Darwinian Evolutionary Ideas in Business Economics and Organization Studies

Denise Ellen Dollimore

PhD

April 2006

A thesis submitted in partial fulfilment of the requirements of the University of Hertfordshire for the degree of Doctor of Philosophy. The programme of research was carried out in the Accounting, Finance and Economics Department, Business School, University of Hertfordshire

Abstract

This thesis is a study of the use of Darwinian evolutionary ideas in business economics and organization studies. Mindful of the explosion of evolutionary rhetoric in the socio-economic domain over the last three decades and informed by the modern generalized Darwinian perspective, the research has been focused on the evaluation of the precise nature and extent of use of Darwinian ideas in three of the most influential evolutionary accounts in these disciplines. Notably, Nelson and Winter's *Evolutionary Theory of Economic Change* (1982), Hannan and Freeman's *Organizational Ecology* (1989), and Howard Aldrich's *Organizations Evolving* (1999). It is a work of comparative theory.

Also since 1980, theoretical and conceptual advances in evolutionary theory confirmed the generic nature of Darwinian theory and provided generalized terms for its articulation. Whilst some major criticisms of Darwinism are easily dismissed, significantly scholars have shown that Lamarckian acquired character inheritance must be accommodated within the meta-theoretical framework of Darwinism. This study shows that whilst the damaging rhetoric of 'Social Darwinism' continues to discourage widespread active engagement with Darwinian theory, the pervasive implicit or 'covert' adoption of Darwinian ideas by social scientists nevertheless clearly endorses its general nature, confirms a Darwinian social ontology and underlines the inevitability of Darwinism in the socio-cultural domain.

Following a detailed exposition of general Darwinism, this study presents a forensic comparative evaluation of the evolutionary theories under study, highlighting theoretical gaps and inconsistencies, and demonstrating their resolution within the Darwinian framework. Through the systematic application and dissection of these disparate theories, one of which is labelled 'Lamarckian', the analysis shows the deep extent to which they all are Darwinian. And furthermore, underlining the promise of the Darwinian system for yielding further results, the study clearly illustrates the importance of the explicit adoption of modern Darwinian concepts for helping scholars to understand the complex evolutionary processes they seek to explain.

Acknowledgements

I should like to express my sincere gratitude to Geoffrey Hodgson for his inspiring, dedicated and patient supervision of my research. I am truly privileged to have worked under the guidance of such a fine and outstanding scholar. My thanks also go to my second supervisor, Winand Dittrich, for his valuable feedback and kind support, and to Frank Currie for his constructive role in my progression examination. I am also grateful to a host of other generous scholars who offered feedback on my work and, or, responded to queries, especially, Howard Aldrich, Marion Blute, David Hull, Charles Galunic, Kevin Greene, John Gowdy, Thorbjørn Knudsen, Stephen Klepper, John Laurent, John Nightingale, Peter Richerson, Jill Shepherd, Jack Vromen and John Weeks. I am especially grateful to Ulrich Witt for inviting me to the Max Plank Institute in Jena where I had the opportunity to meet many leading experts in my field of research.

I am also very grateful to the Business School for financing my attendance at the CRIE and EAEPE conferences, and to individual members of the School who, in many different ways have supported me in my research, especially Jane Hardy, Denise Firman, Dorothea Noble, Susan Grey, and Mick Broadbent. I also wish to acknowledge the tremendously supportive environment created by the Business School's research community, with special thanks to my colleagues, Huascar Pessali, Alex Lascaux, Zhen Ye, Jonathan Irons, Fabiano Dalto, Cynthia Forson, Michael Leznik, Anthony Kasozi, Alex Salles, Ursula Murray, Moira Calveley, and Pavel Luksha.

Closer to home are many family members and friends to whom I am indebted for their untiring support and encouragement, with special thanks due to, Andrew and Dolorous O'Grady, Phyllis O'Grady, Molly Dollimore, John Barber, Angela Towler, Sheilagh Greenman, Clare Roberts, Luci Simms and Karen Monk.

Finally, for their enduring love and support, I thank my family. Especially for their cheerleading qualities I thank my charming sons, James and Christian. And, above all, and for simply everything, I thank my wonderful husband, Marcus.

Contents

Part I

Introduction

> The key factor in widening the field of application of evolutionary reasoning is the realisation (Campbell 1974) that this is a general mode of historical change, of which the evolution of biological organisms is only one example.
>
> John Ziman (2002)

1 Introduction

The Explosion of Evolutionary Rhetoric

> The evolution of theories in many different disciplines from providential through instructionist to selectionist is a provocative suggestion of the superiority of selectionism. And this recent movement in so many different fields of inquiry constitutes what may be considered a second Darwinian revolution.
>
> Gary Cziko (1995)

Introduction

There has been a positive explosion of evolutionary rhetoric in the socio-economic domain over the last three decades (Murmann et al 2003; Hodgson, 1996). The recent flourishing of evolutionary theory in business economics is widely attributed to Nelson and Winter (1982) and their seminal work *An Evolutionary Theory of Economic Change* (Coriat and Dosi, 1982; Metcalfe, 1987, 1998; Hodgson, 1996). In organization studies this accolade is shared by Howard Aldrich (1972, 1979) for pioneering the ecological perspective (McKelvey and Baum, 1999; Galunic and Weeks, 2002), and Hannan and Freeman (1989) for establishing the approach in their seminal work, *Organizational Ecology* (Murmann et al, 2003; Zald, 1994).

Through such works the evolutionary perspective is having a growing impact on the respective disciplines with theoretical and empirical research being undertaken, for example, in the fields of management and strategy (Teece et al, 1997; Kogut and Zander, 1992; Burgelman, 1991, 1994), jobs and routines (Miner, 1987, 1990, 1991, 1994), technological innovation (Ziman, 2000) and industrial economics (Metcalfe, 1994; Klepper and Simmons, 1997; Audretsch and Klepper, 1999; Amburgey and Rao, 1996; Carroll and Hannan, 2000). One of the points established in this thesis is that regardless of how they may be cast, the ideas at the heart of these new evolutionary theories are Darwinian in origin and form.

Whilst the expansion and momentum of evolutionary theorizing in these fields is frequently observed (Coriat and Dosi, 2002; Vromen, 1995; Nelson, 1993; Baum and

Singh, 1994),[1] it is argued here that the Darwinian lineage is often unrealized, unrecognized, played down or simply just ignored. This is a very important observation since, in the first instance, this subtle camouflaging effect belies the true influence of Darwinism on these disciplines. And, secondly, it thwarts the productive exploitation of what is demonstrably the most promising evolutionary theory for the socio-cultural realm (Boyd and Richerson, 1985; Hull, 1988; Hodgson, 2002b, 2005; Hodgson and Knudsen, 2006a; Wilson, 2002).

'Evolution': A very Imprecise Term

Significantly, and rather confusingly, the evident explosion of evolutionary theory across the socio-economic domain covers a very broad spectrum of evolutionary approaches. And these are variously described as Lamarckian, developmental, self-organization, 'BVRS' (blind-variation-selective-retention), selectionist, ecological, and Darwinian. The point is, as observed in evolutionary economics (Hodgson, 1996), the use of the term 'evolutionary' is often vague and imprecise, and tends to be roughly understood as 'development' (sometimes in the rather special and old-fashioned sense of the 'unfolding' of a predetermined process). Moreover, given its assorted interpretations (Hodgson, 1996, pp. 37-51), it has not served to clarify matters that the term 'evolutionary' has been used as a 'catch-all' description for the variously inspired theories of earlier prominent thinkers. For example, the 'stages' approach of Marx[2] (1867); the Darwinian natural selection perspectives of Veblen (1898, 1899) and Campbell (1965); the 'Spencerian' Lamarckian perspective of Marshall (1890) and the explicitly non-biological development approach of Schumpeter (1934).

The term 'evolutionary' is undoubtedly a very vague concept and clearly, with the evident confusion and the fragmentation of evolutionary perspectives in these disciplines, it does not bode well for the much sought-after 'unified' theory of socio-economic evolution (Pfeffer, 1993). The dilemma is classically illustrated in the theoretical and empirical irreconcilability of the 'innovation effect' and the 'selection effect,' in other words, the apparent irreconcilability of adaptation and selection (Murmann and Rivkin, 2004). And this unquestionably relates to the widespread and erroneous view amongst social scientists that Lamarckism and Darwinism are rival

[1] And evidenced in the appearance of new periodicals, for example, the Journal of Evolutionary Economics, the Journal of Social and Evolutionary Systems, and the Journal of Bioeconomics.

[2] Marx promotes a teleological 'stages' theory of evolution where he perceives history as advancing 'inevitably' through a series of stages, such as feudalism, capitalism, socialism and communism.

evolutionary theories (Mayr, 1982; Hull, 1982; Hodgson, 2001; Knudsen, 2001).[3] Although important inroads into this 'false dichotomy'[4] have been achieved, such as Nelson and Winter's (1982) recognition of a causal relationship between micro and macro level phenomena, and Aldrich's (1999) challenge to the overplaying of organizational inertia (Nelson and Winter, 1982; Hannan and Freeman, 1989) and emphasis on the inherent dynamism of organizations (in the face of the selection mechanism), these important theoretical insights have not been widely appreciated or explored. Indeed for several reasons, evolutionary theory is not progressing as well as it should or could. Rindos (1985, p. 65) below offers a fair summary of the nature of the problem;

> Most contemporary views of cultural change are derived from pre-Darwinian sources and hence are conditioned by a series of unstated assumptions that governs the analysis of cultural dynamics. Reification, typological thinking, and a belief in directed variation – remnants of a Spencerian evolutionism – are still present in most modern analyses of cultural change, even those that claim to apply modern evolutionary theory.

To be sure, the current diversity of evolutionary perspectives continues to be shaped by various combinations of deeply ingrained (and constraining) assumptions about the nature of evolutionary change (Dewey, 1997), and this diversity is augmented with the overlaying of the variously interpreted biological theories of Jean Baptiste de Lamarck (1809) and Charles Darwin (1859, 1871). Indeed close examination of this literature reveals numerous configurations of both Lamarckian (development, 'adaptationism' and 'acquired character inheritance') and Darwinian ('population thinking', variation, inheritance and selection) ideas, with most accounts comprising a mixture of the two. While 'alternative' theories like 'spontaneous order' (Hayek, 1988) and 'self-organization theory' (Kauffman, 1995; Foster, 1997; Witt, 1997, 2003) characterise the remaining diversity in evolutionary theory, these represent a very small element of a genre which is predominantly fuelled by the biological metaphor. And indeed it is this particular diversity that the present study has investigated - with illuminating results.

[3] This is discussed in Chapter 2 below and discussed at length in Chapter 6.

[4] From a modern Darwinian perspective it is a false dichotomy. Lamarckian adaptation and Darwinian selection are both accommodated in modern Darwinism. See Chapter 6 below.

The Unmentionable Darwin

Remarkably, a puzzling and important paradox emerges in the investigation of this expansive literature and it is curiously suggested in the combined citations of Cziko and Rindos above. Essentially, it appears that in spite of the apparent Darwinian pedigree of most evolutionary accounts, Darwin's name or his influence is rarely mentioned. Darwinian ideas, particularly the selection mechanism, can be shown to be variously deployed and invariably propping up theories which are associated with the names of other evolutionists. Nelson and Winter (1982) are the classic case in point. As is demonstrated here in Chapter 8, the key Darwinian principles are clearly adopted throughout Nelson and Winter's evolutionary theory of economic change, and yet they explicitly describe it as 'Lamarckian'.

The point is, regardless of the label or composition, there appears to be a 'Darwinian thread' woven into each of these evolutionary theories. This could be in the underlying philosophy, the structure of the theory, or, in the handling of variety or the selection mechanism. However, what is of crucial significance here is that this Darwinian influence is mostly implicit. Furthermore, even where it is explicit it is called by different names, played down or simply just ignored. Thus, mysteriously, within this recent explosion of evolutionary literature in organization studies and business economics there appears to be a hidden or 'covert' Darwinism.

JSTOR Journal Analysis

This assertion is born out in a JSTOR journal analysis where the upsurge of evolutionary theory was observed over the three decades from 1970 to 1990, and where references to Darwin were rare. The figures were compiled by conducting keyword searches of the titles and or abstracts of articles in sociology and economics journals. Searching for the terms 'evolution' or 'evolutionary,' the combined figures for both disciplines were, 38 in the 1970s; 66 in the 1980s; and 128 in the 1990s. If the search is extended to include book review articles, these figures rise substantially, for example, to 50 in the 1970s; 145 in the 1980s and 230 in the 1990s. However, when the same search is conducted for the terms 'evolution' or 'evolutionary' *combined* with 'Darwin', 'Darwinian' or 'Darwinism' there are only a handful of results. Specifically there were five in the 1970s; none in the 1980s and only two in the 1990s. Thus, confirmation that the terms 'evolution' and 'Darwin' are rarely found together in these disciplines.

The same paradox is also observed in relation to books produced by evolutionary economists. Citing several notable texts, Laurent (2001, p. 15) comments that many have 'evolution' or 'evolutionary' in the title, but then;

> one seeks with difficulty, however, for economics titles with the words 'Darwin' or 'Darwinism' in them, notwithstanding the common use of 'Darwinian' or similar words in everyday economic discourse[5]

Indeed it is interesting to note that whilst many scholars observe and applaud the explosion of evolutionary theory in organization studies and evolutionary economics (Dietz et al, 1990; Coriat and Dosi, 2002; Baum and Singh, 1994), very few discuss its Darwinian composition or heritage. It is to Laurent and Nightingale (2001) and a small number of evolutionary colleagues that the interested reader needs to turn for enlightenment here (Hodgson, 1996, 2001a, 2001b, 2002, 2003a, 2004a, 2004b, 2005; Knudsen, 2001, 2002, 2004; Hodgson and Knudsen, 2006a; Metcalfe, 1987, 1988; Vromen, 1995).

Certainly this 'covert Darwinism' presents a striking anomaly given Darwin's historic influence on the social sciences (Bagehot, 1872; James, 1880; Pierce, [1898] 1992; Baldwin, 1909; Ritchie, 1890, 1896) and the relevance of Darwinism (Veblen, 1898, 1899; Campbell, 1965; Dawkins, 1984; Dennett, 1995), particularly in its modern formulation (Mayr, 1982, 1988, 1991; Hull, 1988, 2001; Sober, 1984; Brandon, 1990, 1999), for the socio-economic domain (Hodgson, 2001b, 2002b, 2004a; Hodgson and Knudsen, 2006a). Indeed, it is suggested here that the reluctance on the part of organization theorists and evolutionary economists to explicitly acknowledge Darwinism basically reflects a widespread and unnecessary 'fear' of Darwinism.

Evolutionary theory continues to be developed in business economics and organization studies, and indeed Darwinism continues to be exploited in different and understated ways. This study pays close attention to the theoretical foundations of these various theories, and to their composition and their reliance, implicit or otherwise, on Darwinian principles. Drawing attention to the little known theoretical developments in Darwinian theory over the last thirty years and to its subsequent exploration and constructive application, and with particular reference to the influential works in business economics and organization science (Nelson and Winter, 1982; Hannan and Freeman, 1989; Aldrich, 1999), this thesis essentially 'uncovers' the Darwinian thread

[5] Laurent (2001, p.15) searched the 'Worldcat' database and reported just eight titles.

that runs through the literature. Thus, it ultimately demonstrates the importance and indeed the inevitability of Darwinism for socio-cultural theories of evolution, and moreover it crucially reinforces the notion of a 'generalized Darwinism'. This now fittingly brings the present Chapter to the aims of the thesis and to its programme and scope.

Aims of Thesis

The central aim of this conceptual research project is to evaluate the degree and manner of application of Darwinian evolutionary ideas in business economics and organization studies. It is essentially a work of comparative theory, drawing on, for example, biology, and philosophy of biology, anthropology, organization studies and evolutionary economics. Its purpose is fourfold; firstly, it is to examine the range of evolutionary theories in organization studies and business economics, paying special attention to the seminal accounts in both disciplines; secondly, it is to reveal and document the true extent of Darwinian usage across these disciplines examining the nature of that adoption; thirdly it is to explore the tractability of the theories under study, highlighting gaps and inconsistencies, and where appropriate, pointing to their resolution in modern Darwinian theory; and finally and most importantly, it is to stress the implications of the existence of 'covert Darwinism' in socio-economic theories of evolution, showing how it signals the inevitability of Darwinism for the social domain and thus, ultimately, the validity of the notion of a 'generalized' Darwinism.

