by a number of theorists who are interested in developing what they refer to as 'complexity thinking' (Cilliers 1998, Cilliers 2000a, Cilliers 2002, Richardson 2004, Richardson, Mathieson and Cilliers 2000).

Nevertheless, the difference between the two approaches, their different understanding of the role of time or 'irreversibility' in complex processes (which is connected to whether the system has a boundary or not) so I shall argue in the next chapter, leads also to a critique of representation at the level of the sign. At the level of representation *itself*. This in turn, leads to an *even more* profound shift in our understandings about knowledge. This difference between the two 'complexity' approaches, has been largely overlooked by those working on the epistemological implications of complexity (but see Popolo 2003). In the next chapter I hope to show why

complexity presents more of a radical challenge to representational epistemology than has previously been thought. Both the 'complexity thinking' approach of Richardson and Cilliers (Richardson and Cilliers 2001) and the computer modelling approach (which Richardson and Cilliers have referred to as 'new reductionism') assume that representation *closes down* meaning. This stems from a representational or dualistic understanding of the sign. Prigogine's interpretation however, suggests that representation opens meaning and it does this at precisely the same moment that it shuts it down. In this way it is very closely aligned with deconstruction, as I shall explain in the next chapter.

Chapter 5

THE EPISTEMOLOGY OF COMPLEXITY

Thinking beyond representational conceptions of knowledge

5.1 PREAMBLE

One of the ‘side-effects’ of complexity research is a theoretical discussion about the ‘implications’ of complexity for debates about knowledge and knowing. Such discussions (Cilliers 1998, 2000a, 2002, Dillon 2000, Popolo 2003, Richardson 2004, Richardson, Mathieson and Cilliers 2000) transpose insights from complexity science into the domain of epistemology and philosophy, which opens up another realm of exploration and debate for complexity. It is this ‘side-effect’ or ‘outgrowth’ of complexity that is the subject of this chapter. My interest is in articulating a way of working with or reading complexity that is more sensitive to its own conclusions: a reading that helps us think about the world and knowledge in a way that does not result in, or seek closure. I shall do this in two stages.

First I explore complexity’s challenge to representation at the epistemological level. I then explore its challenge to representation at the

level of the sign. With the first line of argument I provide a reading of complexity, which suggests that all attempts to fully, or perfectly understand, model or 'represent' complexity, *miss the point of complexity*. This critique does not mean to suggest that the attempt to engage with or 'understand' complexity should be abandoned. The point, rather, is that the logical difficulties that arise in representing or 'understanding' complexity suggest at least two alternatives to a 'picture' theory of knowledge. An *interpretivist* (or 'relativist') alternative which can be aligned with many 'postmodern' philosophical positions and a *pragmatist* alternative (i.e., a 'use' theory of knowledge) which can be aligned with Dewey's 'transactional realism.' This argument therefore does not take issue with the idea of representation itself. It does not challenge representation at the level of the binary sign (i.e., it does not take issue with the idea of 'presence.'). With this argument the question is not whether we can have knowledge of what is present, but with the epistemological status of our knowledge of what is present. Because it assumes something (a structure of sorts) is present, it is a *structuralist* argument.

In the second stage I show how complexity also poses a poststructuralist argument against representation. The poststructuralist argument takes issue with the notion of presence. To develop this argument I use insights generated by Prigogine's 'microscopic theory of irreversibility' (Prigogine

and Stengers 1984, p. 310) to suggest that when we understand the historicity of complex systems in a Prigoginian sense we can no longer take for granted the idea that the world is 'there' for us as every day objects are 'there' for us. In this regard I show that when Prigogine's theory is taken into account, we arrive at an understanding of signification which can no longer rely on the idea of presence, i.e., the idea that the sign reflects that which is already there. This semiotic position, so I shall argue, can be aligned with deconstruction.

5.2 THE STRUCTURALIST CHALLENGE TO REPRESENTATION

The idea that models of complex systems do not have a 'conventional' (i.e., one-to-one) representational relationship with 'reality' has been strongly stated by Paul Cilliers (1998, 2000b, 2001, 2002) and related arguments have been put forward by several others (see for example Lissack and Richardson 2001, Richardson 2002, Richardson, Cilliers and Lissack 2001, Richardson, Mathieson and Cilliers 2000). These authors are principally concerned with two intertwined features of complex systems that disallow a simple representational understanding of complex systems, these being (i) their nonlinearity and (ii) the uncertainty of their boundaries. Although nonlinearity and boundary problems are closely intertwined, in what follows I shall try to deal with each of these features separately in order to

give a more nuanced account of the 'unrepresentability' of complex systems.

5.2.1 Nonlinearity ('incompressibility')

As was described at some length in the previous chapter, the fact that the components making up a complex system are nonlinearly interconnected means the behaviour of the system is unpredictable a priori. This is because feedback loops within the interconnected network of components ensure that no one component has a discrete effect on any other. The effects of interaction are distributed throughout the system such that most of the information contained 'in' a complex system lies in the relationships between the components of the system, not the components themselves. This interconnectedness of complex systems masks linear cause-and-effect type relationships between the individual components which means we can't just add up individual (linear) effects to predict the 'total effect' produced by the system. Furthermore, we cannot take the system apart to understand it because in doing so we destroy the 'part' that contains much of the information – i.e., the relationships.

Cilliers uses this feature of complex systems to argue that such systems are 'incompressible' (Cilliers 1998, pp. 9-10). By this he means that we cannot leave anything out of a complex system without producing a distortion.

This in itself is unremarkable, obviously if we leave anything out of any system we are going to get a distortion and this applies equally to linear and nonlinear systems. But this is not Cilliers' point. His point is that if we leave something out of a linear system we know exactly what the effect of that omission will be, and so we can compensate for it, but this is not the case with complex systems. Because of the nonlinear nature of the interactions and the unpredictability of the emergent products of these interactions, if we leave something out of such a system, Cilliers contends, we cannot accurately predict either the nature or the magnitude of the distortion this will produce.

When this line of thinking is extended to models of complex systems, we see that to model a complex system we would have to model the whole thing, in its entirety (i.e., in a one-to-one sense), if we want the model to accurately reflect the system we are modelling. We cannot leave things out (i.e., 'compress' the information) without introducing unpredictable effects. This conflicts with conventional understandings of modelling, which suggest that the model must always be simpler than the thing modelled. Holland, for example, suggests that making a 'well conceived' model means (simply) 'extract[ing] the regularities from incidental and irrelevant details' (Holland 1998, p. 4).

Shearing away detail is the very essence of model building. Whatever else we require, a model must be simpler than the thing modelled (Holland 1998, p. 24).

Holland's argument is that even nonlinear systems obey laws that have a compact description and he uses computer simulations of complex systems – such as cellular automata³¹ (CA's) – to demonstrate the fact. For Holland, the behaviour of CA's is isomorphic³² with that of 'real' complex systems and so these models can be understood to suggest that in the 'real' world very simple initial conditions plus a few simple transformative rules can combine to produce the unlimited complexity we see around us.

Even with virtual reality... the underlying model obeys laws that have a compact description in the computer – a description that generates the details of the artificial world' (Holland 1998, p. 24).

If Holland is correct, and complex systems can be represented in terms of their rules of interaction – i.e., by rule-based models – then complexity would pose no threat to the notion of representation and it would be

³¹ See Chapter 4, (Section 4.3.1) for a brief description of the structure and functioning of cellular automata.

³² I should state here that I do not mean isomorphic in the simplistic sense that one cannot draw an accurate picture of, say, an electron. As any physicist will endorse, it is impossible to draw a picture of an electron. An electron is a purely theoretical construct which provides an explanation for many actual physical phenomena. Nevertheless it is possible to make models of where an electron might be in an atom. For example, quantum mechanical pictures of Hydrogen atoms use dots to represent the places where the electron is most likely to be. These models suggest that if we assume the existence of electrons, this is how electrons would actually behave in reality. Such models therefore claim to be isomorphic with 'reality' in that they claim to reflect or depict something about the way the world really is.

possible to use models of complex systems to understand 'real' complex systems. A 'picture' theory of knowledge would therefore be quite sufficient.

However I do not believe Holland is correct. Holland's mistake, in my view, is due to an undifferentiated understanding of causality/determinism. Holland does not differentiate between 'explainable' (a priori) and 'descriptive' (a posteriori or empirical) forms of causality/determinism.

Holland's argument that complex systems can be reduced to their rules of operation is closely linked to the concept of emergence which, historically, has had a problematic relationship with the principle of causality (see Chapter 4, Section 4.3.3). Typically, emergence is understood as something *in principle* unexplainable by science and it has been considered the key ingredient that makes a system complex because in many ways it captures something of the a priori unpredictability of the output of complex systems. However, as Holland (1998) has remarked, the advent of high speed computers and nonlinear mathematics have shown that emergence, far from being something mysterious, can be accounted for by nonlinear dynamics. Computer simulations such as CA's, have shown that a simple set of rules governing nonlinear interactions can produce emergent features and moreover these emergent features are consistent in that the same set of

agents, organised in the same way, will repeatedly produce the same emergent feature/s. In other words, computer modelling approaches suggest that despite their a priori unpredictability, emergent effects are *causally determined*. Computer simulations therefore provide us with the extremely important insight that an outcome can in principle be determined a priori, even if it cannot in practice be predicted a priori, i.e., that *predictability and determinism are not necessarily linked* (see Chapter 4, Section 4.3.3).

This insight has led Holland and other prominent complexity scientists (e.g., Kauffman 1995, Wolfram 2002) to (mistakenly, I think) understand emergence (and by implication, complexity) as something that is in principle (even if not in practice) explainable by or reduced to a simple set of rules. I believe this view is mistaken because even if emergent effects *are* causally determined this does not help us *foresee* the nature of any particular emergence. As Emmeche, Køppe and Stjernfelt (1997) point out, not all causality results in a priori predictability. These authors distinguish between (i) 'explainable causality' which enables a priori predictability and (ii) 'descriptive causality' which can result only in a posteriori predictability. In this context, their quote which I used before (see Section 4.4.1) can now be understood in a slightly different way:

Emergent phenomena ... are unpredictable until the moment they are described. Then they are in a certain sense not unpredictable anymore. After the relations between the preceding conditions and the phenomena produced are described for the first time, one can claim that the event hereafter can be predicted and is therefore causally described (Emmeche, *et al.* 1997, p. 100).

From this it should be evident that at most, what is 'explained' by the nonlinear dynamics of computer simulations such as CA's is a low-level organising principle or mechanism by means of which the phenomenon of emergence *per se* is made causally possible. Such an 'explanation' remains silent about the nature of any *particular* emergent effect. It cannot give an a priori explanation of why – given a certain set of initial conditions and rules of interaction – a particular emergent effect will emerge, nor can it describe exactly what emergent effect will emerge. Knowing about the rule and the elements does not in any way help us toward an a priori understanding of what exactly will happen when a particular set of elements interact with each other according to a particular rule or set of rules. To know we have to wait and see what happens. What this means is that even if we have an unlimited amount of information about a complex system, even if we know all of its components, and all its rules of interaction, we still cannot know how the system will behave or what emergent effects will emerge. There are limits to what we can know. Moreover, the same principle applied in

slightly different circumstances or with slightly different initial conditions can result in widely different emergent effects. It would seem, therefore, that – contrary to Holland’s claims – the ‘incidental and irrelevant details’ (Holland 1998, p. 4) cannot be ‘sheared away’ to produce a model as these details are an integral part of the nature of the actual complex system, contributing as much, if not more, to the specific behaviour of the system as do the ‘rules of interaction’. As Cilliers (1998) has argued, by removing such ‘incidental and irrelevant details’ we could significantly change the output of the system (alternatively the system may change little, or not at all, there is no way of knowing this in advance).

Cilliers (1998) argues that it is precisely *because* models have to reduce complexity (leave things out) in order to function as models that we cannot model complex systems. The nonlinearity of complex systems means we are unable to leave anything out of such systems without introducing a distortion of unpredictable magnitude. The emergent behaviour of our models of complex systems will therefore always be *unpredictably* different from that of the complex systems they purport to model. Cilliers adds that even if we *could* put all the components of the complex system into our model – which we cannot, for presumably we cannot make a replica of life, the universe and everything, and moreover this would defeat the objective of modelling – we still would not be able to understand the behaviour of a

complex system, as ‘the behaviour of the model would be as complex – and unpredictable – as that of the system itself’ (Cilliers 2000b, p. 48).

My conclusion is that it is impossible to have a perfect model of a complex system. This is not because of some inadequacy in our modelling techniques, but a result of the meaning of the notions ‘model’ and ‘complex.’ There will always be a gap between the two. This gap should serve as a creative impulse that continually challenges us to transform our models, not as a reason to give up (Cilliers 2001, p. 138).

Since we cannot make a model of a complex system – due to the reductive nature of models and the nonreductive nature of complexity – it would seem that ‘picture’ theories of knowledge are inappropriate *when it comes to understanding complex systems*. This, of course, also means that if ‘reality’ is complex (as the complexity scientists would have it) then ‘picture’ theories of knowledge are also insufficient more *generally*.

The nonlinearity (or ‘incompressibility’) argument, if it holds, is enough on its own to do away with the possibility of retaining a ‘picture’ theory of knowledge at the same time as acknowledging the relationality of complexity. However, one problem with this argument is that it depends entirely on emergence not being predictable – or fully describable – a priori and this may not always be the case. As Emmeche *et al.*, (1997) comment: the ‘unexplainable’ nature of emergence has ‘always [run] the risk of being

overridden by history in the development of science' (Emmeche *et al.* 1997, p. 84). Complexity science and nonlinear mathematics have already shown how emergent features can be seen as being causally determined (if only after the fact) and if we were to concede that we may some day be able to make a priori predictions about the exact nature of a particular emergence (instead of only being able to 'predict' such emergences after the event) we need to ask ourselves whether this would have any effect on the representability of complex systems.

At first glance it would seem that everything would be turned around if we could predict an emergence a priori. If an emergence could be fully described in terms of a set of rules we could know *why*, given a certain set of components and rules of interaction, a particular emergent effect would emerge. If we could *fully describe* a particular emergent effect in terms of a rule, the emergent effect would be *reducible* to the rule, and if reducible, the difficulty of representing complex systems would be removed. In this case a 'picture' theory of knowledge could stand (or be reinstated) even if we hold that the world is complex.

The nonlinearity (incompressibility) argument, on its own, may therefore not be sufficient to do away with 'picture' theories of knowledge. This, however, does not allow a relapse into direct or one-to-one

representationalism, as there is another feature of complexity that precludes the possibility of this sort of representation. This is the openness or undecidability of the boundaries of complex systems, as addressed in the section below. With this argument I have assumed that ‘descriptive’ (a posteriori or empirical) causality is the equivalent of its stronger ‘explainable’ (a priori) version (i.e., that emergent features are ‘explainable’ simply because they are causally determined).

5.2.2 The undecidability of boundaries

One does not need to evoke all the old philosophical arguments that scientific models cannot be ‘proved true’ or ‘verified’ (see Chapter 3, section 3.3) to understand that ‘real’ complex systems cannot be represented with certainty. Although these arguments are crucially important, we can reach the same conclusion simply by examining the way in which rules function in alliance with boundaries to constitute a system. Open complex systems (such as language and ecosystems) have uncertain boundaries while closed complex systems (such as CA’s³³) have certain or ‘hard’ boundaries and this has implications for what we can say about the effect of an operating rule in

³³ Although CA’s are good at showing that remarkable complexity can spring from a few simple rules of operation, CA’s in almost all respects are closed systems and strictly speaking, cannot be considered as complex systems. In fact Gilliers (2000b) suggests that such systems are more accurately described as ‘complicated’ systems. Unlike ‘real’ complex systems, CA’s do not interact with or exchange information with their environment (except for the fact that they draw energy from an outside source). Their boundaries are well defined and the initial state of the system precisely known.

these two sorts of systems. My point is that boundaries (or the lack thereof), more than rules, affect our ability to represent a system precisely.

In a closed, nonlinear system, such as a CA, where all the initial conditions are known – and presuming the principle of causality holds – there is only a single trajectory which the system can follow and the operating rules sharply determine this trajectory. As a rule is implemented/reiterated the system moves inexorably along this trajectory from an initial state towards its final state. All possible states of the system can therefore be reliably predicted and the outcome (or outcomes) of the initial conditions can be understood fully in terms of the basic rules of operation. Since the system is functioning in a pre-programmed way, it can be accurately described or *represented* in terms of the operating rule *plus the initial conditions of the system*. It is for this reason that Holland believes that emergence (complexity) can in principle be fully described (and therefore understood) by means of an operating rule. However the fact that CA's have a hard boundary – something that is not present in 'natural' complex systems – is for the most part glossed over by Holland. It is crucially important however, as the boundary of the system must be understood to work together with the operating rules to *constitute* the system that it bounds. To put this another way, it is only when the boundary is known that we can confidently search for a rule that governs the behaviour of the system.

However, specifying clearly where a boundary could be is not obvious when we are dealing with open systems that interact with or exchange information with their environment, transforming themselves and the environment in the process. Such 'boundaries' can never be certain or clearly defined. They are not 'hard' boundaries. When this is the case, an operating rule can no longer be understood to sharply determine the trajectory or structure of the system. At most, such rules enable the system to 'settle' into a state that more-or-less satisfies the constraints imposed upon it (Cilliers 2000b). Thus the 'final state' (if such can be said to exist) is always contingent on numerous 'external' factors (which themselves are emergent products of other interacting complex systems) so there can be no pre-determined path or definite pre-determined 'final state' of the system, as was the case with CA's. 'Real' complex systems remain radically contingent even if we concede that 'operational' boundaries can emerge as a result of such systems 'settling' into some state that more or less satisfies the constraints imposed upon them. This means that even if rules do govern the behaviour of the system, we can have no firm or accurate description of such systems. Without prior knowledge of the contingent 'external' conditions affecting the system, open systems cannot be fully, completely, or even reliably represented. To represent them we have to create a boundary – which then functions more like a hypothesis/conjecture: i.e.,

under *these* boundary conditions such-and-such *may* happen. The radical contingency of these systems prevents us from saying anything with certainty (see Cilliers 2002).

But this is not all there is to say about 'boundary problems.' Engaging with the boundary problems of complex systems also leads to another set of insights which are connected with the *radical* interconnectivity of complex systems. The term 'radical' qualifies 'interconnectivity' here in the following way. It means interconnections extend not only within and between systems but also within and across *different hierarchical levels of complexity*. For example an emergent effect may feed back into the system that 'produced' it (see Figure 5.1). Because of this radical interconnectivity complex systems are not neatly nested. The 'parts' or 'sub-systems' of a complex system are also always simultaneously part of many different systems (Cilliers 2001) which presumably have their own 'rules' of operation. This means that different rules of operation criss-cross in 'individual' complex systems (see Figure 5.1) and so it becomes questionable whether a system can be described/represented by a unified set of rules.

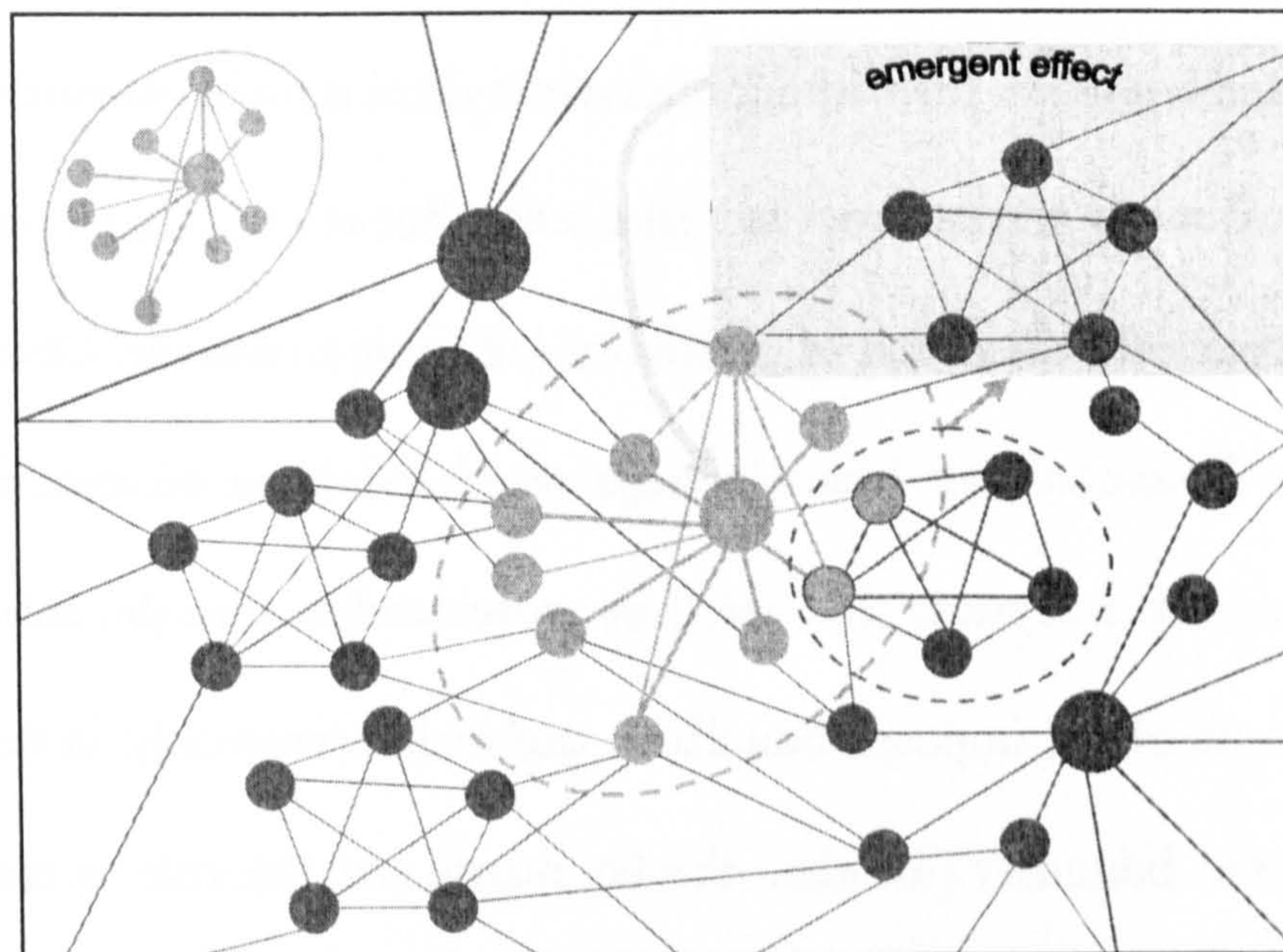


Figure 5.1

In this illustration the ‘rules’ are depicted by means of interconnecting lines. Note that the light grey ‘system’ in the dotted circle in the centre of the illustration – which is ‘isolated’ in the solid circle in the top left-hand corner – is only a ‘system’ if it is artificially delineated as one. Its ‘behaviour’ is therefore contingent on ‘rules’ which cannot be contained within its boundaries. The ‘isolated’ model in the top left-hand corner would therefore exhibit different behaviour from its interconnected ‘real’ counterpart, or, if it showed the same behaviour, it would do so only by means of a completely *different* set of rules, i.e., a set that operated with different boundary parameters.

As Cilliers (2000b) points out any 'rules' that are developed to describe a particular system, are based on a framework or boundary that is *selected for a specific purpose*. Let me put it another way. To describe a system we have to impose a boundary for without boundaries there is no information at all: we have to impose boundaries to make sense. But in creating a boundary, we also create the condition of possibility for a rule to emerge. Only if we impose a boundary can 'rules' emerge which allow us to describe the behaviour of this 'system' but we have to remember that the rules exist only because of the imposed boundary, and makes sense only in terms of the imposed boundary. Neither the boundary nor the rule is naturally given.

This also means that if we want to argue that a model or theory represents some 'real' pattern or regularity that actually exists, then we see that when we attempt to use our model to identify the rules of operation of this real pattern or regularity, we can't do this because the behaviour of any particular regularity (or pattern) is contingent on many different and overlapping sets of rules (note the 'isolated' model in the top left-hand corner of Figure 5.1). So the problem becomes one of how we can represent the behaviour of a real complex system in terms of a single or unified set of rules when its output is partially determined by sets of rules that we have

no access to. My point is, if we want to model or theorise about the behaviour of a real complex system we first have to give it a boundary because only then can we start looking for its rules of operation. But in giving it a boundary, we then have to find a new set of rules that can work with *these* particular boundary conditions to produce the effect we are looking for. And in doing all this we find we have completely re-invented the system we wanted to find out about. So this means while our model (or theory) may produce (or account for) the same effect as that produced by the real system we are modeling (or theorising about), it is a completely different set of rules that produce (or account for) this effect. The rules of our models and theories are not isomorphic with the rules driving the real system. Rules and 'laws' that we discover are not 'real' features of the systems we are modelling. This conclusion can be understood from at least two perspectives. One leads to relativism, the other pragmatism.

5.2.3 The relativist and pragmatist alternatives

I shall deal with the relativist interpretation first, to get it out of the way and then I shall turn to pragmatism, which I believe is more interesting from an epistemological perspective as it leads away from the objectivism-relativism impasse I described in Chapter 3.

The relativist alternative arises from the idea that any 'features' we 'discover' (i.e., rules or laws of complex systems) can only ever be a function of the frame we have *subjectively chosen*. In other words, the boundaries we 'see' are partly a function of the way in which we choose to see. We would have to acknowledge that our knowledge making endeavours have a certain subjectivity.³⁴ However this does not mean the boundaries or 'entities' we see are *entirely* subjective. Cilliers puts it like this:

...we frame the system by describing it in a certain way (for a certain reason), but we are constrained in where the frame can be drawn. The boundary of the system is therefore neither purely a function of our description, nor is it a purely natural thing. We can never be sure we have 'found' or 'defined' it clearly, and therefore the closure of the system is not something that can be described 'objectively' (Cilliers 2001).

As such, the 'features' we 'discover' are always context dependent. Because every representation of a complex system that we may come up with has been framed in this way, none of these representations can say anything *universal* about the nature of reality. Since the rules we 'find' that enable our models to simulate 'reality' do not describe the 'real world' we cannot

³⁴ Even the concept 'organism' cannot be conceived independently of our cognitive mapping of systems and their boundaries for it depends on the hierarchy of life one is trying to defend (Dillon 2000, p. 12).

set the rules of our models to achieve a certain outcome and then impose these rules on the real world and expect the same outcome (see Richardson 2002). Neither can we assume that by observing the emergent behaviour of our models we may obtain a priori knowledge of complex natural systems which previously resisted empirical analysis, although as Richardson and Cilliers (2001) have noted, this is precisely the understanding that dominates much of the complexity literature (see also Horgan 1995). Instead, we are led once again to the conclusion that if we assume the world is complex, 'picture' theories of knowledge are inadequate for understanding it. This perspective has similarities with a number of 'postmodern' or 'interpretivist' epistemologies which deny that there is any merit in looking for the truth, a move which is often construed as opening the way for an 'anything goes' postmodern relativism. I would suggest, however, that we are not bound to an endless controversy between 'truth-orientated' and 'interpretivist' discourses, both of which, I should add, still share a concern with the accuracy of our 'pictorial' representations. Both claim that either we *can* or *cannot* make accurate (i.e., pictorial) representations of our world and are therefore trapped in the logic of 'picture' theories of knowledge. An alternative to both these stances – which I believe complexity also offers – would be to explore whether there is some other way of understanding

knowledge that gets us out of this impasse. It is here that I believe pragmatism is helpful.

The pragmatist alternative arises from the idea that while the rules of our models of complex systems may produce the same effect as the 'real' complex system, it is a completely different set of rules and initial conditions that create this effect. In other words, regularities exist, we can detect them and even find rules that reliably describe their behaviour, but the rules we find *are not real things*. There is no isomorphic relationship between the rule in the model and the rule in the 'real' system (if such rules even exist). The correspondence is not representational or *truthful* but functional or *pragmatic*. Our models and theories are not *pictures* of 'reality' but *tools* to help us do things in the world. The conclusion that our models and theories of complex systems are pragmatic rather than pictorial implies that what we consider to be knowledge of an independent complex 'reality' that is wholly other to us is in fact only knowledge of the effects of our actions in the world which brings us very close to Dewey's understanding of knowledge and ontology (see Biesta and Burbules 2003, for details about Dewey's understanding of knowledge and truth).

Dewey understood knowledge and learning as being about action or, more accurately, 'transaction' (Dewey & Bentley 1949; see also Biesta & Burbules

2003). Dewey articulated his 'transactional' theory of knowledge very concisely using the concept of the 'Reflex Arc' (Dewey 1896), which is conventionally understood in biology as a 'stimulus' setting an organism in motion to produce a 'response.' Contrary to this linear understanding of the way in which an organism interacts with its environment, Dewey understood that

the stimulus is only found at the very moment in which the (adequate) response has been found. It is only when the organism has 'hit' upon an adequate response that coordination is achieved, that the organism 'knows' what the stimulus was (Biesta and Burbules 2003, p. 35).

Biesta and Burbules suggest that for Dewey, finding a response that brings about coordination is the same as saying that the meaning of the situation for this organism has become clear (Biesta and Burbules 2003, p. 36). Meaning in other words *emerges* from the complex organism-environment transaction. The experimental transaction of organism-environment not only leads to more specific habits, but also results in a more 'differentiated', more meaningful world. In other words, 'the world is no longer a vast penumbra of vague unfigured things, but gradually becomes a figured framework of objects' (ibid., p. 37). With this understanding we see that the quest for knowledge is not in order that we may develop more accurate or

pictorial understandings of the finished universe, *as it is*. Knowledge is not something to look at, nor is it itself a process of looking. Rather, the quest for knowledge is about finding more and more complex and creative ways of interacting with our environment and through doing this – through intervening in the processes of the universe – we find out how to create new and more complex environmental conditions with which we can interact in yet more complex and creative ways.³⁵ The point is, for Dewey there are no final solutions, only ongoing interactions leading to increasingly more complex interactions (and ‘solutions’). With the pragmatist alternative we see that a complexity inspired understanding of knowledge puts the observer back in the world as an *active participant* rather than a *disinterested observer*. In this sense the world, and our actions in it *are part of the same complex system*. Nevertheless whatever emerges from the world-participant *transaction* can be understood to be the real ‘reality,’ which the participant can then have knowledge *of*. In this sense pragmatism is structuralist. At some level it is still foundational – something must pre-exist the sign, and hence the knowledge representation. As such, it does not escape the Cartesian epistemological framework where knowledge is still a

³⁵ Think about the invention of the wheel, cars, computers, the Internet, all of which enabled leaps in creative possibilities for our interactions in the world.

representation of something which lies outside itself. As a critique of representation, pragmatism is still representational *at the level of the sign*.

From this discussion about nonlinearity and boundaries, I hope to have made clear that as long as nonlinear systems are 'open,' we cannot hope to understand these systems in a conventional one-to-one representational sense. Models with clearly defined boundaries that purport to be models of 'real' or 'natural' complex systems may be very good at simulating the complex processes we see around us, but the rules we 'find' that enable these models to simulate 'reality' do not give us a 'picture' of the 'real world.' The nonlinearity and boundary arguments, it would seem, are more than sufficient to put 'picture' theories of knowledge to rest, at least in terms of understanding complex systems. These arguments suggest that if we acknowledge that 'reality' is complex we can only approach complexity in terms of interpretivist (relativist) or pragmatist (use) theories of knowledge. These however, are themselves reliant on the logic of representation *at the level of the sign*. They remain within a structuralist ontological framework and a Cartesian epistemological framework. But this is not all there is to say about complexity's challenge to representation. I believe complexity's challenge to representation also takes place within a poststructuralist framing.

5.3 THE POSTSTRUCTURALIST CHALLENGE TO REPRESENTATION

The poststructural challenge to representation, as posed by complexity, is closely related to complexity's unusual nonlinear (as opposed to linear) understanding of temporality. I believe this feature of complex systems has not been given sufficient attention by theorists concerned with working out the epistemological implications of complexity.

Since one of the central postulates in complexity science is the notion of 'time irreversibility' (Prigogine and Stengers 1984) and moreover, since it has also been argued that emerging notions of temporality and history are the single most important phenomenon characterising the 'collapse of representation' (see for example Foucault 2002/1970a), it would seem an analysis of temporality, with regard to the epistemology of complexity, is absolutely *indispensable*.

5.3.1 *A non-linear understanding of temporality*

Complexity's understanding of temporality and process contrasts with linear understandings which assume that processes (causal sequences of events) happen over time so can be understood from *particular* temporal standpoints (with no temporal standpoint being privileged). With linear understandings phenomena that are not static can be understood to 'unfold' in time in a linear fashion. With this understanding, 'reality' can be viewed

‘not as a continuous flux ... but as a series of instantaneous “snapshots” extracted from this flux’ (Gutting 1989, p. 51). The assumption is that the flux of time is divisible into isolated elements. What this means is that when time is brought into analyses of phenomena, it is brought in as just another variable, i.e., phenomena must be understood from a particular temporal standpoint (with no temporal standpoint being privileged). However it is precisely this ‘snapshot,’ ‘reversible’ or ‘continuist’ understanding of temporality as ‘just another variable’ that complexity challenges.

5.3.2 Two challenges to linear temporality

There are at least two levels at which we can try to understand this challenge to linear temporality. The more basic level explanation is concerned with boundaries (albeit temporal rather than spatial boundaries), the other with the ‘irreversibility’ of complex processes. I shall deal with both explanations, although it is the latter that is of the most interest and usefulness to this discussion.

At the more basic level, we can understand the temporality of complex systems in terms of what I shall call ‘nonlinear causality.’³⁶ For this we see that the idea of framing a system by putting spatial boundaries around it is

³⁶ Which refers to the idea that the emergent effects produced by nonlinear interactions are causally determined but are not predictable a priori (i.e., ‘explainable causality’ does not hold).

wholly dependent on the assumption that we can also isolate it as a 'snapshot' in time. If this cannot be done, the system cannot be spatially framed and therefore cannot be represented. However this argument is not much different from the 'boundary argument' I discussed earlier (Section 6.2.2) where I pointed out that interconnections extend not only within and between systems but also *within and across different hierarchical levels*. Cilliers puts it like this

...hierarchies are not that well-structured. They interpenetrate each other, i.e., there are relationships which cut across different hierarchies. These interpenetrations may be fairly limited, or so extensive that it becomes difficult to typify the hierarchy accurately in terms of prime and subordinate parts (Cilliers 2001, p. 143).

Cilliers, of course, is talking from a spatial rather than temporal perspective (although it becomes difficult to distinguish between these two perspectives with complex systems). However if we understand emergent features as phenomena on a different hierarchical level from the elements that interacted to produce the emergent feature, then we are led to explore complex systems from a temporal perspective. However, if we do this, we find that we cannot talk about one set of structures 'giving rise to' another in the usual linear fashion. We cannot say that at 'time A' we have interacting elements, while at 'time B' we have the emergent feature

produced by these interacting elements. With complex or 'emergent' systems there are no distinct elements or phenomena that precede or follow real points in time. We can begin to get some understanding of this by returning to the discussion of Emmeche, K ppe, and Stjernfelt:

Very often the idea of a temporal succession in the creation of new [emergent] levels is spontaneously interpreted so as to imply a causal process. This idea leads to a metaphysical mistake which is evident when one considers objects in which several levels coexist at the same time: the idea that the lower levels *cause* the higher levels to exist. Of course this is true in a common-sense use of the word 'cause' but not in the standard scientific way of using it: if the higher level consists of units of the lower level, then they exist simultaneously [e.g., brain cells and consciousness]. There is no temporal, causal process going on 'creating' the higher level out of the lower one, and no reductionist saying so has ever been able to show a cause running from the lower towards the higher level (Emmeche, K ppe, and Stjernfelt 1997, p. 93, italics original).

Although one level is more 'basic' in that it presupposes the higher level – i.e., the higher level could not exist without it – both levels must be understood to exist simultaneously. If the lower level exists, then *at the same time* the higher level also exists. Another way of understanding this is to visualise higher level emergences as stable, reproducible patterns in time and space of the lower level elements. Although the lower level elements constitute the pattern, the pattern cannot be 'explained' by the lower level

elements. For Emmeche *et al.*, '[t]he act of creation in the same moment create[s] conditions and product' (ibid., p. 93). The upper level is in this respect as much part of the regularity as is the lower one. However there is something more that must be taken into account. Here Emmeche *et al.* draw on Polanyi's (1968) theory of boundary conditions to suggest that the emergence of the higher level *also* places limits on the lower level.

Each level relies for its operations on all levels below it. The level reduces according to Polyani the scope of the one immediately below it by imposing on it boundary conditions that harnesses it to the service of the next higher level, and so on (Emmeche *et al.* 1997, p. 108).

Because higher level emergences place limits on what is possible for the lower level, *emergence can be understood to select its own constraining conditions*. To illustrate this point we can use an example from physics and chemistry. John Holland offers the following:

The laws of chemistry are indeed constrained by the laws of physics and, in this sense chemistry is reducible to physics. However, chemistry has its own [laws]. The macrolaws that govern the interaction of molecules are formulated and used without reference to the laws of particle physics. In unusual circumstances chemists refer to deeper levels (such as the effects of radioactivity), but these are the exception not the rule (Holland 1998, p. 245).

If we understand this quote from Polanyi's perspective, we could say that *in addition* to chemistry being constrained by the laws of physics, the laws of physics are also constrained by chemistry in that they can only manifest in certain ways, i.e., according to what the laws of chemistry allow. They are *harnessed* by the laws of chemistry. Although it is the presence of lower level constraints (the laws of physics) that enable the emergence of a higher level order (chemistry), we also have to bear in mind that as soon as these preceding conditions bring about an emergence (chemistry), new constraints (the laws of chemistry) are in operation at precisely the same time as the emergence comes into effect. New emergence, new constraints. Thus emergence *creates its own constraining conditions* and this cannot be understood in a unidirectional or linear way. It must be understood that while the lower level provides the necessary conditions for the higher level to emerge, something else is also at stake here in the emergence of new (or 'higher') levels of order. There is a 'supplement' which is itself not present in the lower level. This 'supplement' to the lower levels is provided by the 'laws' of the higher level, i.e., 'chemistry has its own [laws, which] ... are formulated and used without reference to the laws of particle physics' (Holland 1998, p. 245).

These higher level laws, in other words, have introduced something (a 'supplement') *which was not there before*. At this point linear determinism

fails. We are forced to give up the idea of *foundational* bits and pieces from which everything in the world can unfold – like an automaton – in a linear fashion. We see that *there is always something missing*. It is at this point that we begin to see complexity's challenge to the notion of 'presence,' upon which the whole dualistic structure of representation depends. To explore this challenge further in relation to complexity, we need to go to Prigogine's work.

5.3.3 *Complexity's challenge to the notion of presence*

Prigogine (1997) insists that although new order (emergence) results when a complex system explores and finds new ways of working with the initial conditions, and that these initial conditions are provided by the lower hierarchical level – and are 'causal' in this regard – the elements making up the lower level do not provide *everything* necessary for order of a particular kind to emerge at the higher level. In his words:

The system 'chooses' one of the possible branches available when far from equilibrium. But *nothing in the macroscopic equations justifies the preference for any one solution* (Prigogine 1997, p. 68, emphasis added).

The single actualised version – the 'solution' that is 'chosen' by the system – is always one among a number of plausible alternatives that happened not

to occur. This means that the 'solution' a system will finally 'settle on' is not a foregone conclusion, but always a matter of chance. To put this another way, the pattern (or organisation) that emerges at the higher level is not only a product of the system's relational past but also of 'something' (a 'supplement') that is not present in the system at all. The combination of the system's relational past with the totally intractable or unrepresentable to produce new emergent order that supervenes on lower levels *ad infinitum* ensures that the system is never in a state where it is fully actualised, it is never fully 'present' at any point in time, because an integral part of it is that which is *not* part of it. It therefore remains always in the process of becoming without being or, more accurately, becoming *something else* without *first* being *something concrete*.

What I have tried to argue is that complex systems (if such can be said to exist) are therefore not only open in space, but also open in time. Being open in space leaves open the possibility that they are spatial things, i.e., concrete entities with a *structure* that can be grasped. One problem with this sort of understanding is that it could be argued that the view of the universe as being composed of closed interacting entities could be *replaced* by the view that universe is instead 'radically relational.' This however is still a structuralist position. This is because the idea that the world is either like *this* or like *that* relies on the idea of a foundational world – one with all the

bits and pieces of its history ready to recombine in an infinite variety of new ways – a world that we can know, one that is *separate from our knowledge of it*. As long as complex systems are understood as spatial entities the temptation remains to look for the big picture, the biggest picture, which encompasses *all* the openness. To look for the one final or ultimate boundary in which all this interconnected ‘being’ exists. However the openness in time is more intractable. When there is no moment in which to say ‘stop’ we not only lose the boundaries of the present but we also *have nowhere to begin*. We lose The Past (the past as immutable, real, ‘true’). If complexity suggests an epistemology, this will be an epistemology which dispenses with foundations, dispenses with a structuralist ontological scheme. It will be ‘historical’ but this ‘history’ will have no place to begin. In the next section I draw on Prigogine’s critique of determinism, Derrida’s understanding of deconstruction and combine it with G.H. Mead’s emergentism to outline a possible ‘epistemology of complexity.’

5.4 THE EPISTEMOLOGY OF COMPLEXITY

My argument so far is that both Prigogine and Derrida bring into question the idea of presence, upon which the idea of representation is founded. Prigogine’s work suggests that the existence of a world *present to itself* which can unfold – like an automaton – in a deterministic fashion is at least not an

inevitable assumption. This critique of classical determinism is not the only scientific discourse that brings determinism into question. It can also be found in a broader debate in theoretical physics which Max Planck has referred to as the 'determinism quarrel' (see Freire 2003) which is mostly concerned with the philosophical (epistemological) implications of quantum mechanics.³⁷ This debate about determinism framed within the quantum mechanics literature has raged for the last eighty years at least (Freire 2003). I believe the reason quantum mechanics has been (and continues to be) so unsettling in theoretical physics is precisely because it too brings into question the idea of presence, the foundation upon which modern epistemology depends. Quantum mechanics says the universe is not 'there' for us, as objects in our every day world appear to be 'there' for us.³⁸ The debate about quantum mechanics is, in other words, a scientific controversy with fundamental semiotic and epistemological implications. But the problematisation of presence is perhaps most well developed in Derrida's critique of the 'metaphysics of presence' (Derrida 1976b) which I introduced in Chapter 3.

³⁷ Max Planck was one of the founders of quantum mechanics. Planck's views on this are expressed in *Deteminimus oder Indeteminimus*, Leipzig, Barth, 1938.

³⁸ Werner Heisenberg, for example would have it that 'the electron and the atom possess not any degree of physical 'reality' as the objects of daily experience' (Heisenberg 1926, in Miller 96, p.120).

This, of course, raises the question as to why we need Prigogine to discuss the problem with presence, rather than these other better established debates lodged in quantum mechanics and deconstruction. One reason for using Prigogine is that he still employs metaphors we can relate to in our macroscopic world. This is not the case with much of modern physics (particularly quantum mechanics) or Derrida, both of which throw us into a crisis of imagination.³⁹ We can no longer use 'real' world metaphors to imagine the world that is presented for us by Derrida or by quantum mechanics. Metaphor fails us. This 'failure' of metaphor is momentous. Solomon Marcus comments:

For the first time in human history, the main concern of science, art and philosophy is situated *beyond the macroscopic world*, while human semiosis, as it was projected and developed during a long period of its history, had remained limited to the macroscopic world (Marcus 2000 in <http://www.uni-kassel.de/iag-kulturforschung/archiv2/krise.htm>).