The original contribution of this thesis is in the presentation of a systematic, incisive Darwinian dissection and comparative analysis of the leading evolutionary theories in organization studies and business economics. Whilst Darwinian ideas have notably been exploited in a variety of ways in these distinct fields, seminal works have not yet been evaluated side by side in any study nor specifically compared or contrasted to discover the nature and extent of use of Darwinian ideas, or their theoretical tractability. The present study embraces this task through examination of the key texts in evolutionary economics and organization studies, noted for the quality and influence of their evolutionary accounts. Set in the context of the explosion of evolutionary rhetoric in their respective disciplines, the 'Lamarckian' theory of Nelson and Winter, and 'Darwinian' accounts of Hannan and Freeman and Howard Aldrich are all carefully unpacked and the explicit and implicit use of Darwinian ideas is demonstrated and discussed. The analysis notably shows the very deep extent to which

the authors are all Darwinian. And furthermore, highlighting the promise of the Darwinian system for yielding further results in the socio-economic domain, the study clearly illustrates the importance of the *explicit* adoption of the modern Darwinian concepts for helping scholars understand the complex evolutionary processes they seek to explain. The following section will proceed by setting out the programme and scope of the thesis

Research Programme and Scope

Evolutionary Theory and the Philosophy of Biology

As stated above, this study is specifically focused on the nature and extent of use of Darwinian ideas in organization studies and evolutionary economics. And Darwinism here refers to the modern formulation of the theory, which is defined by the general principles of variation, inheritance and selection, and builds around a replicating and heritable entity (Hull, 1988). Accordingly, in order to assess the sense in which Darwinism has been deployed in the socio-economic domain, the foremost literature on evolutionary theory has been consulted in the philosophy of biology. Indeed the necessary understanding of the ontological foundations of the theories under discussion would be impossible without this philosophical and theoretical underpinning (Dewey, 1910, 1957).

Over the last three decades there have been important theoretical developments in evolutionary theory coupled with conceptual clarifications that have made the theory far more accessible and its general application far more apparent. Moreover, these developments, little known outside the field (Jablonka, 2000), decisively address the traditional misconceptions about Darwinism which have thwarted its productive exploitation and delayed the progress of evolutionary theory in the socio-economic sphere. For example, the erroneous view that group selection is not possible, that Darwinism discounts purposive behaviour and that Darwinism and Lamarckism are rival theories.

Mayr's (1959, 1976) articulation of Darwin's 'population thinking' perspective helps to clarify the ontological foundations of Darwinism. Mayr contrasts this with the 'typological thinking' of Darwin's own era, demonstrating how Darwin's revolutionary approach critically established that variety was *necessary* for evolution to occur. Clarification of the role of variety was complemented by important theoretical advances in selection theory. The long-running 'units of selection' debate was successfully

untangled and resolved (Lewontin, 1970; Hull, 1980, 1981; Sober, 1984) through, amongst other things, the realization that selection was a 'two-step' process (Mayr, 1978) which involved a replicating entity and an interacting entity (Hull, 1981,1988). These advances in theory have simultaneously resolved the group-selection issue and usefully encouraged the theoretical possibility of multilevel selection theory (Brandon, 1986, 1990; Sober and Wilson, 1998; Wilson, 1999; Henrich, 2004; Field, 2004).

Of particular interest for social scientists, the resolution of these theoretical problems largely came about through the deliberate conceptualization of Darwinian evolution as a general theory (Hull, 1980, 1981). And indeed conversely, evolutionary economists have subsequently clearly demonstrated its generalized nature (Hodgson, 2005; Hodgson and Knudsen, 2006). The 'replicator' and 'interactor' concepts (used to denote the genotype and phenotype in biology and the organizational routine and the organization in socio-economic theories), which have served to clarify the complex processes involved in natural selection, have now become 'generalized terms' (Brandon, 1990), with their usage now witnessed in sections of the organization studies (Baum and Singh, 1994b; Baum 2002) and evolutionary economics literature (Hodgson, 2002b; Hodgson and Knudsen, 2004a, 2006a, 2006b).

Application of Evolutionary Theory to Socio-Economic Domain

Regarding the application of these principles to phenomena beyond the sphere of biology, in other words, the notion of 'universal' or 'generalized' Darwinism (Hodgson, 2005; Hodgson, and Knudsen, 2006a), key theorists have been closely consulted. These include the zoologist, Richard Dawkins, (1983), who coined the term 'universal Darwinism', the philosopher Daniel Dennett (1995) and psychologists Gary Cziko (1995) and Henry Plotkin (1997, 1994) who unpacked and popularized the idea, others like Hull (2001) and Sober and Wilson (1998) who similarly articulated and demonstrated its credibility as a meta-theory, and finally those who have since promoted and specifically explored its feasibility in the disciplines here under study (Hodgson, 2005; Hodgson and Knudsen, 2004a, 2004b, 2004c, 2006a). The important and central notion of universal or generalized Darwinism is discussed at length in Chapter 3.

This grounding in the key literature on evolutionary theory has guided the research agenda which has involved tracing the development of evolutionary theory in the organizations studies and evolutionary economics literature (Cyert and March, 1963,

Cohen and Sproll, 1996; Baum and Singh, 1994a; Baum and McKelvey, 1999; Baum, 2002; Ziman, 2000; Laurent and Nightingale, 2001; Wheeler et al, 2002; Hodgson, 2002b, 2004a), examining the various ways that social scientists have thought about and analysed organizational change and economic growth over time, and engaging in the detailed analysis of the foremost evolutionary theories in the respective fields (Nelson and Winter, 1982, Hannan and Freeman, 1989, Aldrich, 1999).

Indeed up-to-date knowledge of evolutionary theory has essentially enabled a systematic survey of this disparate literature, directing evaluation of the evolutionary analyses through pertinent and incisive questioning. Accordingly the study has focused on how scholars have conceived of and analysed the entities, processes and events that pertain to the evolution of socio-economic phenomena (Baum and Singh, 1994b). For example, what is their unit or level of analysis? Do they focus on the individual agent or the collective entity of the organization? Or do they adopt a systems-level approach and focus on the environment or population? Moreover, what do they see as the main agent of change? Or indeed, the key processes of change? Is causality located, for example, in the learning or innovative behaviour of individuals, the adaptive behaviour of organizations or the selective forces of the macro-social environment? To be sure, the considerable theoretical advances and conceptual refinements achieved in evolutionary theory over the last three decades have provided a reliable means of assessing the coherence of these socio-economic theories of evolution, crucially bringing to light the character of the causal assumptions therein.

Thus, having established the focus and nature of the evolutionary approach under study the research then goes deeper by exploring the following type of questions; are Darwinian ideas being used in these disciplines metaphorically or by analogy? Is Darwinism being used wholly or partially, or is it perhaps merged with other evolutionary ideas such as Lamarckism? Are these social scientists using Darwinian ideas explicitly or implicitly in their theories? Are they knowingly adopting and developing a Darwinian approach or is there an ‘unwitting’ deployment of the general principles? More significantly, are some of these theorists actually applying the Darwinian principles to socio-economic phenomena? Indeed, does the empirical and theoretical research in these fields imply a Darwinian ontology?

What do Evolutionary Theories Seek to Address?

In addressing this broad range of questions the approach has thus essentially been to explore precisely what it is that evolutionary theories of organizations or firms seek to explain, and then to examine the structure of the analyses and nature of its evolutionary attributes. As indicated, such theories typically have three major foci (Baum and Singh, 1994b, p. 3), namely *entities*, (e.g., routines, jobs, organizations, ecosystems) *processes* (institutionalization, convergence, entrepreneurship, competition), and *events* (birth, death, transformation, speciation) and it is the precise handling of these interrelated phenomena, by social scientists, that has concerned this research project. For as Baum and Singh summarize, 'organizational evolution is concerned with the events in the histories of these entities that are produced by these processes'.

Accordingly, the thesis is loosely structured around the three themes of entities, processes and events. And, woven into this structure is acknowledgment of another related threesome, that is, the *three levels* of inquiry that is typically deployed across the literature (Baum and Rowley, 2002; Aldrich, 1999). In organization studies these are described as the intraorganizational level (within organizations), dealing with individuals, groups, knowledge and tasks; the organizational level (organizational), dealing with organizational processes, boundaries and strategies; and the interorganizational level (activities between organizations), dealing with relationships among aggregates of organizations (Baum and Rowley, 2002). And these apply equally well to the evolutionary economics literature.

Awareness of these levels is very important when navigating this literature, because the level of analysis impacts on how individual scholars perceive the levels above or below their chosen level and thus the operation of their evolutionary mechanisms. Inevitably this causes a certain amount of confusion when trying to unpack the analyses and attempting to compare like with like. And moreover it reveals a certain amount of confusion on the part of the theorists themselves as they attempt to reconcile units and levels in their elucidation of the selection process. Much of this confusion relates to misunderstandings around the proper articulation of the selection process, and significantly it is reminiscent of the 'units debate' that occurred in biology which has

long since been resolved (Lewontin, 1970; Hull, 1980, 1981; Sober, 1984; Brandon and Burian, 1984; Brandon, 1990, 1999).[6]

Throughout the study key issues and debates in organization studies and evolutionary economics are highlighted, such as the use of biological analogy and the issue of intentionality. Attention is drawn to the relevant developments in biology and evolutionary theory and how these influenced social scientists and advanced their evolutionary analyses, for example, the conceptualization of groups as cohesive wholes in a selection process. Correspondingly, attention is also drawn here to the perceptible and emerging commonality of approach between the two fields, as important theoretical assumptions, consistent with modern evolutionary theory are evidenced in the literature, for example, a population thinking perspective and acknowledgement of a some kind of social replicator. Finally, due attention is also paid to the current status of evolutionary theory in the socio-economic domain, highlighting contemporary issues of concern and future theoretical and empirical research questions.

In consequence this thesis is coursed with a number of interrelated themes; the questions poised by organizational theorists and evolutionary economists as they seek evolutionary explanations of social phenomena; the entities, processes and events that are the foci of these inquiries; the level at which the analysis takes place; the issues and debates that have ensued; the advances in evolutionary theorizing in the respective fields; and finally, identification of the current issues of concern and future research questions. The aim here is to pull these multidimensional themes together and map the development of Darwinian thinking in the socio-economic domain.

Summary of Chapter Contents

The remaining two Chapters of Part I focus on the concept of general Darwinism. Chapter 2 looks at the origins and chequered history of Darwinian theory in the social domain providing, through a discussion of the rhetorical impact of 'Social Darwinism', background to an evident fear of the theory and the notion here of 'covert Darwinism'. The idea of general Darwinism is explained whilst major objections to it are addressed through demonstrations of how the theory has been, and continues to be, misunderstood and misrepresented. The evident revival of Darwinian thinking in the socio-cultural realm is discussed, and significantly it is revealed that whilst this is widespread in the

[6] This issued is fully explained in Chapter 5 and highlighted in examples throughout the text. It is particularly relevant for Nelson and Winter (1982) featured in Chapter 8, and it also appears as an issue for Aldrich (1999) in Chapter 10.

organization studies and evolutionary economics literature, it is largely implicit or 'hidden.' The Chapter concludes with a discussion of the implications of covert Darwinism for socio-economic theories of evolution.

Chapter 3 discusses the need for a generalized Darwinism. The theory is unpacked and its generic nature made clear through its modern formulation. As well as assisting evaluation of current evolutionary theories in the socio-economic domain and drawing out their Darwinian characteristics, it is shown how engagement with general Darwinism, particularly the replicator-interactor distinction, assists understanding of the entities and processes that the former seek to explain, unraveling confusions and meeting theoretical shortcomings.

In preparation for a rigorous evaluation of the case studies, Part II of the thesis is devoted to the explanation of Darwinian theory. Returning to its roots in biology and Darwin's construction of the theory, Chapter 4 provides an explanation of its important ontological foundations and an introduction to its key evolutionary concepts. These include; 'population thinking', adaptation, variation, inheritance and selection. The evolutionary significance of the Darwinian 'population thinking' perspective (for the conceptualization of change in form over time) is established, as is its relevance for the socio-economic sphere.

In Chapters 5, 6 and 7, the most critical developments in evolutionary theory over the last three decades are set out. Chapter 5 focuses on the selection process, and is centred on the notorious 'unit of selection debate'. It is shown how conceptualization of selection as a 'two-step' process and deployment of the 'replicator' and 'interactor' concepts have served to both illuminate the intricacies of Darwinian natural selection and paved the way for its articulation as a general theory. Chapter 6 builds on these clarifications and looks in detail at Lamarckism, the question of the inheritance of acquired characteristics, and at the important relationship between Lamarckism and Darwinism. Significantly, it is shown how these are not mutually exclusive theories, but that Lamarckism is theoretically dependent upon Darwinism in order to work as a theory. Chapter 7 brings general Darwinism right up to date and is focused on group and multilevel selection. Again drawing on the replicator-interactor concepts, it is demonstrated how developments in selection theory have facilitated the clearer articulation of group selection and thus the conceptualization of multilevel selection. The significance of these developments for the social domain is underlined where with reference to the individual problems of the case studies it is indicated how explicit

engagement with the clarifying concepts of general Darwinism would positively advance these theories.

Part III focuses on the case studies and the examination of the explicit and implicit adoption of Darwinian ideas. Chapter 8 introduces the first, which is from the field of evolutionary economics. This is Nelson and Winter's seminal work, *An Evolutionary Theory of Economic Change* (1982). Here I show how, despite their claims to be Lamarckian, the authors actually develop a modern Darwinian theory by applying the core principles of variation, inheritance and selection to socio-economic phenomena, and significantly, by assuming the replicator-interactor distinction. I highlight the parities they draw between entities and processes in the biotic and the social sphere (establishing their Darwinian social ontology), illustrate the intractability at the heart of their theory around selection and inheritance (showing how they inadvertently develop a multilevel selection theory), and demonstrate its resolution and advance in generalized Darwinism.

Chapter 9 features the sociologists, Hannan and Freeman, whose theory, *Organizational Ecology* (1982) derives from population ecology. I show here how Hannan and Freeman, by emphasising one particular strand of evolutionary theory, namely selection, end up presenting a rather one-sided view of organizational phenomena. I illustrate how their complete shift in focus, away from the individual organization in its 'local environment,' inevitably leaves out the important causal story generating from this lower level of the hierarchy, and fuels the infamous 'adaptation versus selection' debate of organization studies. Again with reference to recent theoretical advances, in particular, 'General Selection Theory', I show that implicit in the authors' selectionist account is an undeveloped inheritance mechanism and a social replicator, thus signalling reconciliation of the adaptation versus selection polarization of theory.

Chapter 10 is devoted to the third and final case study, *Organizations Evolving* (1999), by sociologist, Howard Aldrich. I show here how this account builds on the achievements of its predecessors and benefits from Aldrich's insightful plundering of the philosophy of biology. Aldrich's work proves to be the most ambitious and exciting yet and it *is* explicitly Darwinian. However, whilst it appears the most comprehensive Darwinian account it is shown here how important ideas, like the replicator-interactor distinction and multilevel selection, nevertheless remain confused and undeveloped, so that the theory similarly has much to gain from the explicit engagement with modern generalized Darwinism.

The Conclusion in Part IV discusses the important implications of 'covert Darwinism' and makes the case for the explicit adoption of general Darwinism. Reflecting on the analyses of the case studies, with their various strands of covert Darwinism and evident theoretical confusions, the Chapter stresses the importance for evolutionary scholars to explicitly recognise the Darwinian concepts and engage with the promise of the Darwinian system. Summarizing the key findings of the study, it underlines the significance of the generalized Darwinian concepts for helping to understand the evolutionary processes these scholars seek to explain. The Chapter closes with a resume of on-going theoretical and conceptual research in this area, identifying the most important and productive areas for future research.

Thus, by drawing attention, in this interdisciplinary research project, to recent developments in biology and the philosophy of biology I illustrate the generic nature of Darwinian theory. I show how, as a result of the theoretical and conceptual clarifications achieved, socio-economic theories of evolution can be clarified, reinterpreted, and advanced. Modern Darwinism is here defined, explained, expanded and applied. It is furthermore evaluated in the context of a general resistance to its importation into the social field where common fallacies and misunderstandings have prejudiced and delayed its fruitful advance. Chapter 2 begins the exploration of this resistance by posing the provocative question, 'Who is Afraid of Darwinism?'

2 Who is Afraid of Darwinism?

> The history of science is replete of examples in which concepts, ideas, insights and modelling techniques that were first introduced in one domain, have turned out to be fruitfully applicable also in other domains. So why would we rule out that possibility for Universal Darwinism from the outset?
>
> Jack Vromen (2004)

Introduction

Why is there a near silence of Darwinism in the organization studies and evolutionary economics literatures? In view of the long-standing (Veblen, 1898, 1899; Campbell, 1965) and widespread adoption of Darwinian ideas in these fields, as well as the common use of Darwinism in everyday discourse (Laurent, 2001), the lack of explicit reference to Darwinism in these literatures obviously presents a peculiar anomaly. In order to properly address this puzzle and realize its important implications it is vital to consider the history of Darwinism in the socio-cultural domain, and to confront the hostility that emerged over the use of Darwinian ideas in the social sphere. Following a long and controversial history in sociology (Haines, 1992), for example, much of the field still remains influenced by an 'antibiological and antievolutionary outlook' (Neilson, 1994) and it has systematically ignored and rejected biological thinking for a half century (van den Berghe, 1974, 1990). Albeit perhaps to a slightly lesser degree, a similar picture has emerged in economics where 'the role of biological ways of thinking in economics has been a source of genuine puzzlement and not infrequent outbursts of irritation' (Metcalfe, 1987, p. 54) and where even evolutionary economists remain largely ignorant about Darwin's theory (Laurent, 2001).