For this reason it is my belief that Prigogine's work gets us to a place where we can begin to feel more comfortable – or at least less uncomfortable –

³⁹ Some of the more 'unimaginable' concepts include curved space, which is finite yet unbounded; a four-dimensional spacetime continuum; mutually exclusive properties possessed by the same subatomic entity; the existence of fundamental fluctuations of energy in a total vacuum (see Tarnas 1996, p. 358). Another case in point is the 'Schrodinger's cat' thought experiment which shows the kind of absurdities that arise when we try to translate the ideas of quantum mechanics into the macroscopic world.

with Derrida and quantum mechanics. I do not believe Prigogine's work dispenses with the need to engage with Derrida and quantum mechanics, but that it provides us with an opening or gateway into, onto, or around these other 'non-metaphorical' – and therefore *non-representational* – forms of logic. In view of this I believe Prigogine's problematisation of determinism – which brings into question the notion of 'presence' – makes an extremely valuable contribution to a reconceptualisation of knowledge away from framings which are underpinned by a problematic Cartesian metaphysics.

5.4.1 Epistemology without 'presence'

When the notion of presence is brought into question we arrive at the idea that we can never understand complex processes because something is always missing from their foundational base, such that we are never able to justify any point of departure absolutely. The system, in other words, is never in a state where it is fully actualised, it is never fully 'present' at any point in time. Because it can never become 'present' it cannot be accurately re-presented and therefore it can never become *knowledge* in the representational sense, we can never 'grasp' it. But at the same time we could also say that because what is missing is what prevents final closure, it is this very 'missingness' that permits the appearance of the radically new

(i.e. it permits strong emergence). If we apply this insight to the idea of knowledge we could say that it is the very impossibility of knowing something completely that enables new knowledge to constantly emerge. In this sense what is 'missing' from the world (i.e., that which makes knowledge of the world impossible) is the condition of possibility for 'knowledge' to emerge. The impossibility of knowledge is its condition of possibility. In what follows I shall attempt to 'explain' this conclusion by exploring what a lack of 'presence' means for our knowledge of the past, the future and the present.

5.4.2 Knowledge of the past (the loss of truth in history)

Let me begin by reviewing the meaning of the past – history – in a fully deterministic world. With strict determinism each successive state of a system follows on and is entirely predictable from what came before. Since nothing is missing from the equations that describe each of these states – because chance is not involved – the process can be understood from any temporal standpoint, forwards or backwards in time. So if we are concerned with the history or past states of a system it is possible to refer back to any of the stages in the sequence and work out the correct history of the system, which is immutable, and eternal. With deterministic systems the history of the system is there to be read once and for all because the past

states can be read as fully as the present and future states. This understanding of ‘history,’ as a linearly temporal process, that can be ‘read off’ as a series of stages was described by Henri Bergson as a ‘cinematographical’ view of temporality where processes are understood as a series of ‘snapshots’ of the transitions from one state to another (Bergson 1911, p. 301). With this view, processes – or as Bergson would have it, ‘the flux of time’ (Bergson 1911, p. 344) – is divisible into isolated elements which can be fully described. Each ‘snapshot’ of the process is *there*, so to speak, and so a process can be fully understood from particular temporal standpoints which succeed each other (see Figure 5.2).

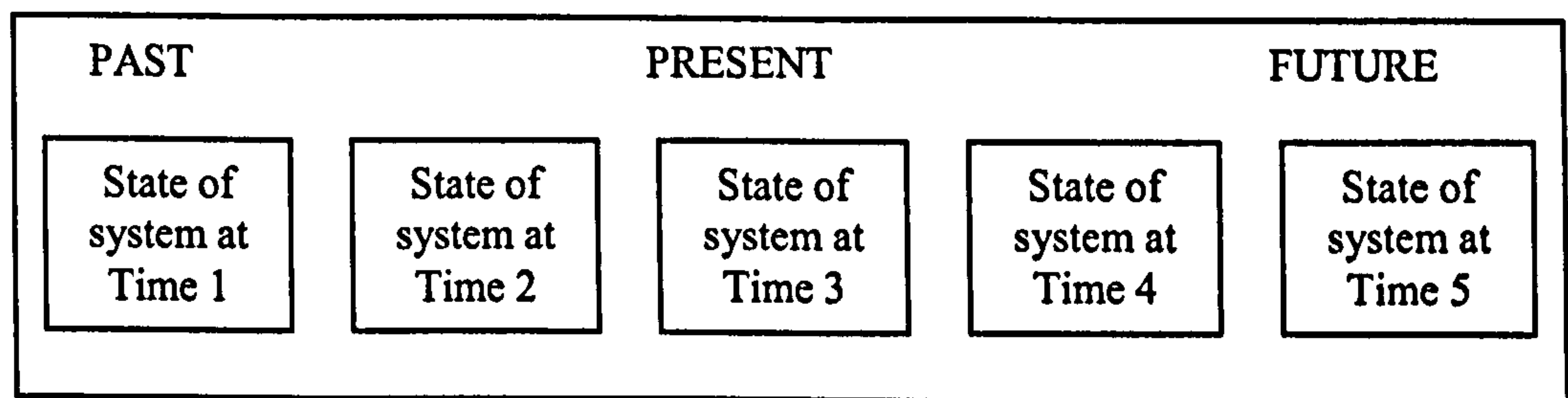


Figure 5.2

A linear understanding of temporality, in which history is immutable.

It is because each ‘stage’ of the process can be understood in the same way from any temporal standpoint – i.e., forwards or backwards in time – that the process can be described as ‘reversible’. According to Prigogine, the

introduction of chance as a fundamental aspect of the dynamics of a system destroys this view of temporality.

If a system is probabilistic rather than deterministic this means we cannot create a series of equations that would accurately describe the trajectory of the system in a linear series of stages that lead up to its current state. We cannot do this because there is always something missing from our macroscopic equations when the system 'jumps' from one state to the next, which prevents us from doing this. A vital part of what emerges at each stage is always a product of chance. This means the history of the system cannot be accurately described in terms of a linear series of definitive 'stages.' But if this is the case how should we understand the histories that we have already constructed? For example what should we make of the series of snapshots that trace the unfoldment of our universe all the way to the Big Bang?

George Herbert Mead's *Philosophy of the Present* (Mead 1932) is quite helpful in this regard for he denies the idea that there is a real or immutable past which we have recourse to. He argues that it is only from our *experience of the present* that we are able to reconstruct the past. This means our historical accounts of the past will always give us a story of the past from the perspective of the present. The past, for Mead

must always be set over against a present in which the emergent appears, and the past, which must then be looked at from the standpoint of the emergent, *becomes a different past* (Mead 1932,, p. 2, emphasis added).

But in an emerging universe, a universe that is always becoming more complex, the present always includes more than was present in the present that has just passed (see Figure 5.3).

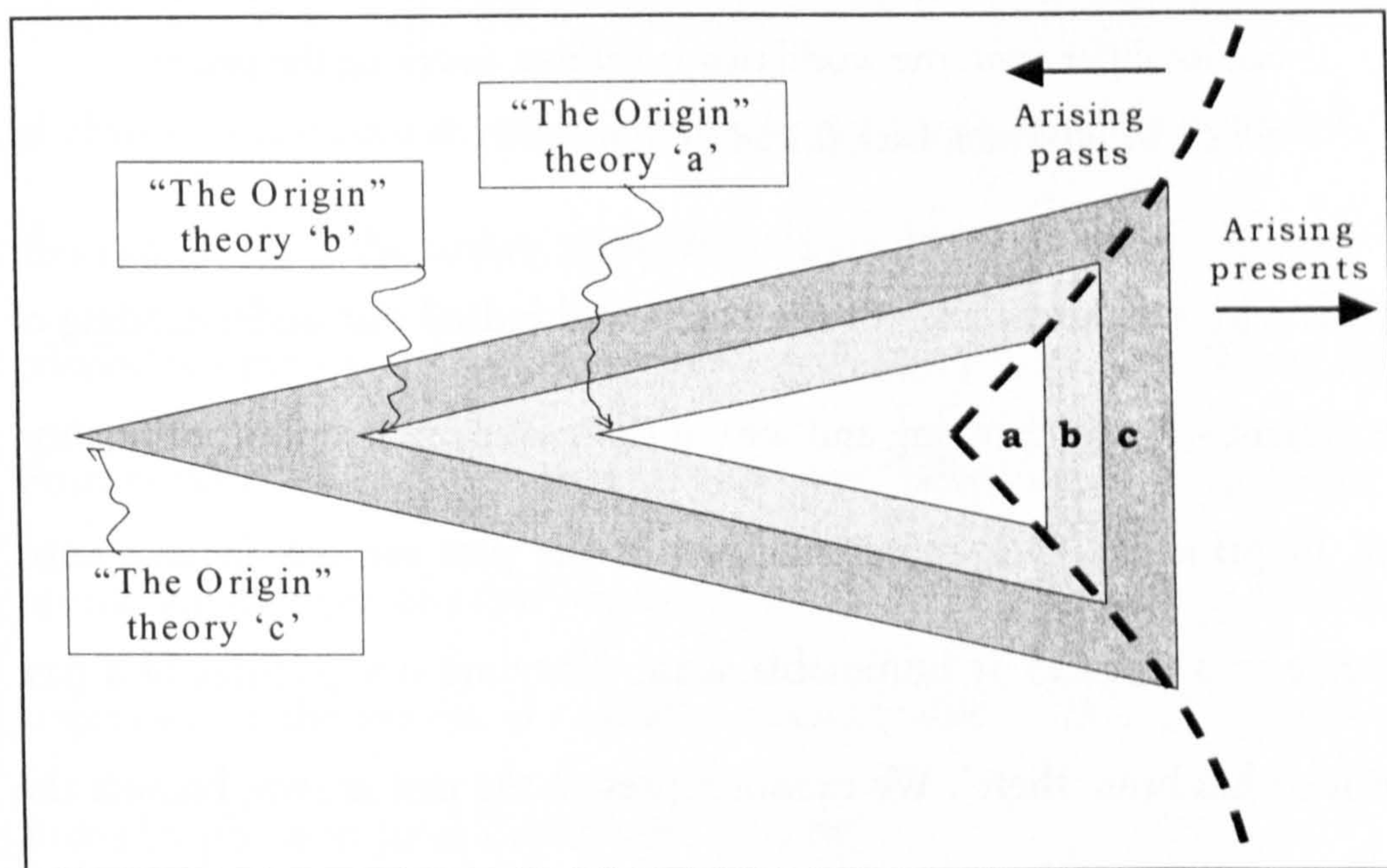


Figure 5.3

Diagram to show how each new present brings a reconstruction of the past. For example theories 'a,' 'b' and 'c' about the possible origin of the universe (these being theories which arise from different presents, a, b and c, respectively) would be *qualitatively* different not *cumulatively* different.

This means that with each subsequent present – which is to say with each additionally complex present, with each bigger present – *we must rewrite the past*. This is the story of our knowledge or significations of the past. As Mead puts it:

There is an entire absence of finality in such presentations. It is of course the implication of our research method that the historian in any field of science will be able to reconstruct what has been, as an authenticated account of the past. Yet we look forward with vivid interest to the reconstruction, in the world that will be, of the world that has been, for we realise that the world that will be cannot differ from the world that is without rewriting the past to which we now look back (Mead 1932, p. 3).

This is why our knowledge of the past – and indeed our understanding of the present – keeps changing and why it can never reach a point of finality, even in principle. Our representations of the past are not in any sense accurate in a timeless or immutable sense. They are not pictures of a past that is or has been ‘there’. We cannot represent the past *as such*, because the past is not present to be re-presented. All we can do is keep reconstructing the past in a way that makes sense from the perspective of the present. For Mead there is no universal or immutable past which is independent of all presents. The ‘correctness’ of our knowledge of the past can be grounded only in our experience of the present, which is the only experience we have.

The materials out of which the past is constructed *lie in the present* and this present is different from past presents. 'Reality' is always in a present which is *more* than its past which means each new present must necessarily bring a reinterpretation of the past and knowledge which is arising in the present is always already passing into being insufficient for that present.

5.4.3 *Knowledge of the future (openness to the unimaginable)*

But it is not only the impossibility of depicting the *past* states of emergent systems as a linear sequence of 'snapshots' that is a problem. Since a 'game of chance' is involved at each 'bifurcation' (see Chapter 4, Section 4.4.3), we also cannot track the future trajectory of such systems. This is because the possibilities for a given process to go do not, in any sense, exist before hand. Furthermore, as it takes only a very few bifurcations to produce an inordinate number of possibilities (see Figure 4.8 in Chapter 4) the future trajectory of the system is *radically* inventionalistic. This point is driven home by physicist John Ziman who remarks

...entities can emerge with features that are so novel that they do not conform to any... pre-existing criteria. It is not just that these new entities have different 'properties.' Previously *unimaginable* notions of what constitutes a 'property' are required (Ziman 2003, p. 1626, my emphasis).

If we could use our knowledge of the present to project forwards to a future knowledge, it might be possible – at least in principle – to work out a past from the perspective of the future, or to work out all possible pasts from the perspective of all possible futures. This, however, is also not possible for, as Prigogine has shown, ‘the emergent is not there in advance, and by definition could not be brought within even the fullest presentation of the present’ (Mead 1932, p.10). In a probabilistic, time-irreversible universe the future is in principle *incalculable*. Here we are reminded of the insights of the ‘British emergentists’ of the late nineteenth and early twentieth centuries who stressed that the new was not simply a ‘regrouping’ of what was already there. For the emergentists, the emergent (and here I am referring to ‘strong’ emergence, as described in Chapter 4) was always *incalculable* from the perspective of the present.

Under what I call emergent evolution, stress is laid on the incoming of the new... if nothing new emerges - *if there be only regrouping of pre-existing events and nothing more* - then there is no emergent evolution (Morgan 1923, pp. 1-2, emphasis added).

This description of ‘strong’ emergence bears a resemblance to Derrida’s radical description of invention. An invention, Derrida argues, is ‘incalculable’ before it actually appears. It has to

...declare itself to be the invention of that which did not appear to be possible; otherwise it only *makes explicit a program of possibilities within the economy of the same* (Derrida 1989, p. 60, cited in Biesta 2001b, p. 33, emphasis added).

Since Derrida is very concerned with 'that which cannot be foreseen as a possibility' (Biesta 2001b, p. 48) – which he calls the *impossible* or the *incalculable* – I take the liberty of reading Derrida as being concerned with 'strong' emergence although to my knowledge he has not used the notion of emergence in his work. This move makes it possible to see the links between deconstruction on the one hand, and the epistemological consequences of a 'Prigoginian' understanding of emergence ('strong' emergence) on the other.

5.4.4 *Knowledge of the present (experiencing the impossible)*

As we have seen from Mead, in an emergent (probabilistic, irreversible or time-orientated) world – which is therefore not a fully 'present' world – knowledge or significations that are arising in the present are always already passing into being insufficient for the present that is passing. This is because knowledge or meaning, as it emerges (the act of signification), is immediately a structural element of the irreducible system from which it emerged and its incorporation into this irreducible system increases the complexity of the system (or information contained in the system).

Signifying practices therefore change (the meaning of) our 'reality' as we signify this 'reality' (i.e., each new signification put us in a present which has a different meaning to the present that has just passed). Meaning, in this sense, reaches me not as something I can receive, but as a response to a meaning I am presented with. Meaning is renewed whenever human beings respond to what they are presented with. From the perspective of emergence 'meaning making,' or simply 'meaning' – which could equally well be called 'emergent' thinking' or 'response' – is continually *taking place*. It takes place as we respond to our world. Meanings are perpetually made anew in the light of the meanings to hand in the present. This, however, is not to say that emergent meaning follows on logically from past meanings. As I explained in Section 5.3.2, what emerges does not emerge according to a set of 'lower level' rules. Although what emerges is constrained or conditioned by what came before, each new meaning is necessarily a *radically new* meaning. It is 'radically' new because it is 'unthinkable' from the ground which precedes it. This capacity for meaning to emerge into that which is 'unthinkable' (because it does not follow on logically from past meanings) implies that emergent meaning necessarily challenges the meanings that precede it, i.e., emergent meaning brings into question the meanings we thought we 'had.' It is about using what we have, but not as a ground to think our way into that which follows on logically

(deterministically) from it (and thereby to 'grasp' or 'understand' the way something is), but rather to find new 'ground' which we 'know' nothing about. If we were only taking 'the next logical step' this would imply we would be responding always from a set of pre-given rules. From the perspective of complexity 'meaning making' is therefore a totally different activity from understanding or 'grasping' a meaning in its 'essence.' Complexity suggests such 'pure' understanding – certainty of meaning – is never possible because a meaning is not a presentation or a representation of anything fixed or positive. It is not something we can receive. Rather, as a response, it is a movement continually emerging into a new form. Complexity – in other words – is calling for the legitimation of the notion of response in the creation of knowledge.

From this perspective knowledge does not reduce a gap between our understanding of the world and the 'real world.' We can never 'catch up' with our own knowledge because it does not bring us closer to an immutable understanding of a world that is there, but rather it always brings forth a new world. *However* we think about the world, there will always be more and different ways to think about it. Each act of knowing opens up new possibilities for knowing and thus opens up a new future, which is *incalculable* from the perspective of the present. This seems to imply that knowledge and signification should be thought of as something

that enables us to penetrate deeper *into that which did not seem possible from the perspective of the present* – to penetrate deeper into the impossible, to experience or *bring forth* the impossible, or that which is unimaginable from the present. Again Derrida comes to mind, this time with his oft quoted ‘definition’ of deconstruction as ‘the experience of the impossible’ which he suggests is the ‘least bad definition of deconstruction’ (Derrida 1992a, p. 200).

5.4.5 Complexity and poststructuralism

The main thrust of Prigogine’s argument is that relationality does not exist *in itself*. It is not simply that all the bits and pieces of the world exist only in relation to each other. His argument makes clear that there is always something else involved in this relationality that is never fully actualised and by definition cannot be fully actualised. This is what Michael Dillon – in referring to the ‘ethic of poststructuralism’ – would call the ‘radical non-relational.’ In his words:

...the radically non-relational is the utterly intractable, that which resists being drawn into and subsumed by relation albeit it transits all relationality as a disruptive movement that continuously prevents the full realisation or final closure of relationality, and thus the misfire that continuously precipitates new life and new meaning. There is no relational purchase to be had on the intractable. It resists relation (Dillon 2000, p. 5).

Dillon believes that both complexity and poststructuralism understand the world as 'radically relational' but that these two positions differ from each other in terms of their understanding of this 'radical relationality.' He believes that: 'For complexity thinkers the anteriority of radical relationality is just that, the anteriority of radical relationality... For poststructuralists the anteriority of radical relationality is *relationality with the radically non-relational*' (Dillon 2000, p. 5, emphasis added). However, I believe Dillon is mistaken. Dillon has not taken into account Prigogine's radical reinterpretation of process. If Prigogine's views on process are taken into account, then we must concede that *together with poststructuralism*, complexity has a concern with the 'radically non-relational' (ibid). Indeed, *contra* Dillon, I believe that 'relationality to the radically non-relational' (ibid) could be considered *key* to Prigogine's logic. The radical non-relational, for Prigogine, is 'chance.' Chance is always missing from the 'preconditions' of what emerges and it is this very missingness that (as Dillon puts it) is 'the misfire that continuously precipitates new life and new meaning' (ibid). What Prigogine is saying in other words is that the world is not simply 'present.' We should understand it, rather, as existing in a state that is fundamentally incomplete. It is 'incomplete' because chance cannot make its appearance in the domain of that which is present. It is nevertheless *constitutive* of that which is present. This, I believe, is very close

to what Derrida is saying. Derrida attempts to show 'that presence cannot present itself, but needs the "help" of what is not present, of absence' (Biesta 2001b, p. 39). But if the world is not simply present then it is also not representable. In this regard, Dillon comments

...for poststructuralist thinkers, not only is there more to life than meets the eye, that 'more' is never something that will ultimately make its appearance in the domain of representation. It is the intractable always already at work within but resistant to representation. Its presence-as-absence spoils the show for representation since it is always already subverting representation's productions (Dillon 2000, p. 15).

In view of my remarks about Prigogine, I believe this is also the case for complexity. Chance is 'always already at work' in complex systems, thereby 'spoiling the show' for representation.'

5.5 SUMMARY AND CLOSING REMARKS

In this chapter I have explored issues of representation and presentation using complexity theory, Deweyan transactional realism and deconstruction. Drawing on structuralist arguments I showed how complexity challenges the idea and possibility of representation at the epistemological level, partly through the idea of incompressibility and partly by showing the problem of attempting to represent open systems

(reality) by closed systems (representations, models, theories). The upshot of this is not that we should no longer attempt to develop knowledge in terms of models, or theories (representations of reality) – but that we shouldn't think of them as 'pictures' of the world. Rather we should understand knowledge-representations as 'tools' that we use to engage with 'the world.' I argued however, that while this releases us from a 'picture' theory of knowledge it does not escape the Cartesian epistemological framework

I then pushed this argument one step further – into the poststructural domain – by also problematising the idea and possibility of 'presentation' and 'presence.' The main step here was to see that time is not a static variable unaffected by systems, but rather an operator in the system itself. By using this line of thinking, and combining it with some insight from deconstruction, I suggested that complex systems can only be understood if we acknowledge the 'presence' of something that cannot be presented, that can never become 'present.' Along these lines I have tried to show that complexity problematises conventional – i.e., Cartesian or representational – ways to think about knowledge in its relation to 'reality,' and offers in place of representational understandings an *emergentist* alternative. I showed that when we use insights from complexity to re-think knowledge *outside* of the Cartesian framework then we must think of knowing not as acquisition

of something already present, but as a response which calls forth something radically new. In this regard a complexity-inspired epistemology shows a strong affinity with deconstruction. In the following chapter I explore what this alternative epistemology implies for a practice of schooling that, for the main part, is based on conventional, Cartesian or representational epistemologies.

Chapter 6

CURRICULUM AND EMERGENCE

Rethinking schooling from an 'emergentist foundation'

6.1 PREAMBLE

In the previous chapter I showed how an emergentist inspired understanding of the sign brings into view the idea that our significations change our 'reality' – they put us in a different present – which immediately opens up a new space of signification which includes more than was present before, i.e. it includes a 'supplement.' If this is the case, we can use signification to open up new ways of being, but we cannot assume significations *represent* that which is truly 'there.' As we signify we emerge into new worlds which engage us in further acts of signification and so on *ad infinitum*. This of course, has implications for knowledge. The epistemology that arises from such an understanding of the sign moves away from representational metaphors for knowledge (where meaning pre-exists signification) and towards emergentist metaphors for knowledge (where 'the world,' meaning and signification emerge together). The

knowledge that emerges from this practice of signification is always *radically* inventionalistic, such that it does not passively *reflect* what is 'present' (what 'came before') but always includes more, bringing prior knowledge into question, challenging it. This different conception of knowledge has deep implications for schooling.

6.1.1 *The 'emergentist' critique of representational schooling*

If we wish to rethink the epistemology of schooling along emergentist lines then the knowledge taught in schools should not be thought of as representing a world that is unproblematically present. With complexity, knowledge cannot be a picture of a past, present or future world for neither the past, present or future is 'present' to be depicted in this way. This opens questions about why we have schools and what we are doing in these institutions.

With a representational view of knowledge schooling becomes a practice that is concerned with closing a gap in knowledge between the student's 'inadequate' understanding of the world and the world as it 'really' is. This can only result in the development of pedagogies of *transmission*. As I argued in Chapter 2, modern schooling practices are, for the most part, built around the idea of teaching students *about* the world or *about* a particular way of life which they do not know about. This is the case

regardless of whether students are (i) expected to 'swallow' the required meanings in tact, or (ii) encouraged to '(re)construct' their own version of these meanings, or (iii) understood to be able to acquire these meanings only through their participation in appropriate 'real world' settings.

So in teaching we either *tell* students about this world or we help them find out about it *for themselves*. Whatever the method we choose for doing this (e.g., traditional, progressive, or 'participatory') teachers ultimately want their students to understand the world 'correctly,' as if this world or way of life is something that is present in and of itself.

For such pedagogies to make sense it is necessary to assume that any presentation of meaning – any *signification* (and this could be the meaningful order of the world itself, or representations of this order) – is a *passive* carrier of the meaning it discloses. We must believe that such presentations simply transmit meaning – pass it on – without themselves corrupting or complicating it. If signifiers *carry* meaning, then meaning must be there *before* signification can take place, which in turn suggests that the world itself is the absolute origin of all meaning. This collection of assumptions adds up to what Derrida refers to as the 'metaphysics of presence.' We can say therefore that the metaphysics of presence, the assumption of an absolute origin of meaning in a world present to itself, is

behind all forms of modern schooling. So if the idea of presence is brought into question – and I believe this is what Prigogine does, together with Derrida and quantum mechanics, as I suggested in the previous chapter – then this means we have to think again about what we are doing in schools. If the world is *not* present to itself, then it *cannot* be the origin of all meaning, and if this is the case then meaning cannot be transferred from the world to the child. Whatever is happening in schools, it is not the transfer of meaning *from* the world *into* the child. What, then, is education?

This final chapter, then, is concerned with how we can theorise education, schooling and the curriculum if we can no longer rely on the idea of meaning being transferred from the world into the child. It is concerned with what happens when we abandon a model of schooling which charges schools with passing on meanings that already exist and in which the meanings being passed are assumed to be unaffected by the passing. Does it make sense to look at education *in these terms*? Does it even make sense to look *at* education if knowledge and meaning do not reflect something that is present? Does the concept of education *itself* make sense?

6.1.2 *The logic of the argument*

In rethinking education and schooling from a position *not* underpinned by a representational logic or semiology (and hence a representational

epistemology of one sort or another) I first examine the kind of pedagogy that would be required if we take seriously the idea that any attempt to transfer meaning from the world into the student is misguided. As such, education and schooling would be about *inventing* meaning rather than *acquiring* it. In this case we are faced with a question about *what* meanings can be 'made' or 'invented' in schools and whether the 'invention' of meaning is educational. More importantly, however, we are faced with the question of whether it is possible to maintain an emergentist conception of meaning in an 'educational' context, i.e., within the structures of schooling. Does it 'make sense' to do so?

In this regard I provide three examples of 'pedagogies of invention' each of which attempts to facilitate (or has been *accused* of facilitating) the 'invention' of meaning in the classroom. In doing this I show that two of these 'pedagogies of invention' in no way challenge the representational logic of schooling while the third, although overtly challenging representational logic, relies on it at a deeper level in that it still attempts to pass on a meaning that already exists. Gregory Ulmer refers to this covert representational effect as 'the pedagogical effect of discipleship' (Ulmer 1985, p. 173).

From this I conclude that it is not possible to challenge the representational logic of schooling *either* at the epistemological level, *or* at the level of the sign. If it is to be challenged, *something else is also required*. I then show that if we bear in mind that it is not only meaning (knowledge) that emerges from a pedagogical intervention but also the subjectivity of the one being educated then we have to concede that education always shapes the subjectivity of the one being educated. It is in *this* regard that education is vulnerable to the obdurate representational problem of 'discipleship' (reproduction of the master's style)(Ulmer 1985, pp. 162-173).

Next, I argue that 'the pedagogical effect of discipleship' (Ulmer 1985, p. 173) is produced only in curricula that are designed with an idea *already in mind* of what a human subject is. To avoid this pedagogical effect, and facilitate a form of education *not* premised on representational logic, it is therefore necessary to develop a curriculum around an understanding of human subjectivity that leaves *open* the question of what it means to be a human subject. Here, again, the logic of emergence is useful for it is only with this logic that it becomes possible to leave open the question of what it means to be a human subject.

The argument I try to make is that it is only when emergentist logic is applied *in a double sense*, to knowledge/signification *and* to human

subjectivity that the representational logic of modern Western schooling can be unsettled. In place of a representational foundation for schooling, I therefore offer an emergentist foundation, which is not a foundation in the usual sense of the word (because this 'foundation' *itself* emerges and in so doing it brings itself into question, and hence erases itself). Nevertheless it is a place from which to start theorising education along the lines of a non-representational logic, even if this is a temporary starting place. Finally, I describe some of the surprising consequences of theorising education from this alternative emergentist 'foundation.'

6.2 THE EMERGENCE OF KNOWLEDGE. PEDAGOGIES OF INVENTION

The semiotic shift suggested by a complexity inspired epistemology – in which re/presentations are not passive reflectors of meaning but add to it – changes the way we understand the process of 'knowledge building.' We no longer build in the sense of *acquire* knowledge through a process of uncovering a meaning that is already there. Instead we build in the sense of *invent* knowledge by *adding to* or *complicating* pre-existing knowledge. With the former, a superfluous excess is removed in order that we may 'build' our knowledge (i.e., understand more *clearly* and *accurately*). With the latter, what is 'superfluous' is *necessary* for it is this very supplement that enables knowledge to 'grow.' With the latter there is a concern for the

opening up, rather than the narrowing down or *closure* of knowledge. If 'knowledge building' is understood in this way this raises the question of what it might mean to allow for the opening up or 'invention' of knowledge in modern schooling practices.

6.2.1 *Inventing meaning in 'romantic' progressive education*

The idea of 'inventing meaning' is regarded with a good measure of suspicion by many educators for it is often (mistakenly) linked to the much criticised 'romantic' or 'anti-authoritarian' version of progressive education which is actually a form of 'discovery learning'⁴⁰ in which teachers are advised to recognise the 'teachable moment' and provided they facilitate 'learning experiences,' it does not matter precisely *what* is learned (Kalantzis and Cope 1993). With this form of progressivism the learning process is considered all-important and the role of the teacher is downplayed to the extent that children are left in the position of 'reinventing the wheel.' Furthermore, since assessment is deemed immaterial and since all meanings are considered to be equally acceptable 'romantic' versions of progressivism are open to accusations of 'anything goes' *inventionalism*.⁴¹ It has been argued again and again by conservatives and radicals alike, that that this

⁴⁰ Since the meanings that are constructed or 'discovered' are assumed to reflect a pre-given world, this pedagogy is still heavily reliant on a Cartesian or representational epistemological scheme.

⁴¹ Encouraging young people to 'make things up' rather than deal with the 'reality' of the world.

pedagogy has no real 'educational' value (see for example Ravtich 2000). Dewey himself claimed the approach was not only uneducational but 'really stupid' (Dewey 1984/1926, p. 59) while Arendt (1954a, p. 179) accused it of educational 'bankruptcy.' I mention this approach simply to get it out of the way.

6.2.2 *Inventing knowledge for the 'knowledge society'*

In another endeavour, and one which has attracted a considerable amount of attention in North America, Carl Bereiter (1997, 2002a, 2002b) draws on Popper's conception of 'World 3,' the world of immaterial knowledge objects,⁴² – a world wholly created by the human intellect, which Popper also calls 'objective knowledge' (Popper 1972) – to address the issue of the 'invention' of knowledge in the school. Bereiter points out that although 'World 3' knowledge is a human construction in that it has been produced by minds, it can also be understood as an entity in its own right (i.e., outside of minds) because it can be understood as something that has been created to some purpose and which can be engaged with, criticised, expanded, or used to achieve a different end altogether. One advantage of objectifying knowledge in this way – treating it as an artifact – so he suggests, is that it can be understood as the 'product' of a particular form of labour. Bearing in

⁴² Popper's 'World 1' is the physical world and 'World 2' is the experiential or subjective world.

mind this understanding of knowledge, Bereiter then suggests a curriculum which socialises young people into being 'producers of knowledge' for the 'knowledge society.' This entails designing classrooms as communities of practice whose work is with 'World 3' knowledge (Bereiter 1997).

Bereiter argues that even work conventionally categorised as 'unskilled' involves a great deal of knowledge, but 'knowledge work' is different in that it not only *uses* knowledge but also *produces* it, i.e., theoretical knowledge (scientific theories in particular) is the *product* of this type of work. This kind of work, Bereiter claims, requires a special set of skills. He believes it is

reasonable to assume that students who have had years of experience in explicitly working with knowledge will have an advantage over ones whose experience has been limited to the traditional kinds of scholastic learning and doing in which knowledge, as such [i.e., 'World 3' knowledge], is seldom the object of attention (Bereiter 1997, p. 298).

One problem with this understanding of knowledge building is that it assumes that for 'new' knowledge to be produced, all that is required is to teach people how to 'work' with abstract knowledge. To 'work' with abstract knowledge implies learning a set of rules. Bereiter (1997, 2002a) assumes that it is only once these rules are learned (different rules for each

different body of knowledge) that 'new knowledge' can be produced. In effect, this means that the only 'new knowledge' that can be (legitimately) 'invented' is knowledge that 'builds' on prior knowledge and does so according to a set of rules – a *logic* – which has already been 'authorised.' Any 'new' knowledge which does *not* 'follow' from what came before is illegitimate knowledge. However, for this rather *linear* process of knowledge building to occur it is necessary for prior knowledge – those 'abstract' meanings that already exist – *to exist in a stable form*. Such abstract knowledge must be assumed to *passively carry* its meaning. In other words, it is only with a *representational* understanding of abstract knowledge that educators can entertain the idea that abstract knowledge can be used as building blocks in the production of new (abstract) knowledge. This idea, however, is precisely what an emergentist epistemology denies. With an emergentist epistemology knowledge cannot be 'built' in this way because the meaning 'in' any particular knowledge is always already complicated in its very presentation (as 'abstract' knowledge).

Another problem with Bereiter's pedagogy is that it does not open meaning *enough*. As I argued in the previous chapter, any meanings that result from the application of a set of rules to meanings that already exist are simply rearrangements of what was already there. While they may be 'new' in a mechanistic sense, they cannot be considered new in an emergent sense, i.e.,

in the sense of something that has never been in the world before (something unimaginable before it appears). They are not *radically* new. Bereiter's pedagogy therefore constrains and prescribes the kind of 'new' knowledge that can be invented. In fact it would seem that Bereiter is only interested in the production of *scientific knowledge* about a world that he assumes is already 'there' (waiting to be 'discovered'). In following Popper, he must necessarily adopt a foundational stance, which forces him to understand knowledge as beginning *somewhere* (i.e., in the 'real' world). As argued in Chapter 5, when knowledge is understood to have a point of origin, its 'invention' can only be understood in terms of a linear (or mechanistic) process of development from this point of origin which leaves no room for the unexpected and radically novel. It leaves no room for emergence.

Although Bereiter's pedagogy makes significant moves away from 'traditional' representational schooling practices it is still heavily reliant on a representational understanding of knowledge. What is needed, therefore, is a pedagogy which allows for a form of meaning making in which the new or 'invented' meanings are in *excess* of the meanings that preceded them. In other words preceding meanings should not just 'add up' to form a new meaning. Any new meaning that emerges should always be in excess of what came before (and hence unexplainable in terms of what came before).

An emergentist pedagogy would allow for the *radically* new to appear. It would allow for the emergence of what is ‘incalculable’ or ‘unthinkable’ from the ground (i.e., the meanings) that precede it. Gregory Ulmer’s ‘applied grammatology’ approaches this kind of openness in terms of meaning making.

6.2.3 *Ulmer’s ‘applied grammatology’*

Ulmer (1985) articulates what he calls an ‘applied grammatology’ (his preferred term for what he also calls a ‘pedagogy of invention’) which he proposes might take the place of a practice of teaching underpinned by representational epistemology. This pedagogy (applied grammatology) relies on a conception of meaning making articulated by Derrida’s ‘theoretical’ grammatology (Derrida 1976) – more familiarly known as ‘deconstruction’ – which I introduced in Chapter 3 (Section 3.4.2) and which is remarkably close to the emergentist conception of meaning making I outlined in the previous chapter. Like an emergentist conception of meaning making, ‘theoretical’ grammatology articulates the idea that every signification (that which *presents* or *represents* a concept) ‘always exceeds its concept’ (Ulmer 1985, p. 162), i.e., it always exceeds what it signifies. ‘Applied grammatology’ is therefore a useful way of understanding the pedagogical manifestation of an emergentist conception of meaning making.

Ulmer explains that a pedagogical presentation in a grammatological classroom would be one which is organised around the principle of the 'hieroglyph' (ibid., p. 265) this being an ideogrammatic/pictorial form of writing which *provokes a response* from the receiver (and this response is not only rational but also physiological and subconscious, e.g., knife plus heart = sorrow)(see Moeller 2003, for an account of the relationship between Chinese semiotics and Derrida's semiotics). This idea draws on the notion, well developed in psychoanalysis, that the consciousness is affected before any meaning is formed, *before* anything is signified. It is only through *an addition to itself* (the response of the receiver) that the hieroglyph becomes 'receivable.' Without such response it is 'unreceivable' (not understandable *in itself*). Since every presentation of a hieroglyph provokes a subjective response (a text) which *adds itself* to the presented (but unreceivable) text, every such presentation must be understood as bringing forth a wider reading of itself. It combines subjective and presented 'elements' in something different (a 'double text'). A grammatological pedagogy – so Ulmer claims – is therefore fundamentally inventionalistic or creative. It takes into account an emergentist mode of meaning making, which is neither 'inner speech' (subjective text) nor 'objective writing' (presented text) but an elaboration of both which always *brings something new into the world* (Ulmer 1985, p. 157-188). It would seem, therefore, that in the

grammatological classroom something entirely other than the reproduction of an idea in the mind of the student is taking place. What is taking place, Ulmer says, is '*inventio*' (Ulmer 1985, p. xii). Ulmer considers the presentational strategies adopted by (i) the French psychoanalyst, Jacques Lacan (1901-1981), (ii) the German 'artist-pedagogue,'⁴³ Joseph Beuys (1921-1986) and (iii) the Russian film director, Sergei Eisenstein (1898-1948) to be exemplary in making use of the idea of the hieroglyph to produce a 'double text' (or '*inventio*') and so a brief mention of these presentational strategies follows to illustrate how a grammatological pedagogy might actually be performed.

Jacques Lacan used the principles of psychoanalysis – i.e., the idea that the consciousness is affected *before* any meaning is formed (before anything is signified) – in his presentation style to demonstrate to his students the nature of psychoanalytic knowing itself. To convey this experience to his students, he would exploit both verbal (e.g., homophones) and nonverbal (e.g., images) representational strategies to say 'something else,' to trigger 'unconscious thought' thereby evoking certain feelings in his students, induce in them certain 'effects.' (Ulmer 1985, p. 192-208). In this manner the class was placed in the position of the therapist or analyst, and had to

⁴³ Ulmer calls Beuys an 'artist-pedagogue' because his explanations of his art are an integral part of the artworks themselves.

'psychoanalyse' Lacan's presentation, build connections and come up with their own text. His students were thus provoked into generating their own text around or over Lacan's text, provoked into colluding with Lacan's performance to create a double text. The invitation to generate a double text is what serves to open up thought. It is this that sets the scene for the taking place of *'inventio.'*

Joseph Beuys also adopted a style which involved his audience being moved subconsciously in order to stimulate them to produce something out of themselves in response to his performance art. 'In Beuys's case, the objects [of his art] produce the effect of reference, but without referring to anything. Or rather, the reference is now supplied by the recipient, who in response to the stimulus produces it out of himself' (Ulmer 1985, p. 251). What Ulmer tries to put across is that Beuys's works do not *transfer* a message. They are designed, rather, to move the spectator – by evoking associated memories – into *producing* a message. The message is produced as these memories are explored, 'not to recover the past but ... in order to *think with them into the future*' (ibid., p. 240, emphasis added). The evocative nature of his presentations generates rather than transmits meaning. The meaning 'comes through' already contaminated by other layers of meanings. The effect is the genesis of something new, an *inventio*.

Sergei Eisenstein worked out a style of editing which broke with notions of film as 'passive reproduction' of the 'stagnant order of things' (Ulmer 1985, p. 276). He believed that film editing was more than merely a method used to link scenes together. Rather, careful editing could actually be used to stir the emotions of the audience and bring about the formation of new concepts. In this regard he developed a theory of editing that he called 'montage' (Eisenstein 1943, 1949) in which images independent from the action would be inserted between footage of the action in a way that would create the maximum psychological impact. The juxtaposition of unrelated images unsettled traditional feelings and understandings about the content of the images he was showing.⁴⁴ He used cinema not to reproduce a 'reality' which is 'there' but rather to provoke an alternative reading from the viewer of the images (Ulmer 1985, p. 276). With Eisenstein there is no question of the viewer passively acknowledging the 'truth' of his images for his images are not 'true'. Eisenstein leaves his viewers with no choice but to respond to the images they are presented with. In demanding a response from the viewer his images are instrumental in producing an '*inventio*'. His style is 'a disturbance that excites (incites, not insights), generating "information"' (Ulmer 1985, p. 314).

⁴⁴ For example in *Strike*, which recounts the repression of a strike by the soldiers of the tsar, Eisenstein juxtaposed shots of workers being mown down by machine guns with shots of cattle being butchered in a slaughterhouse.

6.2.4 *The pedagogical effect of 'discipleship'*

Ulmer articulates a pedagogy which opens a space for the elaboration of knowledge, and does so in terms of an emergentist conception of meaning making. This, however, does *not* mean that Ulmer's pedagogy no longer transmits a self-contained message. Ulmer has designed a pedagogy to draw out 'creative' responses believing he knows what it means to be 'creative.' In this sense his own understanding of what it means to be creative *re-appears* in his students. Ulmer labels this representational effect (which he does not notice in his own pedagogy) 'the undesirable pedagogic effect of discipleship' and describes it as a 'reproduction of the master's style' (Ulmer 1985, p. 173). This problem in his work is connected to his understanding of the human subject.

Ulmer's subject is a discrete and isolated being that 'owns' the 'memories' (rational, mythic, unconscious, habitual, cultural, bodily and so on) which it uses to create an *inventio*. In this sense it could be called an *individualistic* subject. It is only this assumption about the human subject that enables Ulmer to work out the principles of a pedagogy in which the subject ends up producing something new, an *inventio*. This assumption about the subject is, in other words, the raw material or *foundation* from which he works out his scheme. He develops his pedagogy from *a particular starting*

point, focussing on how, *given this particular starting point*, the human subject can be stimulated or 'incited' (ibid., p. 314) to produce an *inventio*. This, however, immediately puts him in the position of having designed a pedagogy which will function to replicate a meaning (in this case 'creativity' or '*inventio*') that already exists. He has designed a pedagogy specifically to stimulate creativity (*inventio*) in those who are being educated. This is evident in the following remark:

[a pedagogy of invention is] intended not only to show people the principles of creativity and how to put them into practice but also ... to stimulate the desire to create (not necessarily in 'art' but in the lived, sociopolitical world) (Ulmer 1985, p. 264).

Ulmer believes that he *knows* what the principles of creativity are and he wants *to replicate this knowledge through education*. The 'master' has, in other words, designed a pedagogy which will 'reproduce the master's style.' Although the objective of Ulmer's pedagogy is creativity itself (which masks its representational logic to some extent) this pedagogy can still be understood to be replicating a particular understanding of creativity. It is transmitting an idea. As such, and despite his emergentist (or 'grammatological') understanding of signification and meaning, Ulmer's pedagogy *is still governed by an underlying representational logic*. It aims to

replicate (or mirror) in the mind of the student, a meaning that exists 'outside.'

Ulmer's work makes clear that simply designing a pedagogy that allows for the 'elaboration of knowledge' or the 'invention of meaning' in an emergentist sense does *not* release pedagogy from representational logic. Furthermore, his work also provides a clue as to where the 'discipleship' problem originates. It lies in having a preconceived idea of what constitutes the human subject. It is only in having a pre-conception of *what* the subject is that Ulmer is able to design a pedagogy that moves this subject towards a particular end (in this case towards being creative). In starting at a given point, and moving to another point, Ulmer prescribes a 'possible course of action' (Ulmer 1985, p. x) which is meant to channel the human subject in a pre-determined direction and hence *close down other possibilities for the subject's emergence*. Having a starting point suggests we are heading somewhere, and so implies a goal. It is *this* (the presence of a 'starting point') that produces 'the pedagogical effect of discipleship' with its underlying representational logic.

In producing a pedagogy that replicates his understanding of creativity, Ulmer's pedagogy shapes the subject in a certain way. In this regard Ulmer is no less representational in his pedagogical intent than Bereiter, who wants

to teach young people how to be producers of (scientific) knowledge for the knowledge society. While Bereiter is arguing for a pedagogy that produces people who can work with 'abstract knowledge,' Ulmer is arguing for a pedagogy that produces people who are creative (in Ulmer's sense of the word). The problem of course, is that in suggesting a 'possible course of action' both Ulmer and Bereiter are *intentionally* shutting down other possibilities for the emergence of human subjectivity. In trying to control the product of the pedagogical intervention (i.e., in having a goal) they succeed in replicating their own understandings of the world. In this regard one could argue that their pedagogies are designed specifically to transmit a pre-existing message or ideal. It is in this sense that they rely on a representational logic.