This strong antagonism towards Darwinism and biological analogies in the social sciences is largely due to the rhetorical impact of 'Social Darwinism' (Hodgson, 2004b) whereby 'Darwinism' has been blamed for providing the ideological and pseudo-scientific motivations for such evils as eugenics, Nazism, racism and fascism. The impact of these negative and powerful beliefs on the development of evolutionary theory in these fields cannot be ignored; since they have coloured and constrained the thinking of past and present evolutionary scholars. Indeed it is upon this hostile and persuasive platform that several other major objections to Darwinism continue to be

pursued. These include enduring concerns about ‘reductionist’ methodology and biological determinism (Gould, 1981; Lewontin et al, 1984; Kitcher, 1985; Rose, 2000), the rejection of biological analogies, and the claim that Darwinism is unable to deal with human agency and intentionality (Penrose, 1952; Foster, 1997; Witt, 1997, 1999), and the widespread but mistaken view that Darwinism and Lamarckism are mutually exclusive evolutionary theories, with the latter being perceived as more relevant than the former.

It is argued here that it is the resulting general antipathy towards Darwinism (Dietz et al, 1990; van den Berghe, 1974, 1990: Degler, 1991; Sanderson and Ellis, 1992; Udry, 1995; Hodgson, 2004b) that explains an on-going deep-seated ‘fear’ of Darwinism amongst social scientists, a fear which has in turn frustrated the productive exploitation of evolutionary theory in the fields of organization studies and business economics. Moreover, it is this antipathy, and the fear it provokes, that ultimately explains both the ‘silence’ of Darwinism in the literature as well as the pervasive ‘covert’ Darwinism discussed above in Chapter 1; both of which misleadingly camouflage the true extent of Darwinian influence across these disciplines. However, significantly, it is also argued here that the prevailing fear of Darwinism is basically unwarranted, since it is essentially fuelled by the historic misappropriation (Haeckel, 1874) and misrepresentation (Parsons, 1934; Hofstadter, 1944) of Darwin’s theory, as well as by continuing fundamental misunderstandings about the nature and scope of modern Darwinian theory (Hodgson, 2002b, 2004a; Hodgson and Knudsen, 2006a).

Demonstration of these propositions will begin in this Chapter with a discussion of the ambiguous term ‘Social Darwinism.’ Here it will be shown how Darwin’s theory was misappropriated and misrepresented and how this led to antipathy and fears about Darwinism that prevented engagement with the theory and thus engendered misconceived objections towards its use in the social arena. Following these sections, where both the ideological and theoretical objections are shown to be unwarranted, there is a reflection on the origins of Darwinism in the socio-cultural domain and an historical review of its application to social phenomena. Here the general nature of the theory is highlighted and its long and productive use in this arena is shown to underline its relevance for socio-economic theories of evolution. This leads into a discussion of ‘covert Darwinism’ and exploration of the paradox observed in the enduring rejection of Darwinism and its recent revival in the socio-economic literature. The penultimate section highlights the link between the ‘fear of Darwinism’ and ‘covert Darwinism’ and considers the positive and negative implications of widespread hidden Darwinism for

the development of theory. The Chapter concludes with demonstration of the need for a generalized Darwinism in the socio-economic realm.

Social Darwinism

In spite of the considerable theoretical advances and conceptual clarity achieved in evolutionary theory over the last thirty years,[7] all of which have clearly demonstrated its applicability beyond the realms of biology, the view of Darwinism amongst social scientists has nevertheless continued to be predominantly hostile. As indicated above, the underlying cause of this hostility is largely traced to the rhetorical impact of 'Social Darwinism' and to the damaging myths that emerged about Darwin and his science (Hodgson, 2004a, 2004b). In an historical review of the meaning of the term 'Social Darwinism' in the Anglo-American academic literature Hodgson (2004b) recently demonstrated how Darwin's name became associated with all manner of political ideologies and distasteful ideas. It was used, for example, to refer to those who used Darwinian ideas to mean war or individualist competition and to describe those who used it to support capitalist competition and laissez faire economics. It was also used to describe the German biologist Ernst Haeckel who notably (McGovern, 1941; Gasman, 1971, 1998) harbored racist sentiments, as well as the American Darwinian enthusiast Joseph Le Conte (1892) and anthropologist Daniel Shute (1896), who made no secret of their racist, imperialist and sexist views. And, it was in the post war years, following publication of Hofstader's influential treatise, *Social Darwinism in American Thought* (1944), that the term was then to become forever associated with the promotion of such terrible ills as eugenics, racism, nationalism and war. 'Social Darwinism' was consequently generally seen as a 'Bad Thing' (Bannister, 1979).

However, as Hodgson (2004b) and others (Himmelfarb, 1959; Bannister, 1979) have since demonstrated, it is now patently clear that over time, at the hands of influential authors of various persuasions, Darwin's 'seductive' theory (Dennett, 1995) has been frequently and variously misappropriated (Haeckel, 1874) and misrepresented (Parsons, 1932, 1934, 1937; Hofstadter, 1944). The truth is that Darwin himself was neither racist nor jingoistic (Richerson, and Boyd, 2001; Hodgson, 2004b), and he advocated neither selfishness, competitive behaviour, imperialism nor war. Indeed, as is now well documented, he was unquestionably a progressive liberal and was notably appalled by man's inhumanity to man (Desmond and Moore, 1991; Browne, 1995). Social

[7] These will be discussed at length in Chapters 5 to 7

Darwinism incorrectly linked Darwin with ideological and scientific doctrines that he never proclaimed and Darwinism with propositions that bear no logical relation to the scientific principles of the theory.

Clearly the customary ideological reasons for the continuing rejection of Darwinism from the social sciences are ungrounded. Significantly, however, as Hodgson also makes clear, through the work of Parsons and others (Perry, 1918; Woods, 1920), the meaning of the term 'Social Darwinism' began to change so that it was used to describe scientific as well as ideological doctrines. The reviled 'Social Darwinism' also came to represent the crossing of boundaries between the biological and the social spheres, and as a result Darwinian theory itself became discredited. This subtle extension of meaning has proven to be equally damaging to the development of theory, with contemporary scholars still bitterly disputing the relevance of biological evolutionary ideas for the socio-economic domain (Ellis, 1996; van den Berghe, 1990; Metcalfe, 2004). Social Darwinism has essentially been used to banish biological ideas from the social sphere, and by discouraging theoretical discourse between biology and sociology it has 'forced an unwarranted division between conceptualizations of the natural and social' (Hodgson, 2004b).

The critical point to note is that not only has 'Social Darwinism' been shown to be a highly ambiguous and unreliable term, associated with ideologies as dissimilar as liberalist, socialist, individualist, racist and nationalist (Himmelfarb, 1959; Bannister, 1979; Hodgson, 2004b), but through it, Darwinian theory has been woefully misrepresented. However, this point does not appear to be widely appreciated, and the fear of Darwinism that was established in the 1930s and 1940s seemingly continues to permeate the collective conscience of social scientists. Critically, as a direct result of these misrepresentations, and the damaging myth that any relationship between biology and the social sciences would inevitably be unsafe, Darwinian *theory* has become fixed in the minds of social scientists as a 'Bad Thing'.

Indeed the eventual upshot of the rhetorical impact of Social Darwinism is that generations of scholars in the social sciences have failed to explore the rich pickings of a truly generalized and accessible Darwinian theory. Indeed because of the unwarranted ideological and scientific prejudice, knowledge of modern Darwinian theory actually remains very limited (Haines, 1992; Udry, 1995; Laurent, 2001), and the crucial theoretical and conceptual developments achieved over the last thirty years have not been widely disseminated in the socio-economic arena (Blute, 1976; Jablonka and Ziman, 2000). Indeed, for van den Berghe (1990) and others (Ellis, 1996; Sanderson

and Ellis, 1992), this 'biophobia' has ultimately led to the 'trained incompetence' of sociologists. Essentially, as noted by Hodgson, 'those misguided by the rhetoric of "Social Darwinism" are less well prepared to engage with these developments' (2004b), and this is nowhere more apparent than in the misconceptions and objections that continue to be raised against Darwinism.

Objections, Misconceptions and Generalized Darwinism

The most prominent objections to Darwinism in the socio-economic sphere pertain to the use of biological analogies. As indicated above, critics are sceptical about the relevance of ideas from biology for the social domain; they fear the reduction of socio-cultural phenomena to biological phenomena, they worry about genetic determinism, and they are concerned that Darwinism appears to ignore human agency and intentional behaviour. Another widespread misconception is the view that Darwinism and Lamarckism are rival evolutionary theories, so that for the majority of those who do engage with evolutionary ideas from biology it is that later that they explicitly pursue.

However, what each of these objections and misconceptions reveal are fundamental misunderstandings about the nature and scope of Darwinism, as well as a general lack of awareness of important conceptual developments in biology. Essentially, as will be demonstrated below, these objections are misconceived. Social scientists need to understand that Darwinism is not domain-specific. On the contrary it is a substrate-neutral *general* theory (Plotkin, 1994; Dennett, 1995); its core principles of variation, inheritance and selection are general principles that govern the evolution of all open complex systems which share fundamental ontological similarities (Hodgson, 2001b, 2002b, 2005; Hodgson and Knudsen, 2006a). Furthermore, Darwinism embraces a basic philosophical commitment to detailed, cumulative, causal explanations of change (Hodgson, 2002b, 2005), so that the explanatory mechanisms critically attend to cumulative cause and effect relationships. Hodgson usefully sums up the general nature of Darwinism below highlighting the important ontological similarities (2002b, p. 103);

> As long as there is a population of replicating entities that make imperfect copies of themselves, and not all of these entities have the potential to survive, then Darwinian evolution will occur.

Indeed for Darwinians the application of the general principles to the social domain is clear, because assuredly such populations do prevail in the socio-cultural sphere and it is

not difficult to perceive how they would meet the minimal conditions (Blute, 1976; Metcalfe, 1987). To illustrate, the requisite codifying or replicating entity may exist in the form of ideas (Dawkins, 1976; Hull, 1988), habits (Veblen, 1898) or organizational routines (Nelson and Winter, 1982). And, in the transmission or replication of these entities a certain amount of variation will inevitably result, through, for example, communication or copying errors. And, given this variation it is equally inevitable that not all of the entities will have the same potential to survive, or reproduce, so that selection and evolution will be the inevitable outcome (Blute, p. 730). It is thus in this fashion that the basic Darwinian ontology is established; it just remains for the social evolutionist to specify the nature of the mechanisms in their own particular domain of enquiry. This is essentially what is understood as the modern formulation of 'Darwinism' by those who promote a generalized theory of Darwinism in the socio-cultural domain. And indeed, as will be illustrated below, it is through its modern articulation that the main objections to its use are clearly shown to be ungrounded.

One of the most notable critiques of the use of biological analogies in economics was made by Edith Penrose (1952). In response to Alchian's (1950) attempt to develop an economic selection process, Penrose famously argued that Darwinian 'blind' selection did not take account of human agency and the important intentional or deliberative behaviour which characterizes, and indeed strongly influences, the social realm. However, contrary to popular belief, it has been shown that Darwinism does not deny intentionality (Mayr, 1988, 1992). Indeed, the Darwinian commitment to detailed causal explanation asserts that there is no such thing as an 'uncaused cause' (Hodgson, 2002b, 2004a), meaning that intentional behaviour would itself need to be explained by a linked causal process (for example, present circumstances, education, childhood experiences, and indeed ultimately, as Darwin suggested, the evolution of the capacity to form intentional behavior). The crucial, but subtle, technical point here is that Darwinian selection processes act on variety *regardless* of their cause (Vromen, 2004). This is not the same thing as saying that human agency and intentionality are unimportant or that they do not play a part in the causal story. Indeed a Darwinian account of the social realm accommodates both deliberative action and selection processes.

The rejection of biological analogies, however, continues to be expressed in economics, most notably by Ulrich Witt (1997, 2003, 2004) and John Foster (1997), both of whom propose a theory of self-organization as an alternative to Darwinian selection. While Witt's critique is more akin to that of Penrose and others with his views

on human intentionality and updated concerns about the lack of a close analogy to the gene in the socio-economic domain (Hodgson, 2002b), importantly Foster's critique appears to be centered on a particular understanding of Darwinism which does not correspond with the Darwinism being discussed here (Hodgson, 2001a; 2002b). Essentially Foster rejects biological analogies because, amongst other things, he believes that the selection mechanism analogy is based on 'selfish gene theory' (Dawkins, 1976) which refers to atomistic competing 'selfish genes', and is anthropomorphic (Foster, 1997, pp. 431-433). And furthermore because he perceives that natural selection is presented by evolutionary biologists as a 'time reversible process' and is thus 'ahistorical' (1997, p. 432). In the first case, Foster is simply wrong to suggest that the biological analogy being proposed in a generalized Darwinian account is based on the marginalized 'gene-centered' view of Darwinism. And in the second case, Foster is essentially mistaken in his reading of Maynard-Smith (1970)[8] and in his blanket characterization of biology and biological analogies (Hodgson, 2001a, p. 281). Indeed, it would be very difficult to find an evolutionary biologist who would support Foster's view of evolution by natural selection as a time reversible process. Essentially these and others of Foster's criticisms of Darwinian biological analogies are misconceived.

With regard to the suggestion of 'self-organization theory' as an alternative to Darwinism, it has been shown in the literature that this is an incomplete and insufficient explanation of evolutionary change, because essentially self-organization theory is unable to explain the adaptation and survival of the self-organized structures themselves (Hodgson, 2001a; 2002b; Hodgson and Knudsen, 2006a). So that while self-organization theory does indeed explain important evolutionary processes it is not enough on its own, and requires the Darwinian principle of selection to complete its explanation.

In addition to these particular misconceptions of Darwinism there is a much more fundamental ontological point about Darwinian biological analogy, the lack of awareness of which has clearly hindered progress for evolutionary scholars. This was clearly articulated in the theoretical developments and conceptual clarifications that ensued in evolutionary biology during 1970s and 1980s,[9] and has been indicated here in

[8] Knudsen (Personal Communication, 11th December 2005): 'Since naked natural selection concerns change between two time-steps*, it is ahistorical. Maynard Smith (1970) may well have supported this claim. However, the irreversibility problem concerns the cumulative effect of natural selection. It is (the long-term) evolution by natural selection which is historical and irreversible'. (*Natural selection was shown by Mayr (1978) to be a 'two-step' process. This is explained in detail below in Chapter 5)

[9] These will all be covered in detail in Chapters 5 to 7 below.

the outline of Darwinism above. The simple truth is that modern Darwinism is *not* essentially about analogy; indeed it positively shifts the theoretical approach beyond metaphor and analogy towards the more analytically tractable platform of a Darwinian social ontology (Hodgson, 2002b). This is the whole point of a generalized Darwinian theory; the acknowledgement and analysis of *Darwinian* entities and processes in the social world (Campbell, 1965; Lewontin, 1970; Hull, 1981, 1988; Dawkins, 1984; Plotkin, 1994; Dennett, 1995; Cziko, 1995; Wilson, 2002).

Equipped with this insight it would certainly be easier for evolutionary scholars in the socio-economic domain to realize that their fears of Darwinism are ungrounded. The concern about reductionist methodology is a classic case in point. With the realization that Darwinism is not domain specific, that it has moved beyond analogy and is indeed a general theory it becomes easier to see that social phenomena are emphatically *not* being analyzed in terms of biological phenomena and *nor* is biology determining the social research agenda.[10] Correspondingly, the modern literature on Darwinism makes absolutely clear that there are no allusions to eugenics, genetic-determinism or indeed any of the racist, imperialist or sexist ideologies that have misleadingly become associated with name of Darwin (Hodgson, 2004a, 2004b). Quite simply, Darwinism is about the application of general principles, an approach that implicitly assumes a Darwinian ontology and thus has no need for a reductionist methodology.

This important observation leads to another point that underlines the general nature of Darwinism and introduces the final major objection to the use of Darwinism in the socio-economic sphere, which relates to the little understood relationship between Darwinism and Lamarckism.[11] Whilst the general nature of Darwinism is evidently asserted, and its status as a meta-theory is frequently proclaimed (Hull, 1981; Dawkins, 1984; Plotkin, 1994; Dennett, 1995), it is important to stress that this does not therefore mean that it is a 'complete' theory; this is not a claim of Darwinism. In other words, 'Darwinism cannot itself give a full detailed explanation of evolutionary processes or outcomes' (Hodgson, 2004b, p. 6). However, significantly, the theory's 'incompleteness' is nevertheless indicative of its generic nature and indeed its consequential accessibility for scholars in the analysis of other evolutionary systems. The important point is that Darwinism provides an overarching conceptual framework within which domain-specific auxiliary explanations are accommodated; for example, a

[10] See, for example, multi-authored works such as Baum and Singh (1994), Ziman (2000), Wheeler et al (2002), Baum (2002),

[11] Lamarckism refers to the idea of the inheritance of acquired characteristics. It is discussed at length in Chapter 5 below.

different type of replicator[12] or a different type of inheritance mechanism. And notably this positively includes the Lamarckian inheritance mechanism favoured by most scholars in the socio-economic domain.