6.2.5 *Double emergence*

From the discussion so far we can see that an emergentist conception of meaning is *not sufficient* to release education from the logic of representation. Because the emergence of meaning cannot be separated from the emergence of human subjectivity, we see that in trying to produce a certain kind of subject, educators *are still trying to reproduce a meaning that already exists*. At this point we could give up and say that it is *not possible* to free education from the logic of representation because being an educator is

precisely *about* directing the subjectivity of others. To give up the attempt to direct the subjectivity of others is to give up education. If this would be the case the bringing into question of representational logic would spell the death of education. Complexity offers a different way out, however.

Since what ties education to the logic of representation is the idea that the goal of education should be to form a certain kind of human subject, what seems to be called for is a conception of human subjectivity *which leaves open the question of what it means to be a human subject*. This is where the notion of emergence is once again helpful. In the same way as an emergentist conception of *meaning* leaves open the question of the meaning of a meaning (including the notion of emergence itself, as I explained in Chapter 5), an emergentist conception of *subjectivity* leaves open the question of what it means to be a human subject. While an emergentist conception of meaning, *on its own*, opens different possibilities for pedagogy it is unable to challenge the basic educational logic – born of a dualistic understanding of the sign – which wants to reunite the subject with a pre-existing presence that it is separated from. However, when an emergentist conception of subjectivity is also taken into account, pedagogy can no longer presume to reunite the subject with what it is separated from. To do so would imply a pre-knowledge of the constitution of the human subject. It is only when we can no longer assume what constitutes a human

subject that we can educate *without a pre-determined end*, i.e., without trying to replicate some 'presence.'

The argument I am trying to make is that to theorise education away from representational logic, it is necessary to use the concept of emergence *on two levels*. We need emergence on the level of meaning itself (i.e., at the level of the sign), but because meaning is attached to human subjectivity we *also* (at the same time) need it at the level of human subjectivity. In other words, we need the concept of emergence in a *double* sense. In the next section I therefore explore the notion of emergence as it applies to human subjectivity. For this I rely heavily on an argument developed by Gert Biesta (1998, 1999a, 1999b, 2001a, 2004a) who is concerned with how *not* to close down possibilities for understanding the human subject in an educational context. To do this Biesta draws mainly on Nancy, Arendt and Levinas. In the discussion that follows I have mostly returned to Biesta's original sources.

6.3 THE EMERGENCE OF SUBJECTIVITY. PEDAGOGY WITHOUT HUMANISM

An 'emergentist' perspective on subjectivity would leave open the question of what it means to be a human subject. It would support the notion that human subjectivity can emerge into that which is 'unimaginable' or 'incalculable' from the perspective of the present. It would be concerned, in

other words, with *not* closing down possibilities for human subjectivity, not *representing* the human subject as being either like *this* or like *that*.

Jean-Luc Nancy (1991) has suggested that much of the theorising about human subjectivity is a form of theorising about the human subject that is premised on the question of *what* it is. This is a form of theorising which is forever closing down possibilities for human subjectivity, rather than opening up possibilities or, at least, keeping possibilities open. It is a form of theorising which says *this* is what a human subject is, not *that*, which closes down other possibilities. This, clearly, is a representational understanding of subjectivity. The question then, is how to move from a 'representational' understanding of subjectivity to an 'emergentist' conception of subjectivity. Nancy explains that one way of *not* objectifying the human subject is to understand it in terms of *who* it is rather than *what* it is (Nancy 1991).

6.3.1 Moving from 'what' to 'who'

Nancy (1991) makes the point that when we understand the human subject in terms of *what* it is we are understanding it as a *kind* of something, a case of something more general. He suggests furthermore that the question about human subjectivity – about what makes 'me' *me* – is a question about *uniqueness*. It would seem, therefore, that if we are to 'understand' human subjectivity, we need to focus on human beings *in their uniqueness*. More

precisely, we need to focus on *who* a subject is (in its uniqueness) rather than *what* a subject is (which is only ever *what* it is *a case of*). There is, however, a substantial difficulty in trying to understand the human subject as a unique 'who.' The problem, as Nancy (1991) points out, is that we can always say that someone has become *who* they are (a particular kind of being) because of x, y and z, because of something that lies *behind* them which has *caused* them to become who they are. The question of 'who' someone is therefore immediately reverts to a question of what it is that causes the 'who' to become 'what' it is. Nancy suggests that one way out of this dilemma is to understand *who* a subject is in terms of *where* it 'comes into presence' (Nancy 1991, p. 7). According to Nancy this 'coming into presence' is always a unique *event*, something that 'takes place' (*ibid.*), and so cannot be understood as a linear sequence of events and so does not reduce the subject to a case of something more general. For Nancy the one who comes into presence is always '*one* and *unique* in its coming' (*ibid.*, emphasis added). The 'one' who comes into presence, in other words, only has a 'shape' *in terms of* the space where it comes into presence. It only has a 'shape' in terms of what it *is not*, i.e., in terms of the space itself. Because no two spaces can be the same, the one who 'comes' must also be completely unique (in the same sense as two spaces are unique).

The 'who' that Nancy is articulating is an *emergentist* who in that it is a 'who' who 'comes into presence' in a space which cannot be reduced to either a spatial or a temporal location. The 'who' cannot be described in terms of *what* it is because every attempt to trace what it is (i.e., what lies *behind* the who) immediately explodes it into a myriad of relations and relationships which cannot be contained *in* the 'who.' The point I wish to make is that if we take seriously the 'who' of the subject (such that we do not relapse into the 'what' of the 'who') we are faced with radical contingency, with the idea that we can never know who emerges because the 'who' that emerges is partially constituted by an 'otherness' which is *not* the who that emerges. In other words, part of what *constitutes* the 'who' that emerges is *missing* and not just 'missing' in the sense that we can't get it all into the frame at the same time but *radically* missing in a Prigoginian or Derridian sense (as explained in Section 5.3.2 and 5.3.3). The 'who' that emerges, is never altogether *there*, and so can never be described, can never become a 'what.' Such ideas, of course, are not just compatible with complexity theory in general, which describes complex systems as relational systems (see Chapter 4, Section 4.7). They also come very close to the notion of 'strong' emergence which, as I explained in Chapter 5 (Section 5.4.5), draws on the peculiar logic of *radical* relationality or deconstruction.

6.3.2 *Arendt and Levinas on human subjectivity*

Two theorists whose understanding of human subjectivity come particularly close to the idea of 'strong' emergence are Hannah Arendt and Emmanuel Levinas, both of whom are concerned with *who* a subject is, rather than with *what* a subject is. They are concerned with the human subject in its uniqueness. While I do not want to go into details a brief description of their positions is helpful for understanding what an emergentist conception of subjectivity entails.

Arendt's strategy for understanding the 'who' of the subject is to frame it in terms of human *action* which she describes as 'beginning something new' (Arendt 1958, p. 157). To act, for Arendt, is to make a beginning. This she equates to the condition of natality (being born). For Arendt each one of us is a 'beginning and a beginner' (Arendt 1954b, p.170). When we begin something – when we act – we 'show ourselves' in the human world (as we do when we are born). Furthermore, we cannot refrain from acting, from making beginnings (any more than we can refrain from being born). However, because we live with others – i.e., in a 'public' or 'political' space – our beginnings are always frustrated by the beginnings of others whose beginnings are likewise frustrated by our own beginnings. We are, in other words, never in a position in which 'one man remains master of his doings

from beginning to end' (Arendt, in Biesta 2001a, p. 391). This frustration of the 'purity' of our beginnings is, nevertheless, *the condition of possibility* for us to come into the world as distinctly *unique* beings. This is because the contamination of each one of our beginnings by the beginnings of others has the effect of making each and every beginning completely unique. Since every time we make a beginning we show ourselves and since every beginning we make is completely unique (because contaminated by the beginnings of others) Arendt can claim that when we make a beginning – when we act – we show ourselves *in our unique distinctness*.

Arendt insists, however, that the disclosure of our unique identity (through action) is *not a disclosure of a pre-existing identity*. Because our actions are always contaminated by the actions of others we are never the sole author or producer of our beginnings and therefore also not the sole author of the 'who' that we reveal through these beginnings. As Arendt comments: 'Nobody knows whom he reveals when he discloses himself in deed or word' (Arendt, in Biesta 2001a, p. 392). The 'who' that we reveal is always radically contingent on other 'who's' with whom we live. This means we are *who* we are only by virtue of others who *frustrate* our actions. If we try to preserve the *purity* of our actions (by not being with others, or by forcing others to do what we want them to do, thereby preventing them from making their own beginnings) we deprive ourselves of the

opportunity to come into presence in our *unique distinctness*. In this regard, 'action' – i.e., making a beginning *with* others who *frustrate* our beginnings – is the condition of possibility for becoming a unique 'who.' For Arendt, *who* we are is not something that exists before the other, nor is it something that appears because of the other. Rather it appears only *in relation to the other* (neither before nor after). This understanding of subjectivity suggests that being with others – with those who are different from ourselves and whose beginnings frustrate our own beginnings – is the *only* condition in which subjectivity can *take place*, the only condition in which we can show ourselves in our *uniqueness*. As Biesta comments:

As soon as we erase the otherness of others... we deprive both ourselves and others of the possibility for action and hence for subjectivity (Biesta 2004c, p. 16).

Levinas's account of human subjectivity (Levinas 1981, 1989) is vastly different from Arendt's but on the level I wish to discuss it, it has an important similarity with Arendt's conception. While Arendt uses the concept of *human action* (which she understands as making-a-beginning-*with-others*) to develop her radically contingent conception of human subjectivity, Levinas frames it in terms of response and responsibility. How we respond to others establishes our commitment to them, we have a responsibility to respond – to attend to the other – and therefore

responsibility precedes understanding. Understanding is possible only because *before I even try to understand you* I assume responsibility toward you. This responsibility is therefore 'a responsibility that is justified by no prior commitment' (Levinas 1989, p. 92, in Biesta 1999a, p. 213).

For Levinas, human subjectivity takes place when the subject is faced with another and so *forced* to respond. Responding to the other is therefore not a choice, not something one can avoid. The face of the other *commands* a response. It is this very *inescapability* from the other, the fact that we cannot refuse the other, we cannot *not* respond, that constitutes us in our subjectivity. In responding to the other one is forced to *take a position*. This positioning is, however, always 'already identified from the outside,' (Levinas 1989, p. 96, in Biesta 1999a, p. 214) identified by the other. The self that is 'called up' by the encounter with the other is therefore a self that can only show itself, in relation to *an assignation that it cannot choose*, an assignation presented to it by the other. In this sense subjectivity, so Levinas argues, is a subjection to the other, a being-taken-hostage by the other (Levinas 1989, in Biesta 1999a, p. 213). For Levinas then, as for Arendt, the self is not something that exists before the other. It only appears *in relation* to the other or, as Levinas might say, *in the moment of obligation* to the other. Since Levinas's self is not a self except in relation to the other with whom it is faced we can never say what it is. As such, even the word 'self'

or 'subject' becomes problematic, for it suggests a containment that is not there. As Caputo remarks,

... the word 'self' will not do, because... [t]he 'self' is something which we define in terms of its self-identity. Yet what seems to characterise 'us' above all is non-identity... The self is precisely not that which always abides in itself... The 'self' is much more a place of disruption, irruption, sollicitation (Caputo 1987, p. 289).

Understandings such as those of Arendt and Levinas in which 'the subject is not one but split, not sovereign but dependent, not an absolute origin but a function ceaselessly modified' (Foucault, interview material, quoted in Drefus 2004) make it very difficult indeed to understand the human subject in terms of *what* or even of *who* it is. As Caputo remarks: 'We do not know who we are, not if we are honest' (Caputo 1987, p. 288).

6.3.3 Biesta's '*pedagogy without humanism*'

Biesta has argued that while conceptions of subjectivity such as those of Arendt and Levinas – which are radically relational conceptions of subjectivity – suggest we cannot know *what* or *who* we are dealing with when we are dealing with the human subject, they do suggest something about the nature of the *space* in which the human subject emerges. Because we can theorise about the space in which the subject 'comes into presence'

(Biesta 2005, in press) Biesta argues that this space – which, I would argue is an ‘emergent space’ – can therefore be used as a ‘foundation’ for educational theorising (Biesta 1999a). This ‘foundation’ however, is *not* a foundation in the usual sense of the word. Since the space in which the subject emerges is a space of *radical contingency* (Biesta 1999b, 2001a), it is a space in which the notion of foundations has no place.

To my knowledge there is hardly any work which uses an emergentist perspective on subjectivity in order to theorise education. Although Biesta does not use the term ‘emergence’ and does not specifically situate his work in the field of curriculum studies, much of his work – and particularly his later work – can nevertheless be understood in terms of a retheorisation of ‘curriculum’ as a ‘space of emergence.’ This should be evident from the following remark:

Education, in other words, takes place in the gap between the teacher and the learner. [...] If this is the location of education, if this is where education literally ‘takes place,’ then a theory of education should be a theory about the *interaction* between the teacher and student. A theory of education is, in other words, a theory about the educational relationship, though *not* about the ‘constituents’ of this relationship (i.e., the teacher and the learner) but about the ‘relationality’ of the relationship. I do not think that we already have many of such theories, and perhaps we do not have any at all (Biesta 2004d, p. 12).

In view of what I believe to be a close association between Biesta's 'pedagogy without humanism' and the concept of emergence, in what follows I explore/reconstruct those of his ideas that I believe relate to the notion of the curriculum as a 'space of emergence' and describe some of the surprising forms education takes when we begin to theorise it from this different 'foundation.'

The first thing to notice about Biesta's 'space of emergence' is that it is *not* a space of common ground. Because human subjectivity emerges only when one acts with others who are different (Arendt 1958, Biesta 1999a, 1999b) this means education only takes place where 'otherness' – being with others who are different from us – creates such a space. Biesta's educational vision therefore involves the condition of being in contact with those 'with whom we have nothing in common' (Biesta 2004b). In this sense it is the plurality of the 'space of emergence' that educates, *not* the teacher (Biesta 2004d). However, if plurality is the condition of possibility of education, then this challenges the conventional logic of schooling whereby everything possible is done to *reduce* the differences between those being educated (e.g., in terms of age, gender, ability, interests, etc.) in order to better 'facilitate' the desired educational outcome. The idea of a 'space of emergence' suggests that such regimentation *prevents* education from taking place. For Biesta, theorising education from an emergentist logic means the classroom must be

transformed into a space of difference, of otherness, a 'public' or 'worldly space' (Biesta unpublished manuscript). In his words: we need 'to make sure there are at least opportunities within education to meet and encounter what is different, strange and other' (Biesta 2004b, p. 322). With the increasing balkanisation of communities and 'the creation of quasi-public spaces such as the shopping-mall and high-security university campus – spaces that look public but are organised around private interests' (Biesta unpublished manuscript) – it could happen that schools become the *only* places left for otherness and plurality.

Another consequence of theorising education in this alternative mode is that if, through plurality, we become unique individuals, then we also can no longer understand education as bringing about the *convergence* of individual perspectives (as Dewey, for example, would have it). Education, in other words, is not to make people more similar, not to initiate them into a common way of life (Biesta 1997) but to make them more unique, more *irreplaceable* as singular human beings. Education, in short, is about becoming *someone*. This point is pressed home by Michael Serres:

When all the people of the world finally speak the same language and commune in the same message or the same norm of reason, we will descend, idiot, imbeciles, lower than rats, more stupidly than lizards. The same maniacal language and science, the same repetitions of the same in all latitudes – an earth covered with screeching parrots (Serres 1997, p. 124).

When a curriculum with fixed goals is imposed on a person, particularly a young person, there is little scope for this person to develop in any idiosyncratic way. In fact the very purpose of the curriculum has been to ‘iron-out’ these idiosyncracies, to iron out the ‘kinks’ such that the one being educated can develop in the ‘right’ way. Such a curriculum produces a type that fits into a system, it produces interchangeable units, a product, not a human being *in its singular uniqueness*. By fulfilling their educational responsibility to achieve the desired curricular end, educators are giving up their responsibility to individuals.

Biesta also shows that when we understand education as taking place in a ‘space of emergence,’ it is necessary to acknowledge that situations in which it is difficult or impossible to become the master of our own actions , i.e., where it is *difficult* to achieve what we want to achieve, are the very situations which make education possible (Biesta 2001a, p. 386). This is because from an emergentist perspective it is only through the *frustration* of our intentions (i.e., through the perpetual *contamination* of our beginnings

such that we are *never* the master of our own actions) that we ‘come into presence.’ This frustration of our intentions – that which makes education difficult or even impossible – must therefore be understood as the condition that makes education possible (Biesta 2001a). This is contrary to conventional educational logic where, because the curriculum is conceived as a linear process directed towards a predetermined end, it is believed necessary to remove any obstacles to reaching the desired educational goal. The goal must be reached as quickly and easily as possible. With an emergentist conception of education it becomes possible to see that this logic is detrimental to a human being ‘becoming somebody.’ In this sense, narrow, instrumental and teleological curricula that are designed to produce interchangeable units with minimum fuss can only be seen as *un-educational*. They may be good at delivering a product, but are not conducive to the emergence of individual subjectivity.

Because coming into presence in a ‘space of emergence’ can only be achieved through response, and because we are always forced to respond – to take a position – by those whom we are with (we cannot *not* take a position) it becomes possible to understand all those in the ‘space of emergence’ as the ones being called into presence. This includes educators *and* students. The ‘educator’ calls the student into presence by posing difficult questions such as ‘What do you think about it?’ ‘Where do you

stand?,' 'How will you respond?' (Biesta 2004a, p. 79). Such questions demand an *individual* response from the student. However the student calls the educator into presence *with the same questions* which likewise require an *individual* response. Educator and student provoke *each other* into responding. The educational relationship, that which takes place in curricular space, is therefore not an easy relationship. It is *difficult* and *provocative* and often uncomfortable. Biesta goes so far as to suggest there is a certain 'violence' in the educational relationship (Biesta 2004a, p. 77). It is 'violent' because it faces all those in the curricular space with 'deep, transforming and disturbing challenges' which bring forth unforeseen (and not always pleasant) changes (Biesta 2004a, p. 79). It is violent also because those responding have no choice but to take a position, show themselves, in relation to such questioning. Both the educator and the student disturb each other's complacency, disorganise each other's organisations, re-open each other's closures, forcing each other to keep on showing themselves. Their personal space, their privacy is therefore invaded. By engaging in education (as a teacher or student) one is therefore always exposing oneself, placing oneself at risk. One does not know, cannot know, what will happen, only that something will happen.

I want to argue that it is important not to deny the violence involved in coming, or maybe we should say calling, into presence... It is violent in that it doesn't leave individuals alone, in that it asks difficult questions and creates difficult situations (Biesta 2004a, p. 79).

But the educational relationship is not perfectly symmetrical. It 'should not be understood in terms of full reciprocal discursivity' (Biesta 1998, p. 12). Biesta (unpublished manuscript) argues that the educator is responsible *not only* for calling the other into presence. Responsible *not only* for unsettling the student's closures, but *also* for the *singularity*, for the uniqueness of the student (Biesta 1998, p. 13). 'This ... articulation of the pedagogical is not interested in *what* the subject is; it is interested in *who* the subject is' (ibid.). Educators must acknowledge that their actions call up a *particular* who. They cannot educate without in some way shaping the who that is called into presence. This is not only unavoidable, but any attempt to avoid it would be an act of neglect, for it would mean leaving the student alone. In this sense educators are responsible for a closure (a *particular* being is called into presence through an educator's actions) at the same time as being responsible for the opening of this 'who.' The educational responsibility must therefore be understood in a double sense. Biesta refers to this as a 'double duty,' a term he borrows from Derrida (Biesta unpublished manuscript). Educators are responsible for the *one* called (which is a closure)

and for the unsettlement (violating, opening) of the one called. In other words they are responsible, *at the same time*, for the closing and re-opening of subjectivity. They are responsible for keeping the play in play. This, as Biesta remarks,

...is an extremely difficult task and implies a huge responsibility for those who dare to take on this task. This responsibility [double duty] for the uniqueness, the subjectivity of students, learners, is an unlimited responsibility, that is, a responsibility that cannot be calculated. It is a responsibility without knowledge (Biesta 2004a, p. 80).

6.4 UNDOING THE REPRESENTATIONAL LOGIC OF SCHOOLING

In this section I explain further why an emergentist conception of subjectivity is of such consequence for the critique of the representational logic of modern Western schooling, why this – rather than an emergentist conception of knowledge – is required for disrupting the representational foundation of schooling.

6.4.1 *The death of the subject not the death of education*

The emergentist idea that the human subject is *not* an *object* that can be known, described and theorised about – an idea popularly touted as ‘the death of the subject’ and attributed to Foucault 2002/1970b (see Allen 2000,

for two opposing views on the meaning of this phrase) – has profound consequences for education. Some of these were described in Section 6.3.3. The consequences are profound because the loss of the subject *as an object* challenges the *representational* foundation upon which the entire edifice of modern education is built. This is because the idea of reproducing *in* the student/subject something that is initially *outside* of the student/subject depends on the idea that there is a *kind of being* (a ‘what’) that can be guided in a certain predetermined direction. We need to know *what* we are dealing with before we can ‘shape’ it. However if we cannot know what we are dealing with, then we have no definite starting point, and so we cannot know where we will end up. This loss of the subject-as-object therefore interrupts the idea that education is about representing *in* the student a world that is present somewhere or somehow *outside* the student. An emergentist conception of subjectivity destroys the *representational rationale* or *dualist foundation* upon which modern schooling is built.