Hence the related and equally significant point highlighted here is that, contrary to the widespread misconception, Darwinism and Lamarckism are *not* rival or mutually exclusive theories (Dawkins, 1986; Hodgson, 2001b; Knudsen, 2001). The fact is Darwin himself (1859) did not deny the possibility of acquired character inheritance. Indeed as has been well documented, he embraced Lamarckism in his theory (Mayr, 1976, 1988) and indeed gave it increasing attention in later works. However, it is important to note here that it is the particular meta-theoretical framework of Darwinism that facilitates the accommodation of this 'alternative' inheritance mechanism. Modern Darwinism stresses that the detail about entities and their particular mechanisms will inevitably vary from one domain to another, since what happens in the social domain is clearly quite different to what happens in the biological domain. Indeed, in response to related criticisms of Darwinism (Nelson, 1995; Witt, 2004), this structural feature underlines the point that Darwinism does not mean that the analysis of social evolution will be dictated or skewed by a biological perspective or agenda.[13]

Thus although Lamarckian inheritance is no longer considered viable in evolutionary biology (Mayr, 1982)[14] significantly this does *not* deny its link with Darwinism or indeed its occurrence in the social domain. To be sure Lamarckian inheritance is accommodated within a modern generalized Darwinian account, where it is simply seen as a different type of inheritance mechanism; an inheritance mechanism for the social realm. As stressed above, Darwinism does not claim to be a complete theory; it is a generalized meta-theoretical framework that incorporates supplementary explanations appropriate to the domain of inquiry.[15] The critical theoretical point here is that, unlike

---

[12] The now 'generalized' term for the unit of replication (Brandon 1990). Defined by Hull (1988) as 'an entity that passes on its structure largely intact in successive replications'.

[13] Indeed many social scientists already acknowledge this point, for example, Baum and Singh (1994b, p. 10), 'fortunately, Darwin's idea of evolution - descent with modification - *is not* tied to particular features of biological inheritance (Boyd and Richerson, 1985; Campbell, 1965; Hannan and Freeman, 1989; Hull, 1988). Natural selection is a very general mechanism'.

[14] Note that a tiny minority in biology disagree (Steele, 1979; Steel et al, 1998). However, this does not affect the argument about the validity of Lamarckism in the social sphere. See Chapter 6 below.

[15] This point is also recognised by organization scientists, for example, Baum and Rowley (2002, p. 24); 'An evolutionary meta-theoretical framework based on Campbell's (1965) VSR model is suggested by Aldrich (1977, 1999) and McKelvey (1982) … We do not offer this evolutionary meta-framework as the correct meta-framework, but rather as one standing proposal that enables us to interpret and connect contemporary perspectives on organizations in a meaningful way. [The VSR model] offers an appealing way to categorize multiple organizational perspectives based on their contributions to the evolutionary view of organizational persistence and change, as well as an explicit basis for examining the overlaps and relationships among them'.

Darwinism, and in common with self-organization theory, Lamarckism cannot stand alone as a theory (Hodgson, 2001b, 2004a; Knudsen, 2001) it basically needs the selection process and conceptual framework of Darwinism in order to work.[16] Accordingly, whilst Lamarckism 'nests' as an explanatory mechanism within the meta-theoretical framework of Darwinism (Knudsen 2001), significantly, the reverse situation is not true; this is not a symmetrical relationship.

With regard to the wider relevance of this for the social domain, it has been demonstrated unequivocally that social evolution is both Lamarckian and Darwinian (Boyd and Richerson, 1985; Metcalfe, 1998; Hodgson, 2001b; Knudsen, 2001). Indeed paradoxically, even the polarization of the socio-economic literature into 'Lamarckian' or 'Darwinian' accounts (Murmann and Rivkin, 2004) testifies to this observation, with some scholars clearly perceiving a Lamarckian evolutionary story in the social realm whilst their colleagues evidently identify the same entities and processes with Darwinism. Consequently the theoretical accommodation of Lamarckism is a very important aspect of Darwinism that should not be overlooked by social scientists; indeed it is poised to considerably enhance their analytical approach, where both deliberation and selection need to be explained for a complete causal story.

In summary, all the major ideological and theoretical objections to Darwinism have been shown to be groundless. And significantly it is also acknowledged that in the socio-economic literature these criticisms tend to be based on a very crude Darwinism and limited understanding of the theory (Metcalfe, 2004; Blute, 1976; Haines, 1992; Freese, 2001). As suggested at the outset hostility and fear of Darwinism has prevented thorough acquaintance with the theory so that the remarkable theoretical advances achieved in evolutionary biology which have clarified the theory, illustrated its generic nature and admirably addressed the objections, have seemingly all been lost on its critics. And indeed hostility and misunderstandings evidently continue to prevail.

Hence a curious irony emerges at this stage and it concerns the evident revival of Darwinian evolution in the literature as well as the notion of 'covert Darwinism'. Essentially, in spite of the overt hostility towards Darwinism, the theory is nonetheless being extensively deployed in evolutionary accounts currently being developed in the socio-economic literature. It must be noted that the extent of this revival is not

[16] There are important gaps in the Lamarckism explanation (see Hodgson, 2004a p.52-57), for example it fails to explain why only advantageous adaptations are inherited and not disadvantageous ones. And, at a more fundamental level, it also fails to explain *why* organisms try to adapt to their environments, in other words how is intentionality explained? It is suggested (Hodgson, 2004a, Dawkins, 1983, 1986; Cronin, 1991; Plotkin, 1994) that such gaps need to be filled by a Darwinian or other explanation.

immediately apparent, however, since for the most part the widespread use of Darwinian ideas is *implicit*. And this is where the 'covert Darwinism' comes in. What becomes apparent on close reading of the literature is widespread 'incipient' Darwinism, in other words even if the term is not being used 'Darwinism' nevertheless bubbles to the surface. Thus the revival consists of a small number of evolutionary theories that *explicitly* adopt Darwinism, supported by a much greater number of theories where that adoption is largely implicit.

The Revival of Darwinian Thinking

Clearly, against the aforementioned hostile backdrop the paradox to emphasize here is the recent veritable explosion of implicit Darwinian thinking in some parts of the organization studies and evolutionary economics literature. As highlighted above, it appears that in spite of decades of negative portrayals, Darwinism is undeniably experiencing a revival. There are strong signs that Darwinism is remerging as a model for the socio-economic domain,[17] with its implicit adoption increasingly acknowledged (Galunic and Weeks, 2002) and its explicit adoption increasingly apparent (Ziman, 2000; Wheeler et al, 2002). In fact, growing numbers of conferences are being held in business economics and organization science with Darwinism as the central or underlying theme (Hodgson, 2002c; Murmann and Rivkin, 2004; Witt, 2004),[18] and many of these have resulted in multi-authored volumes on the subject (Ziman, 2000; Wheeler et al, 2002). Indeed the expanding literature (Baum and Singh, 1994; Laurent and Nightingale, 2001) on the topic bears testimony to the growing impact of Darwinism on the socio-economic field, with some scholars acknowledging Darwinism as an 'indispensable tool of thought' (Ziman, 2002), and others proclaiming its status as a general theory (Hodgson, 2005; Hodgson and Knudsen, 2006a). Clearly it would appear that not all in academia are afraid of Darwinism.

Fundamentally what these developments indicate is growing recognition of the explanatory power of Darwinian theory, and ultimately, the inevitability of its widespread adoption by evolutionary scholars in the socio-economic domain;

[17] Having initially been introduced to economics by Veblen (1898), and to organization studies by Campbell (1965).

[18] Hodgson (2002c) University of Hertfordshire 'How do Institutions Evolve?'; Murmann and Rivkin (2004) New Orleans 'Adaptation vs. Selection in Industry Change: Toward a Contingency View'; Witt Max Planck Institute (2004) 'Evolutionary Concepts in Economics and Biology'; Plus the annual conferences of the European Association of Evolutionary and Political Economy.

unquestionably very important outcomes. Significantly, however, on another level what these developments also reveal is that there is still a long way to go in terms of breaking down prejudice and intellectual barriers. The silence of Darwinism tells its own story about the continuing reluctance of scholars to be associated with the name of Darwin, and, moreover, the pervasive covert Darwinism similarly signals deep-seated fears about Darwinian theory.

Before expanding on covert Darwinism and in order to put it in its proper context it is important here to reflect on the background to the current revival and take account of the full history of Darwinism in the socio-cultural domain. Indeed, it is important for critics to realize that Darwinism has been around for a very long time in the social realm, and moreover that there has been a long and positive history of the application of Darwinism to socio-cultural phenomena. To be sure Darwinism's general nature was recognized from the earliest days of the theory. Accordingly, the next section will outline this history and critically illustrate its various applications as a general theory. It will thus draw attention to the origins of the 'Darwinian thread', which so evidently runs through increasing numbers of contemporary socio-economic accounts, and critically thereby presents the little known parentage of the important notion of a 'generalized Darwinism'. This will then lead into a discussion of the current position of Darwinism in the organization studies and evolutionary economics literature, where incipient or covert Darwinism will be highlighted in the various configurations of evolutionary theory.

What are the Origins of Darwinism in the Social-cultural Domain?

The use of Darwinian evolutionary ideas in the social sciences was already being proposed as long ago as the end of the 19th Century. This is evidenced, for example, in the work of Walter Bagehot (1872), William James (1880), Charles Sanders Pierce [1898] (1992), James Mark Baldwin (1896) and David Ritchie (1890, 1896); all of whom explored the broader application of the theory of natural selection to areas such as customs, morality and epistemology. Indeed notably, such explorations were prompted by Darwin himself in *Origins* (1859), where he alluded to the extension of the principles of variation, inheritance and selection to human behaviour and social phenomena, and in *Descent* (1871), where he elaborated on the evolution of language, morality and social groups (Laurent 2001). To be sure these promptings were soon picked up by other social thinkers and there followed a number of serious attempts to

extend Darwinism to socio-economic evolution (Hodgson 2004a). Significantly, what each of these early contributors had in common was an unfettered appreciation of the *general* nature of Darwin's theory and, consequently, an ability to effectively conceptualize Darwinian entities and processes in these disparate fields.

This ability was shared by Thorstein Veblen (1898, 1899), who is credited with introducing Darwinism to the field of economics (Hodgson, 2004a; Witt, 2003; Vromen, 1995), and Donald T Campbell (1965), an inspirational figure for scores of evolutionists in sociology and widely acknowledged for his pervasive influence on socio-cultural theories of evolution (Baum, McKelvey 1999; Ziman, 2000; Baum, 2002). Veblen was struck by what he saw as Darwin's detailed processual explanation of the origin of species, which he understood as a cumulative causal sequence (1898). This 'continuity of cause and effect' (1907) summarized the causal sequence he saw in Darwin's variation inheritance and selection dynamic. Here was a theory that could explain the evolution of socio-economic systems (institutions, customs, habits) in terms of cumulative cause and effect relationships, a process Veblen (1898) promptly labeled 'cumulative causation' and which later came to characterize his approach (Hodgson 2004a).

Significantly, in terms of the development and generalization of Darwin's theory, Veblen proposed the actual application of Darwin's core principles to entities and processes in the socio-economic realm. In other words he acknowledged a Darwinian social ontology. Most importantly Veblen recognized and highlighted the crucial roles of variation, inheritance and selection (Hodgson, 2004a). In true Darwinian form, he emphasized that there must be *sustained* variation in the population and moreover that variation is *preexisting* in the system. He perceived inheritance, or continuity, in the relatively stable and enduring 'units' of institutions and habits (including habits of thought) and these were featured in his perspective as the key objects of selection.

Indeed textual analysis testifies to Veblen's clear understanding of Darwinian causality which, contrary to the aforementioned widespread misconceptions, included explanation of intentionality; a causal explanation that reconciled purposive behaviour with material cause.[19] However, whilst Veblen's Darwinian insight and credentials are unquestionable,[20] unfortunately he failed to present a synthetic overview of his ideas or indeed a clear outline of the principles of his evolutionary economics. Thus, it has been suggested that having introduced Darwinism to economics, offering valuable inspiration

[19] The issue of intentionality in evolutionary theory is discussed at length in Chapter 6.

[20] See Hodgson (2004a), Chapter 7, for an in-depth survey of 'the Darwinian Mind of Thorstein Veblen'.

to evolutionary economists, this is one of the reasons why Veblen's influence was not as widespread and enduring as it might otherwise have been (Witt, 2003; Hodgson, 2004a).

Some time later however, Campbell (1965) picked up the torch in organization studies and went a critical step further by setting out a more formulaic Darwinian evolutionary framework for the social sciences. Hailed as 'the father of evolutionary epistemology' (Hull, 2001, p. 33), Campbell, in his promotion of the generic quality of Darwinism, instructively suggested that we think of organic evolution as being 'but one instance' of a general theory of evolution. Campbell (1965) is author of the 'blind-variation-and-selective-retention' epistemology, otherwise known as the 'BVSR' theory of socio-cultural evolution. Matching Veblen for his incisive grasp of Darwinian theory, Campbell included the adjective 'blind' because he sought to stress the *undirected* nature of the selection process. For, as Campbell points out, 'rather than foresighted variation, hind-sighted selection is the secret of rational innovation' (1977, p. 506).[21]

Without doubt, what these insightful scholars usefully demonstrated was the *generic* nature of Darwin's theory. Indeed, they were absolutely clear about the manner of use of Darwinian ideas in the socio-economic realm. Significantly, there is no suggestion of biological reductionism here (Anderson, 1999; Hodgson, 2004a), but instead only the direct application of the Darwinian principles. And, to be sure, this says as much about the theory, in terms of its general nature, as it does about the achievements of these early Darwinian thinkers.

Undeniably both Veblen and Campbell have had a marked impact on evolutionary theorizing in their respective fields (Hodgson, 2004a; Baum and McKelvey, 1999) although it is fair to say that Campbell's influence has been far more enduring across these and other disciplines. However, as suggested above, in spite of this Darwinian ancestry, and except for a few notable and recent exceptions (Hodgson, 2001b, 2002b, 2003b, 2004a, 2005, 2006b; Knudsen, 2001, 2004; Hodgson and Knudsen, 2004a, 2006a, 2006b), neither organization studies nor evolutionary economics have explicitly pursued, fully fleshed-out or updated the Darwinian perspective. Indeed, 'the significance of Darwinism for the social sciences has been largely unrecognised since Veblen' (Hodgson, 2004a, p. 9).

[21] For some evolutionists, however, the notion of 'blind variation' invites confusion about the theory (Hull, 2001), whilst for others it has actively discouraged consideration of the adoption of Darwinism in the mistaken belief that it discounts the intentional behaviour of the social world. Veblen likewise invited the same confusion in his own expressions of the Darwinian schema (Hodgson, 2004a, p. 151).

The New Age of Darwinism

Since the 1970s, however, after this notable lull, at the fringes of certain research groups there has been an important but hitherto minimally acknowledged resurgence of interest in Darwinism in the social sciences (Popper, 1972; Campbell, 1974; Cziko, 1995). Explicitly Darwinian in form, this significant stream of thinking is just beginning to be noticed, and its development has prompted the suggestion of a 'Second Darwinian Revolution' (Cziko, 1995). Demonstrative of its universal character, Darwinism, like the proverbial 'universal acid' (Dennett, 1995), has been adopted and reinforced by scholars across a wide range of disciplines. For example, following William James (1880), Popper (1972), Toulmin (1972) and Campbell (1974) each formulated their own evolutionary epistemologies. Along similar lines and focusing on the evolution of science, Hull (1988) later offered an updated elucidation of how selection forces impact on conceptual changes in science. Edelman (1987) used Darwinism in his exploration of the development of neural connections in the brain, whilst Plotkin (1994) and Hull et al (2001) applied it to immune systems. More recently Aunger (2002) discussed the Darwinian evolution of computer viruses; Hodgson and Knudsen (2004a) explored the evolution of firms; and Wilson (2002) offered a lucid and credible account of the evolution of religions. Indeed, significantly, as was outlined earlier, this revival of Darwinism has also been witnessed in the organization studies and evolutionary economics literature.

What is remarkable about the work of all of these Darwinian thinkers is the *explicit application* of Darwinian principles; similar entities and causal processes have been identified in their respective socio-cultural realms. The critical common factor is that evolutionary theory's roots in biology did not thwart this group of theorists; essentially they are able to see past this fundamental association, and recognize that there are general principles in Darwinism covering all complex evolutionary systems. Clearly the application of Darwinism has evidently proven, for some, to be a very useful analytical device. And, significantly, this development of theory, in terms of its subtle progress 'from analogy to ontology' (Hodgson 2002b), will have been facilitated and enhanced by the major theoretical developments and conceptual refinements that have occurred in evolutionary theory over the last three decades.

Assuredly, as Aunger (2001, p.1) recently observed, through such developments, which have subsequently been complemented and reinforced by the emergence of new fields such as evolutionary ecology (Krebs and Davies, 1997), evolutionary economics

(Nelson and Winter, 1982), evolutionary psychology (Barkow et al, 1992) and evolutionary linguistics (Pinker, 1994), Darwin's legacy continues to grow, so that the new millennium might justifiably be called 'The Age of Universal Darwinism' (Dennett, 1995, Cziko, 1995).[22]

Evidently Darwinism has been around for a very long time and as Aunger and others suggest, it is certainly not about to go away. The most significant aspect of this however, is that what has been observed in the historical review and all the way through to contemporary contributions, is the clear and sustained use of Darwinism as a *general* theory. Indeed, in response to the critics, it is apparent in both the elucidation of the theory (particularly in its modern articulation)[23] and illustration of its application, that Darwinism is a truly general theory. It is therefore quite legitimate and appropriate to refer to this as 'generalized Darwinism' (Hodgson and Knudsen, 2006a) since this clarifies and admirably sums up the nature of Darwin's theory.

More recently, as indicated by Dennett and others cited above, this general nature was captured in the notion of 'universal Darwinism', a term coined by Richard Dawkins (1983), who famously, and controversially (Dawkins, 1976), drew attention to the general application of Darwin's theory, and who undoubtedly influenced the recent revival of Darwinism in the socio-cultural domain. However, whilst Dawkins has certainly made an invaluable contribution to the theoretical and conceptual advances achieved in modern evolutionary biology, it is very important to note here that his views on genetic determinism are *not* embraced in 'generalized Darwinism.'[24] Indeed, as became obvious in the preceding sections, the idea encapsulated in the notions of 'universal' or 'generalized' Darwinism is, in fact, a very old idea; Dawkins was clearly not its originator, and earlier proponents have clearly not taken the 'gene-view'. Consider, for example, the contributions of Veblen and Campbell; the gene-view is simply not necessary. In truth *because* of the recurring association of the term 'universal Darwinism' with Dawkins and thus, genetic determinism, in an attempt to avoid confusion here I avoid using the term and instead follow Hodgson and Knudsen (2006a) and use the term 'generalized Darwinism', which is, in any case, the more accurate of the two terms, and certainly better expresses the 'New Age of Darwinism'.

[22] Indeed the generic promise of Darwinism has being acknowledged, implicitly and explicitly, by a growing number of academics in every conceivable domain of inquiry (Aunger, 2000).
[23] This has not been elaborated here but will be set out in detail in Chapters 5-7.
[24] Furthermore *nor* are they embraced by the vast majority of other scholars who use the term 'universal Darwinism'. As Hull explains (Personal Communication, 6th June 2004) 'you can be a universal Darwinian without being a genetic determinist'

However, as remarked earlier, the revival of Darwinism that marks this new age has a most peculiar manifestation, for whilst it is extensive it is also largely *hidden*; with 'explicit Darwinism' (Hull, 1988; Baum and Singh, 1994; Hodgson, 2001b, 2002b, 2003b, 2004; Knudsen, 2001, 2004; Hodgson and Knudsen, 2004a, 2006a, 2006b; and others) representing just the tip of the iceberg. The next section explores this widespread covert Darwinism and thus returns the analysis to the subtle and understated issue of the on-going fear of Darwinism.

Covert Darwinism and the Darwinian Thread

Significantly, the revival of Darwinism celebrated above essentially refers to the *explicit* adoption of Darwinism and its subsequent impact. But, as previously suggested, within the explosion of evolutionary approaches that have occurred in the socio-economic literature the pervasive adoption of Darwinism is predominantly *implicit*. A comprehensive cross-disciplinary survey of the literature reveals that very few scholars explicitly exploit or promote the Darwinian model. Correspondingly, as the JSTOR analysis indicates,[25] evolutionary theories are variously described as Lamarckian, developmental, self-organization, 'BVRS', selectionist, ecological and, only *rarely*, as Darwinian. The critical point is that regardless of the labels most of these theories implicitly adopt key Darwinian ideas; there is a Darwinian thread running through most contemporary accounts. Indeed, in various guises the Darwinian thread clearly runs through the disparate case-studies of the present work; these are the notable and influential works of Nelson and Winter (1982), Hannan and Freeman (1989) and Howard Aldrich (1999).

Hannan and Freeman, for example, are explicitly Darwinian in their adoption of Darwin's selection process, but they only implicitly adopt the Darwinian principle of variety , and they describe their theory as 'population ecology'. Nelson and Winter, on the other hand, implicitly adopt the three core Darwinian principles of variation, inheritance and selection, but label their theory Lamarckian. Whilst Aldrich, perhaps the most explicitly Darwinian in orientation, adopts the Darwinian principles of variation and selection, but is remiss in explicitly identifying with Darwinism in a theory described by the author simply as an 'evolutionary' approach. For these and other reasons detailed in later Chapters, these accounts are thus here characterized respectively as, 'partial', 'hidden' and 'underdeveloped' Darwinian accounts.

[25] See Chapter 1 above

The critical issue here is what this 'covert Darwinism' says, firstly, about the way in which scholars are thinking about evolution, and secondly, about the status of Darwinian theory. It is proposed here that whilst pervasive implicit Darwinism camouflages and belies the extent of Darwinian influence in these disciplines, and indeed hampers development of evolutionary theory in the socio-economic domain, its occurrence nevertheless critically reflects an 'explosion' of Darwinian *thinking* amongst evolutionary scholars (whether they recognize this or not) and in consequence indicates the inevitability of Darwinism for the social realm.

Indeed as will become more apparent in the next and subsequent Chapters implicit Darwinism says a great deal about the way in which scholars are thinking about evolutionary theory in general and about Darwinism in particular. Thus it would be useful at this juncture to consider precisely what is meant here by 'implicit Darwinism.' It is important to note that a distinction emerges in the literature between the 'unknowing' implicit adoption of Darwinian ideas and 'knowing' implicit adoption. And considerations of these differences are important for what they reveal about how scholars conceptualize the Darwinian evolutionary processes. Moreover, careful examination of the character of the 'Darwinian thread', in other words, the various configurations which comprise Darwinian and other evolutionary ideas, similarly instructively sheds light on the status of Darwinism amongst social scientists.

Examples of apparent 'unknowing implicit' adoption include those accounts where theorists appear to 'intuitively' arrive at a Darwinian principle or underlying assumption without any obvious reference to its biological analogy. Clearly such occurrences would strongly indicate the relevance of Darwinism for these fields as well as confirm its general nature. There is evidence of this unknowing adoption of Darwinism in each of the case studies featured here and it is present throughout much of literature. A prominent example of unwitting or unknowing adoption is the widespread assumption of Darwin's 'population thinking' perspective[26] with its revolutionary conceptualization of variety and evolutionary change.

In organization studies, for example, scholars became receptive to the population thinking approach through their disciplines' important transition, over twenty years ago,

[26] 'Population thinking' contrasts with the 'typological essentialism' that dominated the thinking of Darwin's own era, and which was committed to the notion of fixed and ideal types, and thus prevented the conceptualization of evolutionary change (Mayr 1959). This will be explained in detail in Chapters 3 and 4.

to the 'open systems' perspective (Baum and Rowley, 2002).[27] Whilst in economics, where the concept was notably introduced by Metcalfe (1987), its unwitting development is traced by him back through the various efforts of economists to understand the role of variety in economic selection processes. Indeed, underlining the logic of the population thinking perspective and its inevitability for socio-economic theories of evolution is a very interesting and undocumented irony. This relates to Penrose's (1952) infamous critique of the use of biological analogies and to her subsequent development of an implicit population thinking perspective in the *Theory of the Growth of the Firm* (1959). Essentially in the later work where Penrose is dealing with the growth of the firm she inevitably has to abandon equilibrium assumptions, and in her detailed analysis and elucidation of variety (its sources, distribution and impact on the growth of the firm) it is clear from the text that without realizing it she then comes to a population thinking conceptualization.

Significantly however, the majority of cases indicate a 'knowing' implicit adoption, where the handling of concepts are clearly Darwinian in orientation but there is the distinct lack of reference to Darwin. Since knowing adoption appears to make up the majority of cases their sheer volume tells an important story regarding the status of Darwinian theory amongst these scholars. Firstly, their mere existence wholly endorses the relevance of Darwinism for the socio-economic domain and demonstrates that more and more scholars are adopting a Darwinian perspective. And secondly and importantly, in spite of this, they also suggest an on-going 'fear' of association with Darwinism.

It is telling, for example, that Nelson and Winter's classic work, which is so transparently Darwinian, is very consciously labeled Lamarckian, and that even 'Darwinian' theorists like Aldrich (1999) avoid calling their theories Darwinian, or appear to carefully cull Darwinian references from the text, while others who explicitly praise the model (Ziman, 2000; Wheeler et al, 2002) thereafter prefer to refer to it simply as 'evolution' or 'ecology'. The Darwinian thread nevertheless remains.

[27] Organizations are now defined as 'open-systems' perceived as 'adaptive and interdependent systems, comprised of various interrelated – possibly conflicting subsystems – attempting to meet and influence the dynamic demands of the environment' (Baum and Rowley, p. 6). Open systems approaches have notably advanced the analysis by shifting attention away from the internal activities of the organization, with its focus on individuals, towards 'the behaviour *of* organizations as entities in and of themselves' (Baum and Rowley, p. 3). In other words there is a focus on organizational processes, boundaries and strategies.

Covert Darwinism and its Implications

Fear of Darwinism has effectively disguised the extent of the Darwinian revival in organization studies and evolutionary economics. Thus covert Darwinism represents an important paradox. Whilst it inadvertently discourages and effectively thwarts the positive exploitation of Darwinism in these fields it also simultaneously celebrates its explanatory potential. Covert Darwinism, whether 'knowing' or 'unknowing', *endorses* the relevance of Darwinism for these fields, significantly underlining the inevitability and the generalizability of Darwinism. Indeed, as will be discussed in more detail in the next Chapter, close examination of the literature reveals the important changing ontological assumptions and the convergence of thinking that have been quietly taking place behind the mask of covert Darwinism.

Covert Darwinism certainly gives out mixed and confused messages about the relevance of Darwinism for the social arena, and its 'practice' seemingly serves to fragment rather than unite theory development. Given the fear of Darwinism and its negative consequences, it is suggested here that one of the most important messages to emerge from the exploration of covert Darwinism is that *labels* still matter. For this reason as much as any other there is clearly a need for a 'generalized Darwinism'.

Fear of Darwinism and its Implications

It is the contention here that fear of Darwinism, or perhaps more specifically, fear of association with 'Social Darwinism' (and all that this has come to represent) remains the main obstacle to its productive exploitation in the socio-economic sphere. This is because it ultimately prevents active engagement with the theory and its development and thus generates continued misunderstandings about the nature and scope of Darwinism. This is clearly demonstrated in the fragmentation of evolutionary accounts discussed in Chapter 1 (Pfeffer, 1993; Murmann and Rivkin, 2002), in the nature of the theoretical and methodological problems experienced, and in the evident gaps in theory (Hodgson, 2001b, 2002b; Hodgson and Knudsen, 2006a; Knudsen, 2001; Metcalfe, 2004). All of which will be illustrated here in the evaluation of the case studies in Chapters 8, 9 and 10.

The theoretical and methodological reasons for rejecting Darwinism in the social arena are exacerbated by the veil of ignorance that fear of Darwinism generates, and covert Darwinism sustains. And this is typified in the somewhat primitive attitude

assumed by critics towards the use of metaphor and analogy and what this suggests about their view of the development of scientific theory (Blute, 1976, 1979; Hodgson, 2002b, 2004a]. For example, in their rejection of the use of biological analogy critics appear to overlook a critical and legitimate part of the scientific process and theory development. The fact is that most scientific theories start out as analogy; indeed metaphor and analogy are foundational conceptual tools for scientists in their hypothesis-building and speculative reasoning. As Vromen (2004) reflects in the opening citation of this Chapter, the cross-fertilization of ideas, insights and modelling techniques from one domain to another, is a well-practiced and perfectly legitimate theoretical device; it is simply illogical to rule out the possibility of Darwinism for the social domain.

The evident resistance to cross disciplinary dialogue, fittingly described as a 'Berlin Wall' between biology and the social sciences (Hodgson, 2004a), is, of course, very counterproductive. There is a considerable waste of intellectual resources through 'reinventing the wheel' type activities, as numerous theorists independently grapple with the same problems, a fact which is very apparent when traversing the socio-economic literature. Moreover, the marked lack of investigation of modern Darwinian theory (Blute, 1976, 1979; Jablonka and Ziman, 2000; Hodgson, 2004a) keeps the disciplines stuck in outmoded attitudes and theoretical structures, still raising the same objections that have long since been dismissed.

In summary, fear of Darwinism fuels embedded prejudices and outmoded historical assumptions and promotes misunderstandings of the nature and scope of Darwinism, all of which seriously frustrate theory development. And this is dramatically illustrated in the stark and unnecessary polarization of theory, evident across the disciplines; between the Lamarckian inspired 'adaptationism' and Darwinian inspired 'selectionist' approaches (Murmann and Rivkin, 2004; Baum and Singh, 1994). Referred to as the 'adaptation versus selection debate' this polarization unhelpfully perpetuates the falsehood that that Lamarckism and Darwinism are mutually exclusive. And, clearly, this does not bode well for the much sought-after unified evolutionary theory for the socio-cultural realm.

The Need for a Generalized Darwinism

Evidently within the well-documented explosion of evolutionary rhetoric in the socio-economic domain there has also been a parallel explosion of *Darwinian evolutionary*

thinking. However, in spite of the palpable potential, there is little indication of the emergence of a unified theory of evolution. It is argued here that what this signals is the need for a generalized Darwinism; for both theoretical as well as ideological reasons.

The rhetorical impact of 'Social Darwinism' has clearly been profound, and yet ironically the much pilloried and rejected Darwinism is the only theory that comprises the necessary principles and explanatory framework to explain the evolution of complex systems (Hodgson and Knudsen, 2006a). It is thus critically important to clarify for social scientists precisely what is meant by the use of 'Darwinism' in the social domain. Accordingly, the need for a 'generalized Darwinism' relates to the issue of rhetoric; specifically, the use of the *term* generalized Darwinism is encouraged in order to avoid those misunderstandings which have become associated with the notion of 'universal Darwinism'. Although for most Darwinians 'generalized' and 'universal' mean the same thing, and are thus used interchangeably in the literature, it is important to recognize that the phrase, 'universal Darwinism', conjures up negative associations for a significant number of social scientists, primarily because of its links with Richard Dawkins (1976) and genetic determinism. And, as has been noted above, social scientists remain very sensitive to labels and their associations. On another point regarding clarity, the term 'generalized Darwinism' also subtly acknowledges the important theoretical and conceptual advances that have essentially articulated its general nature, and indeed facilitated the greater accessibility of Darwinian theory. Thus generalized Darwinism is clearly preferable to that of universal Darwinism since, apart from being less provocative, it more accurately describes an approach centered on general principles and general application.

Putting the issue of labels to one side, there are other more fundamental reasons why we need a generalized Darwinism, and these relate to theory itself. In 1979 the sociologist John Langton (1979) lamented the theoretical impoverishment of the social sciences and he and others (van den Berghe, 1975; Ellis, 1977) anticipated that this would be addressed by a generalized Darwinism. Twenty years later this had not yet happened and Pfeffer (1993) complained about the multi-paradigmatization of organization studies and the lack of a unified theory, while Lopreato and Crippen (1999), who also called for a Darwinian analysis, declared a state of crisis in Sociology[28] observing that in over a hundred years it had not come up with a single well-established law or principle (Udry, 2000). Today the fragmentation of theory

[28] Ellis (1996) makes the same point in a paper entitled 'A Discipline in Peril: Sociology's Future Hinges on Curing its Biophobia'

continues to provoke calls for the unification of evolutionary theory (Murmann and Rivkin, 2002) and, significantly this is now being actively sought in Darwinism.

The need for a generalized Darwinism is currently being variously expressed by many Darwinian thinkers (Hodgson and Knudsen, 2006a; Jablonka and Ziman, 2000; Blute, 1976, 1979; Haines, 1992). For these scholars, it is imperative that evolutionary theorists working in the socio-cultural realm update themselves on modern Darwinian theory. They all stress the remarkable explanatory power of the theory, pointing, for example, to the conceptual tools that unravel the confusion and makes sense of variety in economic and social behaviour (Metcalfe, 1987). For these scholars it appears that Darwinism simply asks the right sort of questions, guides research and provides testability (Gallunic and Weeks, 2002). Darwinism is praised for the example it provides in how to describe and theorize about an historical process (Blute, 1979; Dennett, 1995), as well as for the way that it 'enriches, facilitates and partially shapes our understanding' (Ziman, 2000, p. 312). Moreover, for those few scholars who recognize the accommodation of Lamarckism within a Darwinian framework it offers reconciliation, and addresses the polarization of theory in the socio-economic realm (Ziman, 2000; Hodgson and Knudsen, 2006a; Metcalfe, 2004). Certainly, the need for Darwinism will be underlined in this study where the importance of its explicit adoption in the social domain will be clearly demonstrated.

Having demonstrated here that the major criticisms of Darwinism are ungrounded and that there remains no cause for social scientists to be afraid of Darwinism, the following Chapter will now proceed to underline this claim by elaborating on the concept of generalized Darwinism. By outlining the little-known but critical developments in biological evolutionary theory, and drawing attention to the understated convergence of thinking in socio-economic evolutionary rhetoric (which signals its inevitability) it will be shown here that there really is no alternative to a generalized Darwinism for the socio-economic realm.