One could therefore say that while the critique of representation at the epistemological level *and* at the level of the sign poses a challenge for pedagogy, this does not *directly* challenge the underlying dualistic logic of modern schooling, as it emerged in the seventeenth century. As I showed with Ulmer (1985), it does not challenge the idea that what is outside (the student/school) can be reproduced or re-presented inside (the

student/school). This logic reappears as the 'pedagogical effect of discipleship.' The representational logic of schooling can be challenged only *indirectly* through the 'death of the subject,' i.e. the through the emergentist challenge to the idea of subject-as-object.

As I argued in Chapter 2, it was only with the birth of a dualistic understanding of the sign in the seventeenth century that education became 'representational.' At this point it made sense to teach inside the school, that which was outside its boundaries. As I argued before, education before this time had mostly been a process of enculturation or apprenticeship. One immersed oneself in the culture one was learning about rather than separating oneself from it in order to *then* learn about it. To separate oneself from the culture one was learning about would have made no sense *before* the advent of a dualistic conception of knowledge. Modern schooling has therefore taken shape around this dualistic notion of knowledge. As I argued in Chapter 2, modern schooling is understood *in terms of this logic*. By unsettling the dualistic logic of modern schooling, the 'death of the subject' has therefore thrown the idea of modern schooling into its own crisis of representation. On the one hand it is argued that if we cannot put the world into the student (teach the student *about* something) then education seems to have no purpose. On the other hand the idea of a world in which there is no longer a place for education of some sort or another

(i.e., either along presentational or representational lines, as discussed in Chapter 2, Section 2.4) seems inconceivable. I would like to argue, however, that this dilemma, this crisis of indecision in education – this *impossible* choice – exists only if we maintain a dualistic frame of reference. If we switch to the logic of emergence/deconstruction, we transcend the crisis.

6.4.2 *Transcending the crisis of representation in education*

Emergentist logic demands that we *abandon* the idea that education is about putting knowledge (or significations) *of* the world *into* the student. It challenges the idea that we ‘acquire’ meaning and suggests instead that signification and meaning come into existence *together* and, furthermore, that this act is never completed. Meaning is therefore not something we can ever ‘have.’ Furthermore, since the continuous ‘bringing forth’ of meaning is a human activity, one could also say that it is only in bringing forth meaning that human beings are *who* they are. Through meaning making, which is to say through practices of signification, we are forced to take a position, we are forced to be *someone* in-the-world-with-others. We come into presence not as we get closer to truth, but as we make meaning, as we take a position with others. This ‘taking of a position’ is therefore always a political taking of a position and the meanings we make (with others), therefore always alter the politics of our being-in-the-world-with-others,

thereby immediately facilitating a new round of meaning making. But because our meanings are always political, these meanings also alter 'the world' itself, so our meanings are not passive/neutral but active participants – agents – in 'worldmaking.'⁴⁵ The world is only 'the world' because it is meaningful to us and it is therefore only 'the world' in a *political* sense. In this regard, 'the world' is never simply 'present,' not passively 'there' to be signified, but emerges as we engage in signifying practices.

Through this conflation of signification, meaning making and the emergence of human subjectivity it becomes possible to understand the concern of education as *not* being about the process of putting meanings into the student, but with the process of the student's emergence into and *with* the world. Education is therefore about *coming into the world* or 'coming into presence' (Biesta 2005, in press). Moreover, it is about 'coming into presence' in the company of others who are *themselves* 'coming into presence.' For an educator this would involve attending closely to the others who are 'coming into presence' *in the educator's presence* (who is also coming into presence). The educational responsibility is therefore about attending to the *emergence of these others* rather than seeing to it that these others obtain a 'correct' understanding of a world or way of life that is

⁴⁵ This term comes from Nelson Goodman's *Ways of Worldmaking* (1978), although I do not share Goodman's views on this, which I believe are still informed by a dualistic or representational understanding of the sign.

being presented to them as an object. Educators, in other words, are responsible for *being with* and *responding to* the student *from their own position* and *without manipulative intent*. Responsible for making it possible that the student is able to emerge, able to find their voice, express their opinion, and thereby 'become someone.'

6.4.3 *Schooling, curriculum and emergence*

At one level, the death of the subject-as-object and consequent loss of the representational logic of modern schooling seems to suggest that the idea of the school curriculum as something that shapes the subjectivity of the subject – which, as I argued in Chapter 2, is absolutely central to the project of modern education – is no longer useful. This, however, is not the case. I have shown that the 'death of the subject' rather than doing away with a curricular concern for the subjectivity of the subject, takes it up at a different level. The subject is no longer an object to be manipulated but a being uniquely positioned and in the process of emerging. Rather than 'shaping' the 'subject-as-object' according to some *pre-given* measure of adequacy, which in fact is *not* to respect the *emergent* subjectivity of the subject, but to control the subject, an emergentist conception of curriculum would *call up* the subjectivity of the subject by offering a space in which the subject can express an opinion, take a position, and therefore be *someone*.

This is completely contrary to the logic of representational schooling where the subject is always coerced to take up *someone else's meanings*. Even if the student is allowed to express an opinion, this opinion is always manipulated in the direction the educator wants for it.

With the representational or dualistic view, schools were concerned with how best to transfer meanings into the student, and the subject of schooling could only be a subject *after* the transfer of 'knowledge' had taken place, i.e., after 'schooling' had taken place. Before schooling had taken place the subject was not considered to be a subject in its own right. Educators were more concerned with the transfer of knowledge than with the subject (who was not yet a subject). The transfer was crucially important in order that the subject could become a subject. With the emergentist view, the subject is *already* a subject. With an emergentist view, what is important is not the success of transfer, but the quality of the 'space of emergence' The quality of the interaction between the teacher and the student. Education takes place wherever human subjectivity is *allowed* to emerge. Perhaps one could go so far as to say that education is the passage of emergence, this being a 'difficult accompaniment' into the impossible. The accompaniment *itself* facilitates the passage into the impossible. The *accompaniment* is the 'curriculum' that facilitates the emergence of subjectivity.

If the curriculum facilitates the emergence of the human subject, then one could say that the primary function of schools is not to provide students with the opportunity *to reproduce what already exists* (although they can also do this) but to provide students with the opportunity *to come into presence*. Schools can be places where new meanings are allowed to appear. In this way schools would reposition themselves as being integrally involved in calling forth new worlds that are unimaginable from the perspective of the present, rather than being guardians of a world which took place in a different political time and space. In this case schools would reposition themselves *in* the emerging world rather than positioning themselves on the outside of it.

In conclusion, I turn to the words of Hannah Arendt, who, while being conservative in her general approach to education, nevertheless makes the following comment:

Our hope always hangs on the new which every generation brings; but precisely because we can base our hope only on this, we destroy everything if we so try to control the new that we, the old, can dictate how it will look (Arendt 1954a, p. 192).

6.5 SUMMARY AND CLOSING REMARKS

In this chapter I have presented three ‘pedagogies of invention’ and a ‘pedagogy without humanism’ to show how the representational logic of schooling *cannot* be disrupted only through challenges to representation which take place at the epistemological level or at the level of the sign. Because meaning making is linked to human subjectivity, the only way to disrupt the representational logic of modern schooling is indirectly, through challenging a conception of human subjectivity that relies on a representational understanding of the sign. It is therefore necessary to use the metaphor of ‘strong’ emergence in a double sense. In this chapter I used ‘strong’ emergence (i) in relation to the emergence of knowledge and signification, and (ii) in relation to the emergence of human subjectivity. When emergence is used in this double sense, we find that schooling can no longer manipulate the subject. With no clear idea of what it is starting with, it cannot manipulate the start point (the human subject) to another position; one defined in advance. It cannot, in other words, aim to reproduce or replicate in the student a meaning which already exists.

If we take seriously the idea the critique of presence offered by complexity and deconstruction, we are obliged to rethink schooling along lines that are more compatible with the epistemology suggested by this critique.

Rethinking schooling along these lines, so I have argued in this chapter, is more radical than previous critiques of representational schooling practices have implied. While previous critiques of representational schooling have left in place the idea that what is present outside the school can be replicated in the student, and so leave in place the dualistic logic of modern schooling, an emergentist conception of subjectivity requires a fundamental reorganisation of schooling, which is not another pedagogical version on the representational-presentational spectrum that I discussed in the Chapter 2. I have argued that if we re-think the purposes of schooling from the premises of 'strong' emergence and deconstruction – which suggest that neither the world nor the subjectivity of the subject is simply 'present' – then we must think of education as being concerned with providing opportunities for the subject to emerge or 'come into presence' through meaning making in the presence of others.

I have also shown that the critique of presence offered by complexity and deconstruction calls for a different understanding of the notion of curriculum. With complexity and deconstruction the curriculum is not something that can be *implemented* or *prearranged*. It has no moral, no cause nor effects, no beginning end or middle. It is not something one can have or control. Rather the 'curriculum' is the space in which a subject is allowed to

come into presence in the presence of others who are themselves coming into presence.

Finally, I have shown that if we theorise education and schooling from an emergentist perspective, we find that the educator's first responsibility is not an epistemological responsibility, but a responsibility to be with the student and respond to the student in a genuine (non-manipulative) way, from his or her *own unique position*. Through this interaction the educator is *directly* responsible for the student's 'coming into presence,' *directly* responsible for the singularity and uniqueness of the student. To put this more plainly, the educator's primary responsibility is to respond and make room for the student to respond in turn (and so come into presence). This means keeping open a space in which *responsible* responses (which are responses without preconceptions of what 'should' be done) can take place.

However I would also like to add that since we all live in the world with others, we are all always in a space of emergence. We are all educating and being educated by those we with whom we live. We are all not only in-the-world-with-others, but also in-the-world-educating-and-being-educated-by-others. While the educator has a special responsibility, a duty or perhaps one could say a 'calling' to those being educated, 'educational responsibility' is also not something that any one of us can avoid. It is not something that

happens only in 'pedagogical settings.' In this sense we are all educators. We are all responsible for what and who emerges in our world. We are all responsible for keeping things open, for keeping the play in play.

Chapter 7

SUMMARY AND CONCLUSIONS

Significance of the research and possibilities for further study

7.1 SUMMARY OF THESIS

In this thesis I have argued that the curriculum of modern Western schooling is organised around a representational understanding of the sign which emerged together with mass education in the seventeenth century. This representational understanding of the sign, which holds that a sign stands for some pre-existing 'presence' facilitates representational or Cartesian epistemology, which relies on the idea that knowledge stands for something in the 'real' world. I argued that regardless of epistemological differences traditional, progressive and situated understandings of curriculum rely on a representational understanding of the sign. The job of the curriculum is to reproduce *in* the learner those meanings which initially lie *outside* the learner.

I then showed how the notion of representation has been challenged at the epistemological and semiotic level in the past century. Here I pointed out

that the epistemological critique of representation, because it does not challenge representation at the level of the sign, has little impact on the basic organisation of schooling, which, ever since the seventeenth century has been structured around the idea that schools can reproduce knowledge that exists *outside* the school, *inside* the learner. Replacing a 'picture' theory of knowledge with a 'use' theory of knowledge therefore does not replace the underlying representational epistemology of schooling. The critique of representation at the level of the sign, does, however, suggest that the representational logic of schooling might be replaced by a 'deconstructionist logic' or something which similarly challenges representation at the level of the sign. This provides the answer to my first research question: *What might take the place of the representational epistemology of schooling?* (see Section 1.4.2).

I then introduced complexity as another contender for challenging representation at the level of the sign, the reason being that it has for some time been known that complexity resists representation in the traditional sense. In exploring the logic of complexity I showed that the logic of 'strong' emergence and the logic of deconstruction both suggest that the sign is partially constituted by that which is *not* present. Both therefore bring into question the idea of presence preceding signification.

I then explored what happens to the 'geography' of schooling when its representational foundation is replaced with an emergentist or deconstructionist 'foundation.' This was done on two levels, the level of the sign and the level of human subjectivity. I showed that it is only when knowledge is linked to human subjectivity and human subjectivity linked to an emergentist conception of subjectivity that the underlying representational logic of schooling is disrupted. Only when this is done, is it possible to rethink schooling along non-representational (emergentist) lines. Once this is done it is possible to move from an understanding of schooling where pre-existing meanings are put into the student, to a practice of schooling which is concerned with the students emergence into the world. With a representational foundation the educator is responsible for moving knowledge from the *world into the child*. With an emergentist conception, the educator is responsible for accompanying the *child into the world*. This is a significant shift. This answers my second research question: *What would be the 'shape' or 'geography' of a schooling practice that is not premised on representational epistemology?* (see Section 1.4.2).

The answer to my third research question: *Is complexity helpful for addressing either of the first two research questions?* is that complexity is indeed helpful for addressing both questions. First, the logic of 'strong' emergence provides an epistemology which unsettles representation at the level of the sign and

therefore provides an adequate replacement for the representational epistemology of schooling. It could be argued, however, that the logic of deconstruction does the same job and therefore there is no need to invoke complexity or emergence. However, the utility of 'strong' emergence is that it provides an extremely useful and serviceable metaphor for non-representational conceptions of signification (such as deconstruction). It is therefore useful both for understanding what takes the place of the representational epistemology of schooling and for understanding the shape of a schooling practice not premised on representational logic.

7.2 MAIN FINDINGS AND CONTRIBUTIONS TO THE LITERATURE

In Chapter 2, I synthesised aspects of the work of Aries, Mollenhauer and Foucault to show that the representational *foundation* of schooling is representational at the level of the *sign* not the level of *knowledge*. This enabled me to show that critiques of representation that come from the fields of curriculum studies and learning theory are not able to challenge the underlying representational organisation of schooling because they launch these critiques at the level of knowledge (the epistemological level) rather than the level of the sign (the semiotic level). In this regard the work makes a novel contribution to discussions about *curriculum reform* which, for the

most part, are structured by representational understandings of the sign (and hence by the dualist logic of Cartesian epistemology).

In Chapter 3 I outline the critique of representation first at the epistemological level and then at the level of the sign (the semiotic level). In doing this I show that of all the critiques of representation discussed, it is only deconstruction that challenges the representational logic of the dualistic sign. While important for my argument, this work is not 'original' in the sense that it brings something new to the field of epistemology.

Chapters 4 and 5 are closely linked. In these chapters I introduce 'complexity science' and in doing so divide the 'field' in terms of two *fundamentally* different positions on determinism. Prigogine's approach on the one hand, and everything else, on the other hand. The difference between these two 'approaches,' I would contend, has been largely overlooked by those working on the epistemological implications of complexity, at least in the English speaking world. The debate, I believe, is better developed in the French literature (see Pomian 1990). The difference, however, is crucially important for epistemology, as it makes it possible to align the 'epistemology of complexity' with poststructural frames, whereas most of the work in complexity thinking is structuralist. In this regard the work makes a significant contribution to the 'complexity thinking'

approach within the field of 'complexity studies'. Chapter 5 continues this epistemological work and I eventually develop an 'epistemology of complexity' which is based on the notion of 'strong' emergence. The development of this epistemology is facilitated by a reading of Prigogine which compares his ideas with those of the 'British emergentists' of the late nineteenth and early twentieth centuries on the one hand and Derrida's deconstruction on the other. This move translates his 'microscopic theory of irreversibility' into a theory of 'strong' emergence and thereby provides a novel reading of Prigogine which is extremely useful for making links between the non-deterministic forms of science that have emerged in the last century and deconstruction.

Finally, in Chapter 6, I show how the logic of emergence can be used to re-think modern Western schooling. For this I rely heavily on arguments coming from a deconstructionist perspective (in particular, Gregory Ulmer and Gert Biesta). Nevertheless the work in this chapter is still 'original' in that it provides an alternative to the 'soft' or metaphorical approach to complexity, which is largely the way in which complexity has been used in the 'field' of complexity and educational research. Instead of using complexity as a metaphor to 'understand' complex social systems, my work suggests that complexity can be used to challenge the logic which suggests that complexity can be used as a metaphor to understand social systems. In

using complexity to challenge this logic, my work opens a different perspective for research on complexity and education.

7.3 SHORTCOMINGS OF THE RESEARCH AND FURTHER WORK

There are at least two areas where the research could have been improved. First the relationship between pragmatism and deconstruction is likely to be far more complex than I have portrayed in this thesis. Due to time constraints I was unable to engage with pragmatism as deeply as I would have liked. I expect a deeper engagement with this discourse (particularly Dewey's version of pragmatism, as explicated by Biesta and Burbules 2003) would result in an analysis which showed that a 'use' theory of knowledge cannot simply be excluded from deconstructive/emergentist thinking. It is likely that deconstruction/emergence bears the same relationship to pragmatism as it bears to structuralism. In the same way as Derrida's critique of de Saussure's drew on de Saussure's to move his conclusions to another place, I believe emergence/deconstruction *uses* pragmatism to reach another place. I would like to see this link articulated more explicitly.

Second, and again due to time constraints, it was not possible to explore the phenomenological critique of representation nor the links between 'strong' emergence and phenomenology. Due to the extent of the literature on phenomenology, this aspect was purposely omitted from the study.

Nevertheless phenomenology – and in particular the work of Maturana and Varela (1987) and Gregory Bateson (1972) – informs much of the research in complexity and education, and a close reading of this work would undoubtedly prove fruitful in relation to the argument presented in this thesis.

Future research on the issue of ‘rethinking education’ from a non-representational foundation might benefit from an engagement with both pragmatism and phenomenology as well as a deeper engagement with Derrida and deconstruction at various levels and in various contexts. The research might also benefit from an engagement with a newly emerging field: the ‘semiotics of the very infinitely small’ (see Marcus 2004). In the week before submitting this thesis I came across the work of Solomon Marcus which I have not had sufficient time to either read or incorporate into the text except in the most superficial manner (see Section 5.4 and Section 7.4 of this chapter). Nevertheless, Marcus appears to have arrived at a similar conclusion to the one I reached concerning the move away from the macroscopic metaphors of everyday reality that has taken place in deconstruction and quantum physics. In Chapter 5 (Section 5.4) I argued that

One reason for using Prigogine is that he still employs metaphors we can relate to in our macroscopic world. This is not the case with much of modern physics (particularly quantum mechanics) or Derrida, both of which throw us into a crisis of imagination. We can no longer use metaphor to imagine the world that is presented for us by Derrida or by quantum mechanics (see p. 230 of this thesis).

Here I sign-posted Marcus's work, adding that

For the first time in human history, the main concern of science, art and philosophy is situated *beyond the macroscopic world*, while human semiosis, as it was projected and developed during a long period of its history, had remained limited to the macroscopic world (Marcus 2000, in <http://www.uni-kassel.de/iag-kulturforschung/archiv2/krise.htm>).

I have since been in communication with Marcus, and a collaboration in the area where complexity, semiotics and deconstruction overlap is likely. What seems necessary is a more thorough exploration of the interaction between the metaphors used by complexity and those metaphors (if these can still be called 'metaphors') that are situated *beyond* the macroscopic world (as employed, for example by Derrida and quantum mechanics). Such an investigation would certainly be of importance to modern schooling, in view of its current representational organisation.

7.4 AFTERWORD: BEGINNING AGAIN

'Let us begin again' (Derrida 1981b, p. 65)

According to Derrida (1981b) the Western philosophic tradition has, ever since the Greeks, assumed the presence of a 'reality' that we have recourse to as something that is wholly and entirely 'there.' Foucault (2002/1970b) adds that prior to the seventeenth century this 'reality' was assumed to exist in 'the signs' which required accurate interpretation and that since the seventeenth century, this 'reality' was understood to exist *independently of signification*, i.e., outside of the signs themselves – such that significations became transparent representations of this reality. In the last two centuries – at least according to Foucault's analysis – knowledge has been understood in a temporal sense as a *process*. Nevertheless this process was still understood as a series of 'snapshots' in linear time – which Henri Bergson called a 'cinematographical' view of 'reality' (Bergson, 1911, p. 301) – a series of static pictures that can be unrolled like a scroll or 'spread out behind us in its entirety' as we make new discoveries (Mead 1932, p.29). Each of these shifts in understanding entailed a rethink of the meaning of the term 'knowledge.' And each time knowledge was redefined it was necessary to begin again with the philosophical project of knowing. Nevertheless, throughout all these beginnings we could always rely on the

idea of a 'reality' that was 'present' as things in our everyday macroscopic world are present.

We are now at a point where our assumptions about knowledge are again being questioned. For the first time in human history, according to Solomon Marcus, the main concern of science, art and philosophy is situated *beyond the macroscopic world* (Marcus 2000). Beyond the macroscopic world we find that our ideas about linear temporality are challenged and we can no longer rely on the idea of presence. Without presence the Newtonian rules of physics no longer make sense. Neither is it possible to understand language and semiosis in terms of a dualistic or representational (metaphorical) logic. The current 'crisis of representation' demands nothing short of a fundamental reconsideration of the foundations of semiosis (Marcus 2000). It seems we must, therefore (again), begin again.

Let me begin again. In his address entitled '*Between normality and pathology*' at the first Crisis of Representation Semiotic Colloquium, Marcus remarks

Crisis is usually perceived as the appearance of a tension ... or as a symptom *that something no longer works in the usual way*. However, this negative perception of a crisis is only one side of the coin. In many cases, the crisis is the symptom of a change that will later be perceived as a positive phenomenon (Marcus 2003, p. 18, my emphasis).

Marcus argues that as the symptoms of change that provoke a crisis become permanent, 'they turn to normality' (Marcus 2003, p. 24). With regard to the logic of deconstruction/emergence, this already has started happening. Rusterholz remarks that Derrida himself describes his concept of *différance* as 'anticipating a future that will completely break with constituted normality, a future which can only provisionally make itself known in the form of a monstrosity' (Rusterholz 2003, p. 54-55). Yet:

It is interesting and thought-provoking that the vision of monstrosity which Derrida had in 1967, and which was received in the same vein by most traditional scholars at the time, is today apparently being granted at least the plausibility of increasing evidence (Rusterholz 2003, p. 55).

Undoubtedly much of what we consider 'normal' is shaped by cultural patterns as Foucault has repeatedly argued (see, e.g., his work entitled *Madness and Civilization*), and so the distinction between what is 'normal' and what is 'pathological' is, to a large extent, conventional (Marcus 2003). In this regard the 'postmodern society' is assisting the 'normalisation' of emergentist/deconstructive logic. According to Marcus, 'the postmodern society has opened the doors for reconsidering many of yesterday's pathological representations as today's symptoms of health' (Marcus 2003, p. 24).