3 Generalized Darwinism

> The open question is not whether there will be a Darwinian theory of culture but what shape such a Darwinian theory will take.
>
> Daniel Dennett (1995)

> Complex evolving systems, consisting of populations of varied and replicating entities, are found in both nature and human society … at a general level there is no alternative to the core Darwinian principles of variation, selection and inheritance to explain the evolution of such systems.
>
> G. M. Hodgson and T. Knudsen (2006a)

Introduction

The 'New Age of Darwinism' heralds the advent of Darwinism as a general theory. Lucidly elaborated by Dennett (1995) and others (Plotkin, 1994; Cziko, 1995) and long anticipated by earlier Darwinians (Bagehot, 1872; James, 1880; Pierce, 1898; Ritchie, 1896; Veblen, 1898, 1899; Campbell, 1965), generalized Darwinism ultimately found its authority and formal articulation during the 1970s and 1980s through the important theoretical developments and conceptual refinements that were achieved in evolutionary biology. Darwinism was finally and clearly shown to be applicable beyond the realms of biology.[29]

Essentially through the unraveling and clarification of the foundational Darwinian 'population thinking' perspective (Mayr, 1959), the mechanisms of variation, inheritance and selection became much more easily understood and their general application more readily apparent. By purposefully adopting a general approach to the analysis of these evolutionary processes, in other words separating them from their biological origins, scholars finally untangled the interminable confusions over the units and levels of selection (Lewontin, 1970; Hull 1980, 1981). Thus in an incisive development which properly situates the heritable unit, the selection process is now generally understood as a 'two-step' process (Mayr, 1988) which notably involves both

[29] These developments relate to the established Darwinism which has long since embraced Mendelian genetics, and which biologists often call 'neo-Darwinism' - specifically to signal its synthesis in the 1950s with Mendelian genetics. It is important here to distinguish this meaning of 'neo-Darwinism' from another that tends to occur in the social sciences literature where neo-Darwinism has sometimes been used pejoratively to refer to genetic determinism or 'ultra-Darwinism'.

a ‘replicating’ entity and an ‘interacting’ entity (Hull, 1988) and specifically entails selection ‘of’ the interacting entity and selection ‘for’ the replicating entity (Sober, 1984). Through the resolution of the long-standing ‘unit of selection’ debate and subsequent developments in group selection (Wilson, 1994; Sober and Wilson, 1998; Henrich, 2002, 2004) and related multilevel selection (Hull, 2001; Brandon, 1990, 1996; Brandon and Burian, 1984; Keller, 1999) the historic notion of generalized Darwinism has now been wholly substantiated. Significantly, ‘evolutionary theory is no longer dogmatically committed to the view that there can only be individual or gene selection’ (Vromen, 2001) or indeed, that it is only relevant to the biotic world. And furthermore, the much sought after conceptual apparatus at last exists to clearly articulate the evolution of socio-cultural phenomena.

It is currently being argued and has convincingly been demonstrated that at a general level there is no alternative to the core Darwinian principles of variation, selection and inheritance to explain the evolution of complex open systems (Hodgson and Knudsen, 2006a). In a series of papers where the aforementioned theoretical and conceptual developments in evolutionary theory have been illuminated and explored, Hodgson and Knudsen have clearly shown that Darwinism is a substrate neutral theory and, moreover, that the most important objections to its adoption in the socio-economic sphere are ungrounded.[30] Crucially focusing on the types of phenomena involved in evolutionary processes, they demonstrate that there are fundamental ontological similarities between all complex evolving systems, that Darwinian entities and processes are operating in the social domain, and moreover, that Darwinism is thus inevitable in the socio-economic sphere. Furthermore, indicating the meta-theoretical framework of the theory, and addressing concerns about fundamental differences between the natural and the social realms, Hodgson and Knudsen notably stress that whilst we clearly need the general Darwinian principles to explain evolving population systems, generalized Darwinism is not enough on its own. Meaning, that Darwinism is not claimed to be a complete theory and that ‘attention to specific detailed mechanisms is always required’ for completion of the evolutionary story in each particular domain of enquiry (2006a, p. 3).

Indeed, as Hodgson and Knudsen and many others have clearly demonstrated, evolutionary scholars across the social sciences have much to gain through familiarity with modern generalized Darwinism. And this suitably indicates the theme of this

[30] See, for example, Hodgson (2001b, 2002b, 2003), Knudsen (2001, 2002, 2004) and, Hodgson and Knudsen (2004a, 2004b, 2004c, 2006a).

Chapter. The purpose here is to explain the notion of generalized Darwinism, to show how it is relevant to the socio-economic sphere and to highlight its potential. It is also to illustrate, through an outline of the developments in evolutionary theory and examples of theories of socio-economic evolution, that the adoption of Darwinism is inevitable and is indeed already widespread. Thus the first section begins with a description of generalized Darwinism. This is followed by a review of the modern expression of Darwinism which centres on the generalized replicator and interactor terms. The next sections focus in turn on the explicit and implicit use of Darwinism in social theories of evolution, drawing attention to a notable convergence of thinking which assumes a Darwinian ontology and underlying metaphysics. Highlighting problems in socio-economic accounts and pointing to their resolution in general Darwinism, the Chapter then concludes with the assertion of the need for general Darwinism in the social domain.

Generalized Darwinism

In order to properly convey what generalized Darwinism means, it is important to clarify at the outset what it does *not* mean. As observed in Chapter 2, misapprehensions and objections, resulting from the rhetoric of 'Social Darwinism' and lack of engagement with Darwinian theory, are abundant and influential, thus their dismissal should not be overlooked. In summary, Darwinism, as Hodgson (2004, pp. 7-8) explains, does *not* imply;

> any form of racism, sexism, nationalism or imperialism, any moral justification of 'the survival of the fittest', that militant conflict is desirable or inevitable, that human inequalities or power or wealth are desirable or inevitable, that cooperation or altruism are unfit or unnatural, that evolution generally involves optimization or progress, that social phenomena can or should be explained in terms of biology alone, that organisms can or should be explained in terms of their genes alone, that human intention is unimportant, or that human agency is blind or mechanistic.

Indeed as discussed in Chapter 2 above and as demonstrated later in this study, the major objections to Darwinism are basically misconceived. Essentially Darwinism is not about analogy but ontology (Hodgson, 2002b), it posits Darwinian entities and processes in both nature and human society (and thus has no need for reductionist methodology), human intentionality is certainly not overlooked in a Darwinian theory

which is committed to causal explanations for all phenomena, and Lamarckism and Darwinism are not rival or mutually exclusive theories.[31]

Assuredly, even preliminary acquaintance with the theory soon reveals that generalized Darwinism is not ideological, reductionist, optimizing, progressive or teleological, and nor does it propose equilibrium outcomes. On the contrary, what Darwinism represents is a dynamic theory which is essentially concerned with explaining patterns and causes of change in open-ended systems which show no signs of coming to a stop (Metcalfe, 2004). Indeed Darwinism is committed to detailed, cumulative, *causal* explanations of change. And this is clearly seen in its process-orientated mode of analysis which explains cause and effect relationships through the 'algorithmic' explanatory device encapsulated in Darwin's interrelated mechanisms of variation, inheritance and selection (Dennett, 1995).[32] Generalized Darwinism refers to the general application of this dynamic causal mechanism.

Darwinian Evolution as an Algorithmic Process

Significantly, in Darwin's treatment of the core principles, he presents the mechanism of evolution as being deducible by a formal argument. In other words, *if* the conditions are met, a certain outcome is assured. By way of illustration of this important theoretical point, Dennett (p. 41) cites a well-known passage from *Origins*[33] where Darwin discusses the principles of variation, inheritance and selection, and then he goes on to observe how Darwin's formulation of these conditions amount to a mindless, mechanical, 'algorithmic process'. This is clearly where the power of generalized Darwinism resides and evidently what has been perceived by countless evolutionary scholars in the socio-cultural domain. In the following affirmation of their general

[31] See Chapter 6 below.

[32] Dennett (p. 50): 'Darwin had discovered the power of an *algorithm.* An algorithm is a certain sort of formal process that can be counted on – logically - to yield a certain sort of result whenever it is "run" or instantiated'.

[33] Darwin's passage [Darwin, Origin p.127 (fas. ed. of 1st edition)] appears here in full (Dennett's boldfacing): "**If**, during the long course of ages and under varying conditions of life, organic beings vary at all in the several parts of their organization, and I think this cannot be disputed; **if** there be owing to the high geometric powers of increase of each species, at some age, season, or year, a severe struggle for life, and this certainly cannot be disputed; **then,** considering the infinite complexity of the relations of all organic beings to each other and to their conditions of existence, causing an infinite diversity in structure, constitution and habits, to be advantageous to them, **I think it would be a most extraordinary fact if no variation ever had occurred useful to each being's own welfare,** in the same way as so many variations have occurred useful to man. But **if** variations useful to any organic being do occur, **assuredly** individuals thus characterized will have the best chance of being preserved in the struggle for life; and from the strong principle of inheritance they will tend to produce offspring similarly characterized. This principle of preservation, I have called, for the sake of brevity, Natural Selection."

application, the evolutionary economist, Metcalfe, offers a useful description of these 'essential' interrelated mechanisms of evolutionary change (1987, p. 56);

> These are: the principle of variation, that members of a relevant population vary with respect to at least one characteristic with selective significance; the principle of heredity, that there exist copying mechanisms to ensure continuity over time in the form and behaviour of the entities in the population and the principle of selection, that the characteristics of some entities are better adapted to prevailing evolutionary pressures and consequently increase in relative significance compared to less adapted entities.

As Metcalfe thus concurs, so long as the said conditions are met, the principles at the heart of this causal story hold true for any evolutionary system, irrespective of the domain of inquiry. Thus generalized Darwinism is a substrate-neutral *general* evolutionary theory (Plotkin, 1994; Dennett, 1995) meaning that Darwinism is not confined to genes or DNA (Dawkins, 1983) and that the core principles of variation, inheritance and selection can be generalized to apply to areas beyond the purely biological, for example, to language, customs or economic systems. Essentially Darwinism may be used to explain the evolution of any open complex system which shares ontological similarities (Hodgson, 2001b, 2002b), in other words, complex evolving systems consisting of populations of varied and replicating entities (customs, routines or institutions) which have different capacities to survive.

An important point to note about generalized Darwinism however, and which has only recently been highlighted, is that whilst these core principles are always necessary for the explanation of such systems, they are never sufficient on their own (Hodgson and Knudsen, 2006a), meaning that the specific mechanisms of the particular domain of enquiry must be taken into account. Every system is naturally going to differ in such details and generalized Darwinism takes account of these. Significantly, generalized Darwinism provides an overarching conceptual framework in which other 'auxiliary' explanations can be accommodated (Lamarckian inheritance, self-organization theory) but it is not, and nor does it claim to be, a complete theory. In truth this is a very important feature of generalized Darwinism which serves to underline its generic character.

Indeed, as stated in the introduction, it is the recent theoretical advances and conceptual developments in evolutionary theory that have enabled such firm

clarifications. In the following section the discussion thus focuses on these and highlights the modern articulation of Darwinian theory.

Modern Expression of Generalized Darwinism

Hodgson's neat summary expression of generalized Darwinism is worth repeating, immediately indicating, as it does, the potential for all complex evolving systems (2002b, p. 103);

> As long as there is a population of replicating entities that make imperfect copies of themselves, and not all of these entities have the potential to survive, then Darwinian evolution will occur.

As observed in Chapter 2 above, whilst the notion of generalized or universal Darwinism has had a long history in the social sciences, its full realization has been severely curtailed by theoretical difficulties, misguided objections and the distinct lack of a viable conceptual apparatus. However, through the modern expression of generalized Darwinism this position has now changed. The conceptual tools now exist to formulate a comprehensive evolutionary theory of organizational and industrial change. The meta-theoretical framework anticipated by earlier Darwinians has finally found its clear expression through the recently established and 'generalized' replicator-interactor concepts. The path to this crucial development will be briefly outlined below where the implications for the social domain are also highlighted. It begins with the ontological foundations of the theory and the revolutionary 'population thinking' approach that Darwin introduced to facilitate its tractability.

Population Thinking and the Fuel of Evolutionary Change

Population thinking was a profound challenge to the 'typological essentialism'[34] that had characterized the thinking of Darwin's own era. Through it Darwin presented an entirely new way of thinking (Mayr, 1976, p. 26), effectively creating a philosophical schism that was barely perceived at the time and which tends, even today, to be underappreciated by evolutionary scholars (Hull, 1990). Essentially Darwin totally dismissed the prevailing analytical priority of representative 'types' and introduced the

[34] Population thinking and typological essentialism are explored in more detail in Chapter 4

population thinking perspective which instead privileges variety, the critical source of change in evolving systems. For the essentialist, entities are grouped according to a fixed number of typical traits that describe their 'essence'. The typical or average 'type' is central to the analysis. For population thinkers, on the other hand, the emphasis is on variable populations of entities in which each individual entity is unique; variety is paramount. Variations from type are perceived by essentialists as being 'deviations' or 'noise in the system', and are thus discounted in the analysis. Whereas, for population thinkers variation serves as is the critical fuel of evolutionary change, without which there could be no selection process.

Clearly population thinking has direct relevance for the analysis of open-ended socio-economic systems where scholars need to make sense of the prevailing variety, and where ultimately there are policy implications.[35] Metcalfe (1987), who highlighted its significance for economics, showed that 'the shift from analyzing ideal cases to examining frequencies and their distribution is central to the elaboration of an evolutionary perspective' (p. 56). It is relevant and important to observe the evidence suggesting that other scholars working in the social domain have gradually come to recognize, either theoretically or through empirical investigation, that evolutionary selection processes simply cannot be articulated in a schema constructed around typological essentialism.[36] Indeed, the implications are that in order to understand evolutionary change researchers need to pay far more attention to the processes that generate and regenerate variation.

Fundamentally, population thinking is what is at the heart of the claim about the existence of a Darwinian social ontology (Hodgson, 2002b; Hodgson and Knudsen, 2006a), and supports its articulation in the social world. Indeed the replicating entity and algorithmic processes of variation, inheritance and selection, are inextricably rooted in this distinctive underlying philosophy which facilitates their operation and illuminates the important role of variety in evolving systems. It becomes clear to evolutionary scholars, for example, that the replenishment of variety (replication and inheritance), as well as its creation (innovation, entrepreneurial activity, 'copying

[35] For example, in economics, how much variety is desirable or sustainable in a particular industry? Is limited variety an indicator of competition or of monopolistic practices? And relatedly, should variety be encouraged or prevented for the health of the general economy?

[36] This 'gradual realization' forms an important part of the argument presented here about *implicit* Darwinism, and the curious epistemological development that can be traced in the literature which shows how scholars, including 'non-Darwinians' have unwittingly fumbled in this direction (Nelson and Winter, 1982). Indeed, significantly, even those (Penrose, 1953) who were famously opposed to the use of biological analogy in economics found themselves coming to a population thinking perspective (Chapter 2).

errors') and dispersion, are all critical aspects of any evolutionary story and therefore should be not be discounted but instead carefully researched and fully integrated into the explanatory schema.

Replicators and Interactors

Building on the firm foundations of the population thinking perspective the geneticist, Richard Lewontin (1970) and philosopher of biology, David Hull (1980, 1981) finally resolved the infamous 'units of selection' debate of evolutionary biology[37] wherein evolutionists were divided over the true unit of selection. It eventually became apparent that 'units' and 'levels' had become confused within the debate and moreover that selection was a two-step process (Mayr, 1978) which involved a replicating entity and an interacting entity. Indicating the nature of the debate and the import of his generalized replicator and interactor terminology, Hull (2001, p. 61), below, illustrates the linguistic confusion;

> When Dawkins says that genes are the units of selection, he means replication. Genes are the primary units of replication and 'hence' selection. When others such as Mayr say that organisms are the primary focus of selection, they mean environmental interaction. In gene-based biological evolution, organisms are the primary units of environmental interaction and 'hence' selection.

Conceptual clarification of this 'indirect selection' of genes, with the properly apportioned location of causality, was greatly assisted by the observation that evolutionists often confused the distinction between 'selection of' an object and 'selection for' a property (Sober, 1984). In the generalized Darwinian terminology this amounts to the 'selection of' an interactor and the 'selection for' its replicator. These were significant developments in theory, for as well as demonstrating that selection is a two-step process, and making clear what happens at each level of the organizational hierarchy, they highlighted the critically important 'dual aspect' nature of the primary unit of selection (Mayr, 1988); otherwise known as the 'primary interactor' (Hull, 1988, p. 434).

The replicator is defined by Hull (1988, p. 408) as 'an entity that passes on its structure largely intact in successive replications', and the interactor is defined as 'an entity that directly interacts as a cohesive whole with its environment in such a way that

[37] The 'units of selection' debate is discussed in detail in Chapter 5.

this interaction *causes* replication to be differential.' These are the entities that function within the selection process and their combination amounts to what we generally think of as the 'individual', in other words, the organism, the organization or the firm. As indicated, these terms were inspired by the replicating function of the genotype and the interacting function of the phenotype. In biology the *genotype* is understood as the genetic composition of an organism whereas the *phenotype* is its developed characteristics or capacities. With this important 'dual aspect' notion of the 'primary interactor', where the selection process is then defined as 'a process in which the differential extinction and proliferation of interactors *cause* the differential perpetuation of the relevant replicators' (p. 409), it is clearly possible to conceive of firms, comprised of replicating organizational routines, operating as interactors and units of selection in an industrial selection process.

Indeed this is precisely what Nelson and Winter (1982) and Howard Aldrich (1999) imply in their respective theories. Whilst they do not use the terms, and their evolutionary interpretations vary, it is clear that they are aware of this important distinction and its causal role in the evolutionary process. In fact some scholars (Baum and Singh, 1994; Galunic and Weeks, 2002) are explicitly promoting the adoption of the terms in organization studies, while others (Hodgson, 2003, 2006; Hodgson and Knudsen, 2004a, 2004b, 2004c) continue to explore these and other social entities as viable social replicators (habits, routines, rules) and social interactors (groups, organizations, institutions).

Significantly, as implied here and will become apparent in later Chapters, the replicator and interactor concepts also enable the conceptualization of group and thus multilevel selection, and moreover they crucially facilitate the articulation of Lamarckian inheritance within the Darwinian meta-theoretical framework,[38] all of which elements are critically important to the development of an evolutionary theory of socio-cultural change.

Crucially what these theoretical and conceptual developments confirm is that Darwinism is unquestionably a general theory. They enable us to see that the social realm is Darwinian and moreover that Darwinism is inevitable in socio-economic accounts of evolution. Indeed as will be demonstrated below, the organizations studies

[38] Indeed it has been shown that it is impossible to conceive of Darwinian *or* Lamarckian inheritance without the replicator-interactor distinction (Hodgson and Knudsen, 2006b). Hull (Personal Communication, 6th June 2004) 'In order for any process to be Lamarckian, we need a genotype-phenotype distinction. Of course, in order for a process to count as Darwinian, we also need the genotype-phenotype distinction'.

and evolutionary economics literatures reveal that scholars in these disciplines are actually thinking this way, there is a notable movement away from 'Darwinian analogy' towards a 'Darwinian ontology'.

From Analogy to Ontology

Undoubtedly, through its theoretical clarifications and modern articulation the generic nature of Darwinism has become much more apparent, and significantly, Darwinism is visibly shorn of biological associations as well as associations with reductionism and ideology. Indeed in its abstract, transparent formulation, now conceptually enhanced with the generalized 'replicator' and 'interactor' terminology (Hull, 1988), the theory has also become much more accessible and consequently it has since been productively employed across a wide range of disciplines (Hull et al, 2001; Edelman, 1987; Plotkin, 1994; Aunger, 2002; Wilson, 2002) including organization studies (Baum and Singh, 1994; Ziman, 2000; Wheeler et al, 2002) and evolutionary economics (Laurent and Nightingale, 2001; Field, 2002, 2004; Metcalfe, 1987, 1998; Hodgson, 2001b, 2002b, 2003b; Knudsen, 2001, 2004; Hodgson and Knudsen, 2004a, 2006a, 2006b). The dramatic implication here is that these scholars, as well as scores of others (too numerous to mention here), have recognized the relevance of Darwinism for the analysis of socio-cultural phenomena. They understand that Darwinism is not domain specific and evidently perceive that similar entities and processes exist in both nature and human society. Thus, significantly, what this growing literature confirms is the inevitability of the Darwinian model for socio-cultural theories of evolution. Clearly Darwinism is in the nature of the phenomena under study, it is in the very nature of complex population systems.

Certainly for those who have already explored the theory there is wholehearted praise for the insight it has produced (Baum and Singh, 1994; Ziman, 2000; Wheeler et al, 2002). Scholars realize that by adopting a Darwinian perspective it guides the research questions and sorts out a lot of the confusion (Metcalfe, 1987, 1998; Ziman, 2000; Field, 2002). Indeed, as Ziman and his co-authors concur, 'Darwin's naturalistic account of temporal change in the living world has a logical coherence and proven explanatory power that is hard to match' (p. 312). And as Galunic and Weeks (2002) explain, Darwinism suggests 'some important constructs (particularly organizational routines) and provides testable ideas for how these may behave (through birth, competition, complementarity, adaptation and death)'. For these writers and their like-

minded colleagues, Darwinism has evidently facilitated a tractable way forward for their evolutionary theorizing, providing an overarching meta-theoretical evolutionary framework, integrated conceptual tools and an accessible general language.

However, as has frequently been observed, the dramatic developments that occurred in evolutionary biology over the last thirty years have not been widely disseminated, even amongst leading evolutionary scholars who are liberally adopting the biological analogy (Nelson and Winter, 1982; Hannan and Freeman, 1989; Aldrich, 1999). Needless to say the widespread ignorance of modern Darwinism has had a profound effect on the development of evolutionary theory in organization studies and evolutionary economics. As discussed in the previous Chapter, misconceptions and prejudice against Darwinism have clearly hampered progress in the development of a viable evolutionary theory of socio-economic change by, for example, dismissing the theory altogether; by diverting attention away from Darwinism towards alternative but limited evolutionary perspectives like self-organization theory (Witt, 1997; Foster, 1997); by generating multiple disparate evolutionary accounts (Pfeffer, 1993) and finally; by creating an unnecessary polarization of theory between Lamarckian 'adaptationist' accounts and Darwinian 'selectionist' accounts.

It is evident from a broad survey of the literature in organization studies and evolutionary economics that clarification of Darwinian theory is long overdue, scholars clearly need updating on Darwinism if they are to move forward with their own evolutionary theories (Udry, 1995; Jablonka and Ziman, 2000; Metcalfe, 2004). It is time for myths to be quashed, misconceptions to be corrected and confusions to be untangled. Evolutionary scholars of all persuasions need to know about what Darwinism *is* and indeed what Darwinism is *not*. They can no longer afford to remain in the dark about the explanatory potential of generalized Darwinism, particularly since its influence in their disciplines is really beginning to take hold (Murmann et al, 2003). The irony is, of course, as observed in Chapter 1, that most evolutionary scholars are in fact already adopting Darwinian ideas, whether they realize it or not, only that adoption is variable and often confused. Thus it would surely help progress if they were to engage with the important theoretical developments that have taken place in modern Darwinian theory.

Indeed, it is the assertion of this thesis that on several fronts, from the theoretical to the ontological, Darwinism has revealed itself to be 'generalizable' and thus wholly relevant to explanations of socio-economic evolution. It is tellingly evidenced, for example, in the changing nature of use of Darwinism in the organization sciences and

evolutionary economics literature, where significantly, there has been a perceptible movement away from what might be termed, 'analogical', 'reductive' or 'ideological' Darwinian reasoning, towards the implicit and increasingly explicit theorization about actual 'Darwinian' entities, processes and events in the socio-economic domain. Specifically, there is the frequent adoption, in varying guises, of the Darwinian principles of variation, inheritance and selection, and the implicit or 'covert' acknowledgement therefore of a Darwinian social ontology and underlying metaphysics.

To be sure, it is this changing nature of use by social scientists, *together* with the theoretical developments and conceptual clarity that has ensued in evolutionary theory, which confirms the dramatic potential of Darwin's theory and its inevitability for the social realm. For what these developments crucially indicate, as Hodgson and Knudsen (2006a) rightly observe, is that 'socio-economic evolution is Darwinian by virtue of (social) ontology, not (biological) analogy'. Clearly, the theory can no longer be considered the exclusive preserve of biologists.[39]

Darwinian Inclinations and Implicit Darwinism

There is now overwhelming evidence in the organization studies and evolutionary economics literature of a significant reorientation of thinking towards Darwinism[40] (Baum and Singh, 1994; Laurent, 2001; Baum, 2002; Ziman, 2000; Wheeler et al 2002; Metcalfe, 2004). 'Darwinian inclinations' here refers to indicators in socio-economic accounts of the subtle recognition or inclusion of the Darwinian formulation and its underlying metaphysical assumptions, in other words, implicit or covert Darwinism. The identification and exploration of the implicit use of Darwinism in this literature is very important, primarily because of what it reveals about the way in which scholars are thinking, but also because of what it says about the credibility of the theory. And, it must be said that its useful investigation has been greatly assisted by the theoretical developments discussed above. It is clear that Darwinian ideas are variously implied, for example, 'knowingly' (Ziman, 2000, 2002; Baum and Singh, 1994; Aldrich, 1999) 'unwittingly' (Nelson and Winter, 1982), 'wholly' (Nelson and Winter, 1982; Aldrich,

[39] A sentiment variously expressed by participants at a recent international conference on 'Evolutionary Concepts in Economics and Biology' (Jena, Germany 2004). For example, Moykr: 'Evolution is just too important to be left to the biologists'; Metcalfe: 'Why should biologists have the monopoly on evolution? Just because evolution was discovered in biology it does not mean that it cannot be used and developed in other fields'

[40] See Chapter 1 above.

1999) and 'partially' (Hannan and Freeman, 1989), and moreover that there appear to be different reasons why it is only implied, for example, possible fear of association with social Darwinism (Nelson and Winter, 1982) or conversely, a taken for granted acceptance of the Darwinian model (Aldrich, 1999; Ziman, 2000).

The critical point here is that implicit Darwinism, in a different and yet decisive way also supports the notion of generalized Darwinism. Implicit Darwinism draws attention to the development of Darwinian thinking in the socio-economic domain, indicating the background to the theory's emergence and the continuing 'rediscovery' of its relevance by social scientists. Clearly this is an endorsement that contrasts with that of explicit Darwinism, in terms of its subtlety, but corresponds with the latter in terms of its persuasive logic, since implicit Darwinism effectively typifies the 'scientific realist' approach[41] to theory corroboration,[42] in other words, the esteemed scientific trial-and-error process of theory development. Thus, we are referring to that section of the literature where, instead of deliberately and explicitly adopting Darwinian ideas, scholars, through grappling with phenomena like variety, dispersion and selection, inadvertently end up adopting Darwinian explanations.

Development of Underlying Assumptions and Emerging Darwinism

It is argued here that evolutionary theory is seen to have evolved towards the Darwinian model as scholars have altered or replaced their underlying assumptions and modified their theoretical frameworks. For example, in organization studies where the theories are markedly different to those employed 20 years ago (Baum and Rowley, 2002) the evolving definition of organizations to that of 'open-systems'[43] signifies the changing theoretical position and corresponding approaches to research (Scott 1998, Baum and Rowley, 2002; Baum, 2002; Aldrich, 1999). The prevailing 'open systems' approaches are seen as improved hybridized versions of the 'rational systems' and 'natural systems' perspectives,[44] where organizations are now perceived as 'adaptive and

[41] What Baum (2002) calls the 'logic-in-use' of organization scientists

[42] Scientific realism is currently the most favoured epistemology of philosophers (Azevedo, 1997). As Galunic and Weeks (2002) explain, Darwinism suggests 'some important constructs (particularly organizational routines) and provide testable ideas for how these may behave (through birth, competition, complementarity, adaptation and death)

[43] 'An open system is one whose boundaries are not predetermined. Further, the nature and range of its constituent variables and the structure of their interrelationships are not predetermined' (Dow, 2002)

[44] Aldrich (1999, p. 2), for example, defines organizations as 'goal directed, boundary-maintaining, and socially constructed systems of human activity'. This compares with the 'goals, formal structure and

interdependent systems, comprised of various interrelated – possibly conflicting subsystems – attempting to meet and influence the dynamic demands of the environment' (Baum and Rowley, 2002, p. 6). Thus, while combining elements of the former perspectives, the open systems approaches have notably advanced the analysis by shifting attention away from the internal activities of the organization, with its focus on individuals, towards 'the behaviour *of* organizations as entities in and of themselves' (Baum and Rowley, p. 3). In other words there is a focus on organizational processes, boundaries and strategies.

Correspondingly, in evolutionary economics where there has been a shift from a static to a dynamic approach and where attention has been drawn to the importance of historical specificity (Hodgson, 1993), there have also been dramatic changes in perspective. For example, the equilibrium, maximization and optimization assumptions of neoclassical economics have been abandoned. Moreover, following the Carnegie School (Simon, 1945, March and Simon, 1958, Cyert and March, 1963) and its concept of 'bounded rationality', and indeed mirroring organization theorists and their dismissal of 'administrative man' (Simon, 1945), evolutionary economists have also dispensed with the traditional notion of 'rational economic man'.

Indeed it would appear that the stage has been reached where certain Darwinian ideas and foundational metaphysics are simply *assumed*. As noted, we are increasingly seeing theories wherein the mechanisms are clearly Darwinian but the intellectual inheritance is simply not mentioned. Clark and Juma (1998) below, offer a reflection on why this might be the case, which reinforces the argument here that scholars are merely 'discovering' the Darwinian nature of the social realm, and that general Darwinism is thus inevitable;

> We do know that that an important factor influencing adherence to particular theoretical positions lies in the character of underlying metaphysical positions, positions which are often not fully appreciated by practising scientists themselves.

In Chapter 2 above, this phenomenon was exemplified through the gradual assimilation in evolutionary economics of the population thinking approach. Here it will again be demonstrated through the example of the subtle acknowledgement of Darwinian 'downward causation'. Like population thinking this is not a widely

---

efficiency' that embody the rational system view, and the 'emergent purpose, informal structure and adaptation' that characterize the natural system view (Baum and Rowley, 2002, p. 5)

discussed feature of Darwinism, but theorists nevertheless intuitively appear to recognize its causal significance in evolutionary explanations.

Downward Causation

In both the evolutionary economics and organization studies literature, there is ample evidence of the recognition of 'Veblenian' (Hodgson, 2001) and 'Campbellian' (Anderson, 1999) notions of Darwinian 'downward causation' (Baum and Singh, 1994). This relates to perceptions of the relationship between agency and structure, and recognition that while the individual may be constrained and molded by the social structure it nevertheless remains causally effective; 'the institutional fabric is an outcome of the conduct of the individual members of the groups' (Veblen, 1909 p. 629). In other words, scholars are paying closer attention, for example, to entrepreneurship and agency and linking these to the establishment and development of organizations and their impact at the community level (Aldrich, 1999; Galunic and Weeks, 2002; Ziman, 2000, 2002).

Significantly, and rather ironically, given their Lamarckian label, Darwinian downward causation is unmistakable in Nelson and Winter's influential account. Notably, what these scholars uniquely achieved (upon implicit population thinking foundations) was the direct application of Darwin's three core principles of variation, inheritance and selection, the handling of which critically acknowledges both micro and macro causal processes. It is unquestionably a 'micro-founded' approach (Coriat and Dosi, 2002; Metcalfe, 1987). Indeed, together with other important theoretical contributions on the selection process (Nelson, 1974, 1995; Winter, 1964) and variety (Nelson, 1991) Nelson and Winter effectively continued Veblen's insightful project (Hodgson, 2004a) and paved the way for the emergence of a distinctly *Darwinian* and much more workable theory in evolutionary economics.

The implications of these Darwinian assumptions for socio-cultural theories of evolution are profound, for while they admit a Darwinian social ontology they also permit resolution of theoretical problems through a modern general Darwinism. At the heart of the adaptation (Lamarckian) versus selection (Darwinian) debate is the thorny question of intentionality or purposive behaviour, and downward causation essentially refers to the theoretical accommodation of this in Darwin's '"causal dualism" - of intentional and mechanical causality' (Hodgson, 2001c). Significantly, as discussed in Chapter 2, contrary to popular belief, Darwinism does not deny intentionality. The

crucial point is that whether behaviour is intentional or not, it will still be subject to a selection process. Darwinian selection works on the existing variation regardless of how this might have been produced.[45]

Ironically, in spite of the rejection of Darwinism over the misunderstanding of this theoretical point, many traditionally 'Lamarckian' scholars are finding that the Darwinian causal story appears nevertheless to be born out in empirical investigations. Regardless of the deliberative intentions of agents, outcomes suggest a considerable degree of 'inertia' on the part of firms (Levinthal, 1997; Carroll and Hannan, 2000, Sorenson and Stuart, 2000). Indeed organizational ecologists stress the relative powerlessness of managers to control the organization's destiny (Hannan and Freeman, 1989), so that at the theoretical level Lamarckian adaptationism clearly needs to be afforded a more appropriate causal position. Certainly, agency and intentionality has an important role to play in the evolutionary process of change, but it is not the only force of change (Metcalfe, 1987).[46]

The important point here is that whilst 'selectionists' and 'adaptationists' continue to debate the causal significance of Lamarckian inheritance and Darwinian selection, not only has it been clearly shown that the social realm is both Lamarckian *and* Darwinian,[47] but developments in evolutionary theory have also demonstrated that Lamarckian adaptation (purposeful or intentional behaviour) can be accommodated within the meta-theoretical framework of general Darwinism.

The Darwinian Thread and the Need for a Generalized Darwinism

Thus, as indicated, and indeed will be demonstrated at length in each of the case studies below,[48] in such underlying assumptions, there is clear evidence of a convergence of thinking amongst evolutionary scholars in the organization studies and evolutionary economics literature. And significantly it is distinctly Darwinian. Whilst variously deployed and not identified as such, Darwinian ideas, entities and processes permeate these evolutionary accounts. There is a 'Darwinian thread' linking, what appear to be,

[45]Vromen (2004) 'When applied to individual human behaviour, '(cumulative) blind variation and selective retention' does not imply that search for better 'variants' is conducted unintentionally, without any conscious thinking or thought, or whatever.'

[46] (Metcalfe, 1987, p. 60) 'Because it is precisely the existence of varieties of behaviour which is the central issue, the exact motivations underpinning these behaviours are of secondary importance. Adaptations may be maximising, they may be satisficing, they may be habitual, they may be unthinking. No matter, providing the relevant motivations result in consistently different behaviours then the scope is created for economic selection'.

[47] Hodgson (2001b), Knudsen (2001)

[48] See Chapters 8, 9, and 10

disparate evolutionary theories. Darwinism is present and, clearly inevitable in socio-economic domain.

It is not articulated but it is nevertheless clear that there has been a crucial shift in theoretical approach from analogy to ontology. The literature reveals that scholars now recognise, whether implicitly or explicitly, that Darwinian entities, processes and events, actually exist in the social sphere. And as a result, in spite of historic and continued resistance to it, generalized Darwinism appears to be nevertheless emerging of its own volition. Indeed this assertion and its demonstration is the central aim of the thesis. Through the close examination of seminal works in evolutionary socio-economic accounts of change a detailed evaluation is made of the extent to which Darwinian ideas have been deployed. And, as will be demonstrated, these case studies unquestionably indirectly support a generalized Darwinism.