This, however, is not to say that the time is now 'right' for the logic of emergence/deconstruction to be 'applied' to education and schooling, with the insinuation that this logic is now more 'legitimate' than previous styles of thought. Rather, the tendency towards the normalisation of knowledge practices should serve as a constant reminder that every normalised practice operates within an accepted system of rules. As Jean-Francois Lyotard has remarked, these rules

do not carry within themselves their own legitimation, but are the object of a contract, explicit or not, between players (which is not to say that the players invent the rules) ... if there are no rules, there is no game' (Lyotard 1984, p. 10).

With regard to the application of the logic and language of complexity science to educational practice, Anne Phelan cautions that 'we are in danger of forgetting that the whole of relevant 'reality' is more complex than any one educational theory suggests or implies' (Phelan 2004, p. 15).

My fear is that we are constructing a redemptive tale and that in complexity science we see not simply another language game but a shining new set of guarantees. And so I am led to wonder what this new language game is up to? ... What happens to the educator who begins to play this game? (Phelan 2004, pp. 12-13)

While such questions are relevant, they are nevertheless caught in the very logic that emergence/deconstruction brings into question. They assume that deconstruction/emergence is a theory *about* something which can be *applied* to something else. This, as I tried to make clear in Chapter 5, is not in keeping with the logic of emergence/deconstruction. The reconstruction of meaning in terms of emergence or deconstruction replaces one set of rules with another *only if one plays by the rules of representation*.

In this thesis I have argued that when the idea of ‘strong’ emergence is used as a metaphor to think through some of the epistemological implications of complexity, i.e., if the conclusions of complexity are recursively applied to the ‘theory’ of complexity itself,⁴⁶ then we see that complexity ‘theory’ – and the notion of emergence itself – erases itself in a deconstructive movement. While complexity is a theory (or collection of theories) its conclusions (or at least those of Prigogine) suggest it cannot be a theory *about* something. If complexity theory is ‘knowledge’ then knowledge does not ‘stand for’ some pre-existing presence. Rather, knowledge is that which ‘brings forth’ something new. Something *incalculable* from the perspective of the present. In this sense knowledge and deconstruction are one and the same. This knowledge/deconstruction amalgam is what Derrida refers to as

⁴⁶ In the same way, Derrida recursively applied de Saussure’s conclusions to the theory that produced these conclusions, a movement which produces deconstructive logic.

'the experience and experiment of the impossible' (Derrida 1992b, pp. 44-45). 'Strong' emergence is a theory and a metaphor by means of which knowledge/deconstruction is brought, at least partially, into the macroscopic world. But we must suffice with a *partial* metaphor (partly in-the-world and partly out of it) and moreover one which is always already in the process of erasing itself. This erasure, or 'deconstructive movement' – the 'taking place' of emergence – is, for Derrida is the condition of possibility of *responsibility*. The exercise of responsibility, Derrida argues, is not something that takes place according to a set of pre-given rules. Responsibility, for Derrida is always an 'impossible' responsibility, that is, it takes place *outside* the parameters of rules and laws, it takes place outside of the 'possible.' He explains it like this:

When a responsibility is exercised in the order of the possible, it simply follows a direction and elaborates a programme. It makes of action the applied consequence, the simple application of a knowledge or know-how. It makes of ethics and politics a technology. No longer of the order of practical reason or decision, it begins to be irresponsible (Derrida 1992b, p. 45).

If deconstruction/emergence is a game, it is therefore a game of *responsibility* (to the other) which is one that cannot play out through any set of pre-given the rules. If it has rules at all, these emerge *in the playing of the game*. Furthermore, the rules that emerge would necessarily self-destruct

as the game emerged. With deconstruction/emergence we enter a different logic, one which *cannot* be understood in terms of the logic of what-has-come-before (the logic of 'what-has-come-before' is a representational-deterministic logic).

At present this logic of emergence/deconstruction is caught between strangeness and familiarity, or, as Marcus might say, between 'pathology' and 'normality' (Marcus 2003). While in some respects it seems to be 'right' for our time (given developments in quantum mechanics, complexity and semiotics), working through its 'implications' for education⁴⁷ presents us with the strange and/or impossible. While the logic of emergence/deconstruction does away with the guardrails of metaphysics (the idea of 'presence'), thereby suggesting we can take nothing for granted, it does not suggest we can say/do nothing. Rather, it opens an entirely new arena for 'theory.' With regard to education and curriculum theory, it opens an arena of curriculum theorising which is not just another version of the representational-presentational (traditional-progressive) debate I discussed in Chapter 2 which has occupied educational theorists since the emergence of modern schooling in the seventeenth century. Rather, it offers

⁴⁷ Bearing in mind that its 'implications' for education suggests 'education' as we know it is *not* education and therefore it cannot have 'implications' for education or, rather, that education must *transcend itself*.

a place from which to begin again. This 'place,' however, offers no guidelines or guardrails for 'educational action.' On that note, and to 'close' this thesis, I therefore offer the following words from Rousseau:

I give my dreams as dreams, and leave the reader to discover whether there is anything in them which may prove useful to those who are awake (Rousseau, in Derrida 1976b, p. 316).

Appendix

The participants of the First World Congress of Transdisciplinarity held at the Convento da Arrábida in Portugal on November 2-7, 1994 have adopted a Charter, which comprises the fundamental principles of the 'community' of transdisciplinary researchers. The Charter is as follows:

Article 1 : Any attempt to reduce the human being by formally defining what a human being is and subjecting the human being to reductive analyses within a framework of formal structures, no matter what they are, is incompatible with the transdisciplinary vision.

Article 2 : The recognition of the existence of different levels of 'reality' governed by different types of logic is inherent in the transdisciplinary attitude. Any attempt to reduce 'reality' to a single level governed by a single form of logic does not lie within the scope of transdisciplinarity.

Article 3 : Transdisciplinarity complements disciplinary approaches. It occasions the emergence of new data and new interactions from out of the encounter between disciplines. It offers us a new vision of nature and reality. Transdisciplinarity does not strive for mastery of several disciplines but aims to open all disciplines to that which they share and to that which lies beyond them.

Article 4 : The keystone of transdisciplinarity is the semantic and practical unification of the meanings that *traverse* and *lay beyond* different disciplines. It presupposes an open-minded rationality by re-examining the concepts of 'definition' and 'objectivity.' An excess of formalism, rigidity of definitions and a claim to total objectivity, entailing the exclusion of the subject, can only have a life-negating effect.

Article 5 : The transdisciplinary vision is resolutely open insofar as it goes beyond the field of the exact sciences and demands their dialogue and their reconciliation with the humanities and the social sciences, as well as with art, literature, poetry and spiritual experience.

Article 6 : In comparison with interdisciplinarity and multidisciplinary, transdisciplinarity is multireferential and multidimensional. While taking account of the various approaches to time and history, transdisciplinarity does not exclude a transhistorical horizon.

Article 7 : Transdisciplinarity constitutes neither a new religion, nor a new philosophy, nor a new metaphysics, nor a science of sciences.

Article 8 : The dignity of the human being is of both planetary and cosmic dimensions. The appearance of human beings on Earth is one of the stages in the history of the Universe. The recognition of the Earth as our home is one of the imperatives of transdisciplinarity. Every human being is entitled to a nationality, but as an inhabitant of the Earth is also a transnational being. The

acknowledgement by international law of this twofold belonging, to a nation and to the Earth, is one of the goals of transdisciplinary research.

Article 9 : Transdisciplinarity leads to an open attitude towards myths and religions, and also towards those who respect them in a transdisciplinary spirit.

Article 10 : No single culture is privileged over any other culture. The transdisciplinary approach is inherently transcultural.

Article 11 : Authentic education cannot value abstraction over other forms of knowledge. It must teach contextual, concrete and global approaches. Transdisciplinary education revalues the role of intuition, imagination, sensibility and the body in the transmission of knowledge.⁴⁸

Article 12 : The development of a transdisciplinary economy is based on the postulate that the economy must serve the human being and not the reverse.

Article 13 : The transdisciplinary ethic rejects any attitude that refuses dialogue and discussion, regardless of whether the origin of this attitude is ideological, scientific, religious, economic, political or philosophical. Shared knowledge should lead to a shared understanding based on an absolute *respect*

⁴⁸ This article is problematic in my view, for it is still governed by the logic of disciplinary thought, i.e., it is concerned with the 'transmission' of knowledge, which suggests transmission of something stable and permanent, a 'disciplinary' system of thought.

for the collective and individual Otherness united by our common life on one and the same Earth.

Article 14 : Rigor, openness, and tolerance are the fundamental characteristics of the transdisciplinary attitude and vision. *Rigor* in argument, taking into account all existing data, is the best defense against possible distortions. *Openness* involves an acceptance of the unknown, the unexpected and the unforeseeable. *Tolerance* implies acknowledging the right to ideas and truths opposed to our own.

Article final : The present *Charter of Transdisciplinarity* was adopted by the participants of the first World Congress of Transdisciplinarity, with no claim to any authority other than that of their own work and activity.

In accordance with procedures to be agreed upon by transdisciplinary-minded persons of all countries, this *Charter* is open to the signature of anyone who is interested in promoting progressive national, international and transnational measures to ensure the application of these Articles in everyday life.

Convento da Arrábida, 6th November 1994

Editorial Committee: Lima de Freitas, Edgar Morin and Basarab Nicolescu
Translated from the French by Karen-Claire Voss



References

- Allen, A. (2000) The Anti-Subjective Hypothesis: Michel Foucault and the Death of the Subject, *The Philosophical Forum*, XXXI (2) 113-130.
- Apple, M. W. (1993) *Official Knowledge: Democratic Education in a Conservative Age*, Routledge, New York.
- Arendt, H. (1954a) 'The Crisis in Education' in *Between Past and Future*, Faber and Faber, London, pp. 173-196. URL: <http://www.eco.utexas.edu/facstaff/Cleaver/350kPEEArendtCrisisInEdTable.pdf>, last accessed 25/05/2005.
- Arendt, H. (1954b) 'What Is Freedom?' in *Between Past and Future*, Faber and Faber, London, pp. 143-171.
- Arendt, H. (1958) *The Human Condition*, The University of Chicago Press, Chicago/London.
- Ariès, P. (1962) *Centuries of Childhood: A Social History of Family Life*, Trans., Baldick, R., Vintage Books, New York.
- Auyang, S. Y. (1998) *Foundations of Complex-System Theories in Economics, Evolutionary Biology, and Statistical Physics*, Cambridge University Press, Cambridge.
- Badenhorst, D. (1998) 'Complex Systems Theory: Some Implications for Education' in *Metatheories in Educational Research*, (Ed., Higgs, P.) Heinemann, Sandton, South Africa, pp. 231-250.
- Bateson, G. (1972) *Steps to an Ecology of Mind*, University of Chicago Press, Chicago.
- Bedau, M., A (1997) 'Weak Emergence' in *Philosophical Perspectives: Mind, Causation, and World*, Vol. 11, (Ed., Tomberlin, J.) Blackwell Publishers, Malden, MA, pp. 375-399.
- Bereiter, C. (1997) 'Situated Cognition and How to Overcome It' in *Situated Cognition: Social, Semiotic and Psychological Perspectives*, (Ed., Whitson, J. A.) Erlbaum, Hillsdale, New Jersey, pp. 281-300.
- Bereiter, C. (2002a) 'Artifacts, Canons, and the Progress of Pedagogy: A Response to Contributors' in *Liberal Education in a Knowledge Society*, (Ed., Smith, B.) Open Court, Chicago, pp. 223-244.
- Bereiter, C. (2002b) *Education and Mind in the Knowledge Age*, Laurence Erlbaum, Mahwah, NJ.

- Bergson, H. (1911) *Creative Evolution*, Trans., Mitchell, A., Henry Holt and Company, New York.
- Bernstein, R. (1983) *Beyond Objectivism and Relativism: Science Hermeneutics and Praxis*, University of Pennsylvania Press, Philadelphia.
- Best, S. and Kellner, D. (1999) Kevin Kelly's Complexity Theory, *Organisation and Environment*, 12 (2) 141-162.
- Biesta, G. J. J. (1997) 'Education, Not Initiation' in *Philosophy of Education 1996*, (Ed., Margolis, F.) Philosophy of Education Society, Urbana, Illinois, pp. 90-98. URL: http://www.ed.uiuc.edu/EPS/PES-yearbook/96_docs/biesta.html, last accessed 25/05/2005.
- Biesta, G. J. J. (1998) Pedagogy without Humanism: Foucault and the Subject of Education, *Interchange*, 29 (1) 1-16.
- Biesta, G. J. J. (1999a) Radical Intersubjectivity: Reflections on the 'Different' Foundation of Education, *Studies in Philosophy and Education*, 18 (4) 203-220.
- Biesta, G. J. J. (1999b) 'Where Are You? Where Am I? Education, Identity and the Question of Location' in *Identity. Questioning the Logic of Identity within Educational Theory*, (Ed., Säfström, C. A.) Studentlitteratur, Lund, pp. 21-45.
- Biesta, G. J. J. (2001a) How Difficult Should Education Be?, *Educational Theory*, 51 (4) 385-400.
- Biesta, G. J. J. (2001b) 'Preparing for the Incalculable' in *Derrida and Education*, (Ed., Egea-Kuehne, D.) Routledge, London and New York, pp. 32-54.
- Biesta, G. J. J. (2004a) Against Learning. Reclaiming a Language for Education in an Age of Learning, *Nordisk Pedagogik*, 24 70-82.
- Biesta, G. J. J. (2004b) The Community of Those Who Have Nothing in Common: Education and the Language of Responsibility, *Interchange*, 35 (3) 307-324.
- Biesta, G. J. J. (2004c) 'Democracy: A Problem for Education or an Educational Problem?' in *Five Professors on Education and Democracy. Inaugural Lectures 1999-2003*, (Ed., Englund, T.) Reports from the Department of Education, 8. Öbero University, Öbero, pp. 1-23.

- Biesta, G. J. J. (2004d) 'Mind the Gap! Communication and the Educational Relation' in *No Education without Relation*, (Ed., Sidorkin, A. M.) Peter Lang, New York, pp. 11-22.
- Biesta, G. J. J. (2005, in press) *Coming into Presence. Education after the Death of the Subject*, Paradigm Publishers, Boulder, Ca.
- Biesta, G. J. J. (unpublished manuscript) *Bildung/Building: On the Architecture of Education*.
- Biesta, G. J. J. and Burbules, N. (2003) *Pragmatism and Educational Research*, Rowman & Littlefield Publishers, Inc., London.
- Biesta, G. J. J. and Egea-Kuehne, D. (Eds.) (2001) *Derrida and Education*, Routledge, London and New York.
- Britzman, D. (1995) Is There a Queer Pedagogy? Or, Stop Reading Straight, *Educational Theory*, 45 (2) 151-165.
- Brown, J. S., Collins, A. and Duguid, P. (1989) Situated Cognition and the Culture of Learning, *Educational Researcher*, 18 (1) 32-42.
- Byrne, D. (1998) *Complexity Theory and the Social Sciences*, Routledge, London.
- Capra, F. (1996) *The Web of Life: A New Synthesis of Mind and Matter*, Harper Collins, London.
- Caputo, J., D (1987) *Radical Hermeneutics. Repetition, Deconstruction, and the Hermeneutic Project*, Indiana University Press, Bloomington and Indianapolis.
- Chalmers, D. J. (2002) 'Varieties of Emergence' Manuscript written for the Templeton Foundation workshop, Granada, August 2002. URL: <http://consc.net/papers/granada.html>, last accessed 25/05/2005.
- Cilliers, P. (1993) *Modelling Complexity*, Ph.D thesis, University of Stellenbosch, South Africa
- Cilliers, P. (1998) *Complexity and Postmodernism*, Routledge, London.
- Cilliers, P. (2000a) Knowledge, Complexity, and Understanding, *Emergence*, 2 (4) 7-13.
- Cilliers, P. (2000b) Rules and Complex Systems, *Emergence*, 2 (3) 40-50.
- Cilliers, P. (2001) Boundaries, Hierarchies and Networks in Complex Systems, *International Journal of Innovation Management*, 5 (2) 135-147.

- Cilliers, P. (2002) Why We Cannot Know Complex Things Completely, *Emergence*, 4 (1/2) 77-84.
- Cottingham, J. (1992) 'Cartesianism' in *A Companion to Epistemology*, (Ed., Sosa, E.) Blackwell Publishers, Oxford, pp. 57.
- Cuban, L. (1984) *How Teachers Taught: Constancy and Change in American Classrooms, 1890-1980*, Longman, New York.
- Culler, J. (1986) *Saussure*, (Revised Edition), Fontana Press, London.
- Dancy, J. (1992) 'Introduction' in *A Companion to Epistemology*, (Ed., Sosa, E.) Blackwell Publishers, Oxford, pp. xiii-xv.
- Davis, A. B., Sumara, D. J. and Thomas, K. E. (1996) Cognition, Co-Emergence, Curriculum, *Journal of Curriculum Studies*, 28 (2) 151-169.
- Davis, B. and Sumara, D. (1997) Cognition, Complexity and Teacher Education, *Harvard Educational Review*, 67 (1) 105-125.
- Davis, B. and Sumara, D. (2001) 'Learning Communities: Understanding the Workplace as a Complex System' in *New Directions for Adult and Continuing Education: Sociocultural Perspectives on Learning through Work*, 92, (Ed., Fenwick, T.) Jossey-Bass, San Francisco, pp. 85-98.
- Davis, B. and Sumara, D. (2004) 'A Pedagogy of Invention' Paper presented at the annual conference of the British Educational Research Association, Manchester, 15-18 September, 2004.
- Davis, B., Sumara, D. and Luce-Kapler, R. (2000) *Engaging Minds: Learning and Teaching in a Complex World*, Erlbaum, Mahwah, NJ.
- de Saussure, F. (1983/1916) 'Course in General Linguistics' Trans., Harris, R. (Ed., Sechehaye, A.) Duckworth Publishers, London.
- Dent, E. B. (1999) Complexity Science: A Worldview Shift, *Emergence*, 1 (4) 5-19.
- Denzin, N. K. and Lincoln, Y. S. (Eds.) (1998) *The Landscape of Qualitative Research. Theories and Issues*, Sage Publications, London.
- Derrida, J. (1973) 'Speech and Phenomena' and Other Essays on Husserl's Theory of Signs, Trans., Allison, Northwestern University Press, Evanston.
- Derrida, J. (1976a) Entre Crochets (Interview). *Digraphe*, 8 (April) 97-114.

- Derrida, J. (1976b) *Of Grammatology*, Trans., Spivak, G. C., Johns Hopkins University Press, Baltimore.
- Derrida, J. (1981a) 'Outwork' Trans., Johnson, B. in *Dissemination*, Athlone Press, London, pp. 3-59.
- Derrida, J. (1981b) 'Plato's Pharmacy' Trans., Johnson, B. in *Dissemination*, The Athlone Press, London, pp. 61-171.
- Derrida, J. (1989) 'Psyche: Inventions of the Other' Trans., Porter, C. in *Reading De Man Reading*, (Ed., Waters, L.) University of Minnesota Press, Minneapolis, pp. 25-65.
- Derrida, J. (1992a) 'Afterw.Rds: Or, at Least, Less Than a Letter About a Letter Less' Trans., Bennington, G. in *Afterwords*, (Ed., Royle, N.) Outside Books, Tampere, Finland, pp. 197-217.
- Derrida, J. (1992b) *The Other Heading: Reflections on Today's Europe*, Trans., Naas, M. B., Indiana University Press, Bloomington.
- Dewey, J. (1896) The Reflex Arc Concept in Psychology, *Psychological Review*, 3 357-370.
- Dewey, J. (1897) My Pedagogic Creed, *The School Journal*, LIV (3) 77-80.
- Dewey, J. (1981/1925) 'Experience and Nature' in *Later Works of John Dewey, 1925-1953*, Vol.1, (Ed., Boydston, J. A.) Southern Illinois University Press, Carbondale and Edwardsville.
- Dewey, J. (1984/1926) 'Individuality and Experience' in *Later Works of John Dewey, 1925-1953*, Vol. 2, (Ed., Boydston, J. A.) Southern Illinois University Press, Carbondale, Illinois, pp. 55-61.
- Dewey, J. (1990/1902) 'The Child and the Curriculum' in *The School and Society/the Child and the Curriculum*, University of Chicago Press, Chicago, pp. 179-209.
- Dewey, J. (1990/1956) *The School and Society / the Child and the Curriculum*, University of Chicago Press, Chicago.
- Dewey, J. and Bentley, A. F. (1949) *Knowing and the Known*, Beacon Press, Boston.
- Dillon, M. (2000) Poststructuralism, Complexity and Poetics, *Theory, Culture and Society*, 17 (5) 1-26.
- Doll, W. (1993) *A Post-Modern Perspective on Curriculum*, Teachers College Press, New York.

- Dreyfus, H. L. (2004) *Heidegger and Foucault on the Subject, Agency and Practices*, Manuscript of University of California, Berkley. URL: http://socrates.berkeley.edu/~hdreyfus/html/paper_heidandfoucault.html, last accessed 25/05/2005.
- Duhem, P. (1953) 'Physical Theory and Experiment' in *Readings in the Philosophy of Science*, (Ed., Brodbeck, M.) Appleton-Century-Crofts, New York, pp. 235-252.
- Eisenstein, S. (1943) *The Film Sense*, Faber and Faber, London.
- Eisenstein, S. (1949) *The Film Form*, Harcourt Brace, New York.
- Emmeche, C., Køppe, S. and Stjernfelt, F. (1997) Explaining Emergence: Towards an Ontology of Levels, *Journal for General Philosophy of Science*, 28 83-119.
- Eve, R., Horsfall, S. and Lee, M. (1997) *Chaos, Complexity and Sociology*, Sage Publications, London.
- Feyerabend, P. (1975) *Against Method*, Verso, London.
- Feyerabend, P. (1987) *Farewell to Reason*, Verso, London.
- Foucault, M. (2002/1970a) 'The Limits of Representation' in *The Order of Things*, Routledge, London, pp. 235-271.
- Foucault, M. (2002/1970b) *The Order of Things: An Archaeology of the Human Sciences*, Routledge, London and New York.
- Freire, O. J. (2003) A Story without an Ending: The Quantum Physics Controversy 1950-1970, *Science and Education*, 12 573-586.
- Fullan, M. (1999) *Change Forces: The Sequel*, Falmer Press, London.
- Fullan, M. (2001) *The New Meaning of Educational Change*, Teachers College Press, New York and London.
- Gell-Mann, M. (1994) *The Quark and the Jaguar: Adventures in the Simple and Complex*, Little Brown Company, London.
- Gergen, K. J. (1994) *Realities and Relationships: Soundings in Social Constructionism*, Harvard University Press, London.
- Gibboney, R. A. (1994) *The Stone Trumpet: A Story of Practical School Reform (1960-1990)*, Suny Press, Albany, New York.
- Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P. and Trow, M. (1994) *The New Production of Knowledge: The Dynamics of Science and Research on Contemporary Societies*, Sage Publications, London.

- Goldman, A. (2001) 'Social Epistemology' in *The Stanford Encyclopedia of Philosophy*, (Spring 2001 Edition) (Ed., Zalta, E. N.). URL: <http://plato.stanford.edu/archives/spr2001/entries/epistemology-social/>, last accessed 25/05/2005.
- Goldspink, C. (2000) Modelling Social Systems as Complex: Towards a Social Simulation Meta-Model, *Journal of Artificial Societies and Social Simulation*, 3 (2). URL: <http://jasss.soc.surrey.ac.uk/3/2/1.html>, last accessed 25/05/2005.
- Goldspink, C. (2002) Methodological Implications of Complex Systems Approaches to Sociality: Simulation as a Foundation for Knowledge, *Journal of Artificial Societies and Social Simulation*, 5 (1). URL: <http://jasss.soc.surrey.ac.uk/5/1/3.html>, last accessed 25/05/2005.
- Goodman, N. (1978) *Ways of Worldmaking*, Hackett Publishing Company, Indianapolis.
- Goodwin, B. (1995) *How the Leopard Changed Its Spots*, Phoenix, London.
- Gough, N. (2002) 'Blank Spots, Blind Spots, and Methodological Questions in Postgraduate Research' Paper presented at the Postgraduate Research Conference Deakin University, 4-6 October, 2002. URL: http://www.deakin.edu.au/dusa/stud_support/noelg_DUSA_2002.pdf, last accessed 25/05/2005.
- Graves, F. P. (1914) *A History of Education: During the Middle Ages and the Transition to Modern Times*, Macmillan, New York.
- Greco, J. (1998) 'Introduction: What Is Epistemology?' in *The Blackwell Guide to Epistemology*, (Ed., Sosa, E.) Blackwell Publishers, Oxford, pp. 1-32.
- Guba, E. G. and Lincoln, Y. S. (1998) 'Competing Paradigms in Qualitative Research' in *The Landscape of Qualitative Research: Theories and Issues*, (Ed., Lincoln, Y. S.) Sage Publications, London, pp. 195-220.
- Gundem, B. B. and Hopman, S. (Eds.) (1998) *Didaktik and/or Curriculum: An International Dialogue*, Peter Lang, New York.
- Gutting, G. (1989) *Michel Foucault's Archaeology of Scientific Reason*, Cambridge University Press, Cambridge, U.K.
- Harding, S. (1987) *Feminism and Methodology: Social Science Issues*, Indiana University Press, Bloomington and Indianapolis.
- Harland, R. (1987) *Superstructuralism: The Philosophy of Structuralism and Poststructuralism*, Methuen, London.

- Hetherington, S. (2001) *Good Knowledge, Bad Knowledge: On Two Dogmas of Epistemology*, Oxford University Press, Oxford.
- Holland, J. (1998) *Emergence: From Chaos to Order*, Helix Books, Massachusetts.
- Horgan, J. (1995) From Complexity to Perplexity, *Scientific American*, 272 (6) 104-109.
- Jackson, P. (Ed.) (1992) *Handbook of Research on Curriculum*, Macmillan, New York.
- Jorna, R. and van Heusden, B. (2003) Why Representation(S) Will Not Go Away: Crisis of Concept or Crisis of Theory?, *Semiotica*, 143 (1/4) 113-134.
- Kalantzis, M. and Cope, B. (1993) 'Histories of Pedagogy, Cultures of Schooling' in *The Power of Literacy: A Genre Approach to Teaching and Writing*, (Ed., Kalantzis, M.) Falmer Press, London, pp. 38-62.
- Kauffman, S. (1993) *The Origins of Order: Self-Organisation and Selection in Evolution*, Oxford University Press, New York.
- Kauffman, S. (1995) *At Home in the Universe: The Search for the Laws of Complexity*, Oxford University Press, Oxford.
- Keeves, J. P. (Ed.) (1997) *Educational Research Methodology and Measurement: An International Handbook*, (2nd Edition), Pergamon Press, New York.
- Kelly, K. (1995) *Out of Control. The New Biology of Machines, Social Systems, and the Economic World*, Addison-Wesley, New York.
- Kiel, L. D. and Elliot, E. (1997) *Chaos Theory in the Social Sciences*, University of Michigan Press, Ann Arbor.
- Kim, J. (1999) Making Sense of Emergence, *Philosophical studies*, 95 3-36.
- Klein, J. T. (1994) 'Notes toward a Social Epistemology of Transdisciplinarity' Paper presented at the First World Congress of Transdisciplinarity, Convento da Arrábida, Portugal, 2-6 November 1994.
- Klein, J. T. (1996) *Crossing Boundaries: Knowledge, Disciplinarity, and Interdisciplinarity*, University Press of Virginia, Charlottesville VA.
- Klein, J. T. (2004) 'Disciplinary Origins and Differences' Paper presented at the Fenner Conference of the Environment. Understanding the population-environment debate: Bridging disciplinary divides, Canberra, 24-25 May 2004. URL:

<http://www.science.org.au/events/fenner/klein.htm>, last accessed 25/05/2005.

- Kliebard, H. (2004) *The Struggle for the American Curriculum 1893-1958*, (3rd Edition), Routledge, London and New York.
- Kohn, A. (1999) *The Schools Our Children Deserve: Moving Beyond Traditional Classrooms and 'Tougher Standards'*, Houghton Mifflin, Boston.
- Krell, D. (2000) *The Purest of Bastards: Works of Mourning, Art, and Affirmation in the Thought of Jacques Derrida*, The Pennsylvania State University Press, University Park PA.
- Kuhn, T. (1996/1962) *The Structure of Scientific Revolutions*, (3rd Edition), University of Chicago Press, Chicago.
- Lakatos, I. (1970) *Criticism and the Growth of Knowledge*, Cambridge University Press, New York.
- Lather, P. (1991) *Getting Smart*, Routledge, New York and London.
- Lather, P. (2003) Applied Derrida: (Mis)Reading the Work of Mourning in Educational Research, *Educational Philosophy and Theory*, 35 (3) 257-270.
- Lave, J. (1991) 'Situating Learning in Communities of Practice' in *Perspectives on Socially Shared Cognition*, (Ed., Teasley, S. D.) American Psychological Association, Washington, DC, pp. 63-82.
- Lave, J. and Wenger, E. (1991) *Situated Learning: Legitimate Peripheral Participation*, Cambridge Press, New York.
- Lehrer, K. (1990) *Theory of Knowledge*, Westview, Boulder, CO.
- Levinas, E. (1981) *Otherwise Than Being, or Beyond Essence*, Trans., Lingis, A., Martinus Nijhoff, The Hague.
- Levinas, E. (1989) 'Substitution' in *The Levinas Reader*, (Ed., Hand, S.) Blackwell Publishers, Oxford, pp. 88-125.
- Lewes, G. H. (1875) *Problems of Life and Mind, Vol. 2*, Kegan Paul, Trench, Turbner, London.
- Lincoln, Y. S. and Guba, E. G. (1985) *Naturalistic Inquiry*, Sage Publications, London.
- Lissack, M. R. and Richardson, K. (2001) When Modeling Social Systems, Models [Do Not Equal] the Modeled: Reacting to Wolfram's a New Kind of Science, *Emergence*, 3 (4) 95-111.

- Lyotard, J.-F. (1984) *The Postmodern Condition: A Report on Knowledge*, Manchester University Press, Manchester.
- Maguire, S. and McKelvey, B. (1999) Complexity and Management: Moving from Fad to Firm Foundations, *Emergence*, 1 (2) 19-61.
- Mandelbrot, B. (1982) *The Fractal Geometry of Nature*, W.H. Freeman, New York.
- Marcus, S. (2000) 'Crisis as Sign: From Change of Representation to Representation of Change' Abstract submitted to the German-Italian Semiotic Colloquium on Crisis of Representation held at the University of Kassel, Germany, 18-19 February, 2000. URL: <http://www.uni-kassel.de/iag-kulturforschung/archiv2/krise.htm>, last accessed on 12 /12/2002.
- Marcus, S. (2003) Representation: Between Normality and Pathology, *Semiotica*, 143 (1/4) 17-24.
- Marcus, S. (2004) 'The Semiotics of the Infinitely Small (Molecular Computing and Quantum Computing)' in *Semiotic Systems and Communication-Action-Interaction, Situation and Change. Proceedings of the 6th National Congress of the Hellenic Semiotic Society*, (Ed., Tsoukala, K.) Hellenic Semiotic Society, Thessaloniki, 28-30 September, 2001, pp. 15-22.
- Maturana, H. R. and Varela, F. J. (1987) *The Tree of Knowledge: The Biological Roots of Human Understanding*, Shambhala, Boston.
- McKelvey, B. (1999) Complexity Theory in Organization Science: Seizing the Promise or Becoming a Fad?, *Emergence*, 1 (1) 3-32.
- Mead, G. H. (1932) *The Philosophy of the Present*, Open Court, La Salle, Illinois.
- Miller, A. (1996) *Insights of Genius; Imagery and Creativity in Science and Art*, Copernicus, New York.
- Miller, J. (2000) What's Left in the Field... A Curriculum Memoir, *Journal of Curriculum Studies*, 32 (2) 253-266.
- Moeller, H.-G. (2003) Before and after Representation, *Semiotica*, 143 (1/4) 69-77.
- Mollenhauer, K. (1983) *Vergessene Zusammenhänge*, Juventa, Weinheim (Unpublished English translation by Robert Nussbaum, available from Deborah Osberg).
- Morgan, C. L. (1923) *Emergent Evolution*, Williams and Norgate, London.

- Moser, P. K. (1992a) 'Gettier Problem' in *A Companion to Epistemology*, (Ed., Sosa, E.) Blackwell Publishers, Oxford, pp. 157-159.
- Moser, P. K. (1992b) 'Tripartite Definition of Knowledge' in *A Companion to Epistemology*, (Ed., Sosa, E.) Blackwell Publishers, Oxford, pp. 509.
- Munitz, M. K. (1981) *Contemporary Analytic Philosophy*, Collier Macmillan Publishers, London.
- Nancy, J.-L. (1991) 'Introduction' in *Who Comes after the Subject?*, (Ed., Nancy, J.-L.) Routledge, New York/London, pp. 1-8.
- Newman, L. (2000) 'Descartes' Epistemology' in *The Stanford Encyclopedia of Philosophy*, (Fall 2000 Edition) (Ed., Zalta, E. N.) URL: <http://plato.stanford.edu/archives/fall2000/entries/descartes-epistemology/>, last accessed on 25/05/2005.
- Nicolescu, B. (2001) *Manifesto of Transdisciplinarity*, State University of New York Press, New York.
- Nicolis, G. and Prigogine, I. (1989) *Exploring Complexity*, W.H. Freeman, New York.
- Noth, W. and Ljungberg, C. (2003) Introduction, *Semiotica*, 143 (1/4) 3-7.
- Oreskes, N., Shrader-Frechette, K. and Belitz, K. (1994) Verification, Validation, and Confirmation of Numerical Models in the Earth Sciences, *Science*, 263 641-646.
- Peschl, M. and Riegler, A. (1999) 'Does Representation Need Reality? Rethinking Epistemological Issues in the Light of Recent Developments and Concepts in Cognitive Science' in *Understanding Representation in the Cognitive Sciences*, (Ed., von Stein, A.) Kluwer Academic/Plenum Publishers, New York.
- Phelan, A. M. (2004) Rationalism, Complexity Science and Curriculum: A Cautionary Tale, *Complicity: An International Journal of Complexity and Education*, 1 (1) 9-17.
- Pinar, W., F and Reynolds, M. C. (1992) *Understanding Curriculum as Phenomenological and Deconstructed Text*, Teachers College Press, New York.
- Pinar, W., F, Reynolds, W., M, Slattery, P. and Taubman, P., M (1995) *Understanding Curriculum*, Peter Lang, New York.
- Polanyi, M. (1968) Life's Irreducible Structure, *Science*, 160 (3834, Jun 21) 1308-1312.

- Pomian, K. (Ed.) (1990) *La Querelle Du D'Eterminisme. Philosophie De La Science Aujourd'Hui.*, Gallimard/Le D'ebat., Paris.
- Popolo, D. (2003) French Philosophy, Complexity, and Scientific Epistemology: Moving Beyond the Modern 'Episteme', *Emergence*, 5 (1) 77-98.
- Popper, K., R (1959) *The Logic of Scientific Discovery*, (German edition published in 1934), Basic Books, New York.
- Popper, K. R. (1962) *Conjectures and Refutations*, Harper, New York.
- Popper, K. R. (1972) *Objective Knowledge*, Clarendon Press, Oxford.
- Popper, K. R. (1980) 'Replies to My Critics' in *The Philosophy of Karl Popper*, (Ed., Schlipp, P. A.) Open Court Publishers, La Salle, Illinois.
- Poundstone, W. (1985) *The Recursive Universe: Cosmic Complexity and the Limits of Scientific Knowledge*, William Morrow and Company, New York, NY.
- Prigogine, I. (1997) *The End of Certainty: Time, Chaos, and the New Laws of Nature*, The Free Press, London.
- Prigogine, I. and Nicolis, G. (1977) *Self Organisation in Non-Equilibrium Systems: From Dissipative Structures to Order through Fluctuations*, J. Wiley and Sons, New York.
- Prigogine, I. and Stengers, I. (1984) *Order out of Chaos: Man's New Dialogue with Nature*, Bantam Books, London.
- Quine, W. V. (1953) *From a Logical Point of View*, Harvard University Press, Cambridge, MA.
- Quine, W. V. O. (1960) *Word and Object*, MIT Press, Cambridge.
- Ravitch, D. (2000) *Left Back: A Century of Failed School Reforms*, Simon and Schuster, New York.
- Reid, W. A. (1997) Principle and Pragmatism in English Curriculum Making 1868-1918, *Journal of Curriculum Studies*, 29 (6) 667-682.
- Rescher, N. (2002) 'Process Philosophy' in *The Stanford Encyclopedia of Philosophy*, (Ed., Zalta, E. N.) Summer 2002 Edition. URL <http://plato.stanford.edu/archives/sum2002/entries/process-philosophy>, last accessed 25/05/2005.
- Richardson, K. (2002) Methodological Implications of Complex Systems Approaches to Sociality: Some Further Remarks, *Journal of Artificial*

- Societies and Social Simulation*, 5 (2). URL: <http://jasss.soc.surrey.ac.uk/5/2/6.html>, last accessed 25/05/2005.
- Richardson, K. (2004) The Problematisation of Existence: Towards a Philosophy of Complexity, *Nonlinear Dynamics Psychology and the Life Sciences*, 8 (1) 17-40.
- Richardson, K. (forthcoming) The Hegemony of the Physical Sciences - an Exploration in Complexity Thinking. To Appear In, *Futures*. URL: <http://kurtrichardson.com/>, last accessed 25/05/2005.
- Richardson, K. and Cilliers, P. (2001) What Is Complexity Science? A View from Different Directions, *Emergence*, 3 (1) 5-22.
- Richardson, K., Cilliers, P. and Lissack, M. R. (2001) Complexity Science: A 'Grey' Science for the Stuff in Between, *Emergence*, 3 (2) 6-19.
- Richardson, K. A., Mathieson, G. and Cilliers, P. (2000) The Theory and Practice of Complexity Science - Epistemological Implications for Military Operational Analysis, *SystemMexico*, 1 (2) 25-68.
- Rogoff, B. (1990) *Apprenticeship in Thinking: Cognitive Development in Social Context*, Oxford University Press, New York.
- Rorty, R. (1979) *Philosophy and the Mirror of Nature*, Princeton University Press, Princeton, NJ.
- Ross, K. L. (1998) 'René Descartes (1596-1650) and the Meditations on First Philosophy' in *The Proceedings of the Friesian School, Fourth Series*, URL: <http://www.friesian.com/friesian.htm>, last accessed 25/05/2005.
- Rusterholz, P. (2003) On the Crisis of Representation, *Semiotica*, 143 (1/4) 53-60.
- Ryle, G. (1945) Knowing How and Knowing That, *Proceedings of the Aristotelian Society*, 46 1-16.
- Salmon, W., C (1992) 'Epistemology of Natural Science' in *A Companion to Epistemology*, (Ed., Sosa, E.) Blackwell Publishers, Oxford, pp. 292-296.
- Serres, M. (1997) *The Troubadour of Knowledge*, (trans. S.F. Glaser with W. Paulson), University of Michigan Press, Ann Arbor, Michigan.
- Sfard, A. (1998) On Two Metaphors for Learning and the Dangers of Choosing Just One, *Educational Researcher*, 27 (2) 4-13.
- Silberman, R. (2002) The Challenge of Liberal Education, *Journal of Education*, 183 (3) 1-6.

- Slezak, P. (2000) 'The Mind-Brain Problem' in *Integrative Neuroscience*, (Ed., Gordon, E.) Harwood Academic Publishers, Amsterdam, pp. 49-63.
- Solomon, J. (Ed.) (2003) *The Passion to Learn: An Inquiry into Autodidactism*, Routledge Falmer, London.
- Stein, E. (1992) 'Evolutionary Epistemology' in *A Companion to Epistemology*, (Ed., Sosa, E.) Blackwell Publishers, Oxford, pp. 122-124.
- Stroud, B. (1992) 'Hume, David' in *A Companion to Epistemology*, (Ed., Sosa, E.) Blackwell Publishers, Oxford, pp. 182-184.
- Sumara, D. and Davis, B. (1997) 'Enlarging the Space of the Possible: Complexity, Complicity, and Action Research' in *Action Research as a Living Practice*, Peter Lang, New York, pp. 299-312.
- Tarnas, R. (1996) *The Passion of the Western Mind: Understanding the Ideas That Have Shaped Our World View*, Pimlico, London.
- Taylor, C. (1995) 'Overcoming Epistemology' in *Philosophical Arguments*, Harvard University Press, London, pp. 1-19.
- Thomas, D. (1979) *Naturalism and Social Science: A Post-Empiricist Philosophy of Social Science*, Cambridge University Press, Cambridge.
- Thrift, N. (1999) The Place of Complexity, *Theory, Culture & Society*, 16 (3) 31-69.
- Trifonas, P. P. and Peters, M. (Eds.) (2004) *Derrida, Deconstruction and Education. Ethics of Pedagogy and Research*, Blackwell Publishers, Oxford.
- Ulmer, G. L. (1985) *Applied Grammatology: Post(E)-Pedagogy from Jacques Derrida to Joseph Beuys*, Johns Hopkins University Press, Baltimore.
- Vallacher, R. R. and Nowak, A. (Eds.) (1994) *Dynamical Systems in Social Psychology*, Academic, San Diego, CA.
- Vallacher, R. R. and Nowak, A. (1997) The Emergence of Dynamical Social Psychology, *Psychological Enquiry*, 8 (2) 73-99.
- Van Uden, J., Richardson, K. and Cilliers, P. (2001) Postmodernism Revisited? Complexity Science and the Study of Organisations, *Journal of Critical Postmodern Organization Science*, 1 (3) 53-67.
- Varela, F. (1997) *Laying Down a Path in Walking: Essays on Enactive Cognition*, MIT Press, New York.

- von Glasersfeld, E. (1984) 'An Introduction to Radical Constructivism' in *The Invented Reality*, (Ed., Watzlawick, P.) Norton, New York.
- von Glasersfeld, E. (1989) 'Constructivism in Education' in *The International Encyclopedia of Education. Research and Studies.*, 1, (Ed., Postlethwaite, T. N.) Pergamon Press, Oxford, pp. 162-163.
- von Glasersfeld, E. (1995) *Radical Constructivism*, The Falmer Press, London.
- von Glasersfeld, E. (1999) 'Piaget's Legacy: Cognition as Adaptive Activity' in *Understanding Representation in the Cognitive Sciences: Does Representation Need Reality?*, (Ed., von Stein, A.) Kluwer Academic/Plenum Publishers, London.
- Waldrop, M. M. (1994) *Complexity*, Penguin, London.
- Walker, J. C. and Evers, C. W. (1997) 'Research in Education: Epistemological Issues' in *Educational Research Methodology and Measurement: An International Handbook*, (2nd Edition) (Ed., Keeves, J. P.) Pergamon Press, New York.
- Westbury, I. (2000) 'Teaching as a Reflective Practice: What Might Didactic Teach Curriculum?' in *Teaching as a Reflective Practice: The German Didactic Tradition*, (Ed., Riquarts, K.) Lawrence Erlbaum Associates, London.
- Westbury, I., Hopmann, S. and Riquarts, K. (2000) *Teaching as a Reflective Practice: The German Didactic Tradition*, Lawrence Erlbaum Associates, London.
- Whitehead, A. N. (1985) *Process and Reality: Corrected Edition*, (Eds. Griffin, D and Sherburne, D), The Free Press, New York.
- Wittgenstein, L. (1953/2001) *Philosophical Investigations*, (3rd Edition), Trans., Anscombe, G. E. M., Blackwell Publishing, Oxford.
- Wolfram, S. (1984) 'Universality and Complexity in Cellular Automata', *Physica*, D (10) 1-35.
- Wolfram, S. (2002) *A New Kind of Science*, Wolfram Media Inc.
- Ziman, J. (2003) 'Emerging out of Nature into History: The Plurality of the Sciences', *Philosophical Transactions of the Royal Society of London*, 361 (1809) 1617-1633.