However, as indicated, although the explosion of Darwinian thinking is evident across these disciplines it is also apparent that in most cases it is a crude or outmoded form of Darwinism which is deployed; hence the inherent limitations on theory. Whilst scholars appear to imbibe critical strands of modern Darwinian theory, including, for example, the notion of group selection[49] and the replicator-interactor distinction, they tend not to unpack these elements or demonstrate their consistency with the overarching theoretical framework. Consequently, as will be shown in the case studies, theories end up confused, incomplete, underdeveloped and ultimately prevented from reaching their full potential. Thus, as previously suggested, there is a discernible *need* for generalized Darwinism in the socio-economic domain.

Undoubtedly, as well as dispelling traditional objections to Darwinism, familiarity with modern Darwinian theory, would liberate theorists from many of the self-imposed theoretical constraints on their theories, such as the erroneous view that Lamarckism and Darwinism are rival theories or that Darwinian does not account for intentional behaviour. And, it would enable them to perceive the Darwinian causal consistency in seemingly conflicting accounts. This is nowhere more apparent than in the unresolved question of the unit of selection (Aldrich, 1999). For example, as is well documented (Baum, 2002), the Darwinian principles of variation, inheritance and selection are deployed at various levels of analysis.[50] And significantly, although the research

[49] Group selection is assumed, for example, in the presentation of collective entities like organizations and firms as 'units of selection'

[50] Indeed, *The Companion* (2002, Baum) chapters are divided up very specifically to reflect the different levels of analysis. At the intra-organizational level, for example, the individual competence or routine is taken as the unit of analysis (and / or selection) (Burgelman, 1991; Weiks, 1979), whereas for population ecologist at the inter-organizational level, it is the individual organization or *set* of routines that is taken

methods are strikingly different at each level, with intra-organizational ecologists undertaking detailed and longitudinal studies of individual organizations, and population ecologists focused on large-scale quantitative analysis, and, although the causal explanations of evolutionary change are completely different, with the former positing the impact of routines on populations (adaptationist) and the later arguing that causality runs in the opposite direction (selectionist), *both* camps explicitly deploy the Darwinian model (Galunic and Weeks, 2002).

The point is this development highlights a widespread confusion amongst evolutionary theorists, for whilst they may recognize the applicability of the Darwinian principles at multiple levels of socio-economic hierarchies, even leading scholars are at odds over causality (Nelson and Winter, 1982; Hannan and Freeman, 1989; Aldrich, 1999). Significantly, however, the unraveling of such confusions is clearly suggested in general Darwinism where the unit *of* selection issue is now resolved and where Lamarckism and Darwinism are reconciled within its generalized meta-theoretical framework.

There is plenty of evidence to suggest that a generalized Darwinism is actively being sought by social scientists, with scholars frequently lamenting, for example, the 'multiparadigmaticism' of organization science (Pfeffer, 1993; March, 1996) stressing the need for a unified evolutionary paradigm (Levinthal, 1991; Baum and McKelvey, 1999; Murmann et al, 2003) and pointing to the Darwinian framework (Aldrich, 1979, 1999; Lopreato and Crippen, 1999; McKelvey, 1982, Baum and McKelvey, 1999). The current polar positions emanating from the organization science and business economics literature (Baum and Singh, 1994) relating to the 'adaptation versus selection' debate[51] is very counterproductive. As indicated, it reflects traditional associations with key aspects of Lamarckian and Darwinian theories respectively and confusingly perpetuates the myth that these are rival evolutionary theories, in the social as well as the biotic sphere. The problem is that both kinds of approach will inevitably be limited and incomplete, with one lacking a selection mechanism and the other lacking an inheritance mechanism. But with generalized Darwinism, on the other hand, such polarization of evolutionary theory can be rectified.

However, as demonstrated in previous sections, in spite of this obvious need to catch up on evolutionary theory, Darwinism is nevertheless positively evident in the literature,

---

as the unit of analysis (and / or selection) (Hannan and Freeman, 1989; Carroll 1984, 1988; Carroll and Hannan, 2000).

[51]Indeed it was made explicit in the title of a recent workshop, organized by Murmann and Rivkin, (2004); 'Adaptation Versus Selection in Industry Change: Toward a Contingency View'.

specifically in the way that scholars speculate and theorize about the nature of the phenomena under study. Although these social scientists work in very different disciplines, they are essentially puzzling over similar types of entities and similar types of processes (Baum and Singh, 1994). They are frequently and quite unwittingly working with a Darwinian social ontology, their use of evolutionary ideas essentially revealing their movement away from Darwinian biological analogy.

Indeed, as social scientists continue to gradually discover, excursions into Darwinism only serves to enhance understanding of the important peculiarities of evolutionary theorizing (Vromen, 1995). And it would appear that more scholars are coming to appreciate that it is *Darwinism* that exemplifies how to describe and theorize about historical processes (Blute 1979, p. 46). In an 'end word' by contributors to a multi-authored volume on technological change, the authors, whose evolutionary perspectives were predominantly Darwinian,[52] observe the exact same points and stress the relevance and implications of the theory for the socio-economic (Ziman, 2000, p. 312);

> But at a much more mundane level, an evolutionary perspective – whether we call it an 'analogy', a 'metaphor' or a 'model' – is clearly a very fruitful way of looking at the actual business of making and doing … it poses practical questions and suggests useful answers for designers, technology managers, policy makers and others in industry, government and academia. These insights are not only valuable in themselves: they also help us to develop and refine our understanding of the underlying principles of technological change.

To be sure, both the need for a generalized Darwinism and evidence of its adoption are not difficult to find in the socio-economic literature. They are evident in the character of evolutionary theories that have been developed, and moreover, they are evident in the epistemological background to this development. As has been demonstrated here, traditional foundational metaphysical assumptions have gradually been eroded and a Darwinian metaphysics is seen to be emerging in theories of the social realm.

Concluding Remarks

In summary, it has been shown here that Darwinism *is* a general theory, that it is implicit in evolutionary accounts of organizational and economic change, that scholars

[52] This is a classic example of where authors use Darwinian theory without attributing it or labelling it as such. But when they talk about 'evolution' they invariably mean Darwin's theory of evolution.

assume a Darwinian social ontology, and finally, that Darwinism is therefore inevitable in the social realm. This returns us to the fundamental questions that prompted this thesis. The task is to investigate the extent to which Darwinian ideas have been employed in socio-economic theories and to evaluate the sense in which they are being employed, whether implicitly or explicitly. For example, are economists using natural selection simply as an analogy? Or, are there phenomena in the socio-economic domain that *evolve* according to basic Darwinian principles? And, furthermore, are the theories tractable?

In order to properly address these questions and establish a Darwinian parentage in evolutionary theories we need to be very precise about the use of the terms and interpretation of ideas. For example, what do we mean by replication and selection? What is being replicated? And what is being selected? Can we, for example, establish parities with these evolutionary mechanisms and entities in economics? And, are the ideas really being used in the same sense as in Darwinism? If so, then we have an instance of generalized Darwinism and the foundations of a credible social theory of evolution.

The next four Chapters in Part II critically inform this process by examining Darwin's theory and the evolutionary concepts in detail. In the next Chapter Darwinism is taken back to its origins in biology, where in an overview of Darwin's development of the theory it will be seen how it easily and unambiguously lends itself to general application. In the subsequent three Chapters the focus will be on the more recent developments in evolutionary theory, and deal in turn with the units of selection debate, Lamarckism and multilevel selection theory. This then paves the way for a systematic and incisive Darwinian evaluation of the case studies that appear in Part III

Part II

Evolutionary Theory and Recent Developments in Biology and the Philosophy of Biology

> Even today's controversies have a root that usually goes far back in time. It is precisely the historical study of such controversies that often contributes materially to a conceptual clarification and thus makes the ultimate solution possible.
>
> Ernst Mayr (1982)

4 An Introduction to Evolutionary Concepts

> I am fully convinced that species are not immutable; but that those belonging to what are called the same genera are lineal descendants of some other and generally extinct species, in the same manner as the acknowledged varieties of any one species are the descendants of that species. Furthermore, I am convinced that Natural Selection has been the main but not exclusive means of modification.
>
> Charles Darwin (1859)[53]

Introduction

In order to gain access to the explanatory power and potential of Darwin's theory of evolution for the social sphere this Chapter aims to break it down into its essential features. Underpinning the previous Chapter and the notion of generalized Darwinism, Darwin's theory is here taken back to its roots in biology where the modern understanding of the theory has been clarified and illustrated through the insightful work of eminent scholars in biology, philosophy of biology, genetics and zoology.

Darwin's theory is first put into context with acknowledgement of its revolutionary nature and a brief discussion of Darwinian 'causality'. A detailed description of the early development of Darwin's theory, and in particular his population thinking perspective, begins with his early speculations about variety during his voyage on the Beagle, and it traces the philosophical conundrums that he faced as he attempted to conceptualize change in form over time. The analysis leads into an explanation of Darwin's core principles of variation, selection and inheritance, and then, with a reflection on the clarifications that ensued in the light of Mendelian genetics, Darwin's causal mechanisms are further illuminated through discussion of the important distinction between the genotype and phenotype. Related clarifications about the 'unit of selection' and thus causal 'direction' in the organizational hierarchy is then shown to throw light on the critical process of adaptation as well as the notion of acquired character inheritance. The basic theory is thereby set out, preparing the way for its

[53] Darwin, Charles [1859] (1975, p. 6) with an Introduction by Ernst Mayr *On the Origin of The Species: A Facsimile of the First Edition*

further elaboration in subsequent Chapters which discuss the more recent developments in evolutionary theory.

Darwinian Ontological Foundations: Causality

Although it is generally understood that Darwin's theory created a dramatic schism between theology and science through the momentous intellectual controversies it provoked, this historic but inevitable division actually served to mask the true nature and locus of the controversy (Dewey 1997, p. 2). Indeed, as Dewey makes clear, 'the issue lay primarily within science itself'. Essentially, while the arguments that were riled against Darwinism were inflamed by their religious associations, Dewey (p. 3) stresses that 'their origin and meaning are to be sought in science and philosophy, not in religion'. And what Dewey alludes to here is Darwinian *causality*, the Darwinian mode of thinking that completely overturned historic scientific and philosophical assumptions.

In contrast to the teleological determinist explanations that dominated the thinking of his own era, Darwin's science involved a commitment to causal explanation. Essentially there was no need for a prior intelligent causal force, or for purposive goal-oriented final cause explanations in Darwin's theory of natural selection. In Darwinism, complex outcomes are explained in terms of a detailed succession of step-by-step causal mechanisms. Darwinism *means* causal analysis (Romanes 1893); it embraces a method of cumulative cause and effect explanation, where every step in the process is expected to have a causal explanation.[54] Clearly Darwinism is focused on processes of change and their causal mechanisms, and the emphasis, as Darwin makes clear below [1985] (1975, p. 471), is on the gradual, accumulative effect of selection;

> As natural selection acts soley by accumulating slight, successive favourable variations, it can produce no great or sudden modification; it can only act by very short and slow steps.

Darwin's theory of evolution involves a continuous interplay between random variation and natural selection, so that causality cannot be described as strictly deterministic or indeterminate. Indeed as Monod (1971) suggests Darwinian causality combines 'chance' and 'necessity'. This unpredictable and indeterminate nature of

[54] Whilst Darwin [1859] (1975 p. 167) admits ignorance of certain causes, for example, with regard to the mechanisms that lead to variation, this does not mean that he thought they arose spontaneously, without prior cause, but only that their cause was 'unknown'.

evolution by natural selection has generated a certain amount of confusion about Darwinian causality and explanation, with recognition that prediction in biology is far more probabilistic than in the physical sciences (Mayr, 1976, p. 58). However, this does not therefore mean that it *necessarily* involves or implies a stochastic or probabilistic concept of causality (Hodgson, 2004, p. 87). Mayr illustrates the point by highlighting the sheer magnitude of stochastic perturbations in a species consisting of one million uniquely different individuals confronted with innumerable factors which determine reproductive success. As he makes clear, it is chance that will determine to a large extent how the unique individuals and their unique environmental constellations will mesh together, but these factors do not weaken the Darwinian principle of causality,[55] or indeed the principle of determinacy.

Noted by Dewey and others, Darwin's revolutionary theory not only overturned the most cherished religious beliefs of the western world, but, as Mayr (1982, p. 501) elaborates, it replaced one scientific belief ('immutable species') with another, encompassed profound philosophical implications (replacement of a static with an evolving world; implausibility of creationism; explanation of 'design' by purely materialistic process; replacement of essentialism with population thinking) and introduced a raft of philosophical and methodological innovations, which, significantly, included the consistent application of the scientifically respected hypothetico-deductive method (Ghiselin, 1969).[56] To reiterate, the schism that Darwin created was to find its true origin and explanation in science and philosophy. Accordingly, having briefly outlined the nature of Darwinian causality and indicated its philosophical implications, these will now be fleshed out with a detailed description of the theory. The discussion will begin with Darwin's replacement of essentialism with 'population thinking'.

Darwinian Ontological Foundations: Population Thinking

> Rather imperceptibly a new way of thinking began to spread through biology soon after the beginning of the nineteenth century. It is now most often referred to as population thinking.
>
> Ernst Mayr (1976)

[55] Mayr (1976, p. 42) 'Stochastic processes occur at every hierarchical level from the atomic nucleus up to the systems produced by the big bang. And stochastic processes, even though making predictions probabilistic (or impossible) rather than absolute, are just as causal as deterministic processes. Only absolute predictions are impossible owing to the complexity of the hierarchical systems, the high number of possible options at each step, and the numerous interactions of simultaneously occurring processes.'

[56] Mayr (1982, p. 501) also stresses 'a new evaluation of prediction … and the bringing of the study of ultimate (evolutionary) causations into science.'

One of the most important challenges that Darwin's theory posed to the thought of his age was the replacement of 'typological essentialism' with 'population thinking'. Ernst Mayr (1959), who is credited with the first full articulation of this revolutionary change, describes it as 'perhaps the most important conceptual revolution in the history of biology' (Mayr, 1976, p. 12), providing a well defined philosophical basis to Darwin's theory, an understanding of which is a prerequisite for the understanding of the evolutionary process (p. 11). This change in perspective requires an appreciation of the 'deeper sense' in which evolutionary biology is historical (Hull, 1990), and significantly it wholly explains the variability so crucial to evolutionary theory. In contrast to the essentialists, population thinkers stress the uniqueness of everything in the organic world; for them there is no such thing as a 'typical' individual, and mean values are an abstraction (Mayr, 1976, p. 46). Significantly, although population thinking was not an idea articulated by Darwin himself, he could not have arrived at a theory of natural selection without it (p. 47). This assertion will now be demonstrated by turning to Darwin himself. The following account of the development of his theory illustrates how he arrived at the population thinking perspective and leads into a demonstration of its foundational role in natural selection. All of which usefully informs understanding both of the logic of the theory as well as its general application.

Population thinking was born out of Darwin's need to explain change in form over time. Darwin was fascinated by the variety he saw in nature. On his five year voyage on the Beagle (1831 -1836) he became intrigued by the variety of species of finches on the different Galapagos Islands and observed in his *Journal of Researches* (Darwin, [1839] 1989) how, with their noticeably different beaks, they each appeared ideally adapted to their own particular environment. He reflected on the relationship between species and the environment. He was similarly curious to learn that natives of the islands were able to identify turtles by their different markings and thus know the particular island they inhabited (1989, p. 276-279). He pondered on the obvious familial likenesses between these species of finches and species of turtles and wondered how to explain their similarities and differences. Fossils and bones of extinct animals that Darwin collected presented similar puzzles, for again there were clear signs of some kind of continuity with existing animals as well as evidence of differences and discontinuity. Darwin later confirms that it was his experience of the Galapagos Islands that presented 'isolation' as an evolutionary factor (Mayr, 1959) and the environment as thereby being causally significant.

Darwin was strongly influenced by his friend and geologist, Charles Lyell[57] (1830), who concluded that the physical landscape had been shaped over many thousands of years and that such changes were brought about by the same geological processes that operate today, for example, sedimentation, erosion, earthquakes and volcanic eruptions. Lyell's (uniformitarian) view of gradual, cumulative change effected by environmental conditions, resonated with Darwin.

Indeed Darwin became convinced that species changed over time. But how could he explain the mutation of species to a scientific community who believed in fixed forms and the immutability of type? This question encapsulates the foundational metaphysical problem that confronted Darwin; its resolution difficult to appreciate today when we have long since jettisoned the closed world-view of Darwin's era. In order to illustrate the significance of this population thinking approach for our understanding of the evolution of complex systems, it is contrasted it below with the Aristotelian metaphysics of Darwin's contemporaries; foundational beliefs about the nature of being that informed the 'typological essentialism' perspective and which left a lasting impression across the sciences.

Metaphysical Foundations and Ontological Commitments

Dewey [1910] (1957) shows how the conceptual impasses experienced in the development of modern science were inextricably linked to the limitations of the ancient world-view. The closed and static world of Plato and Aristotle dictated the framework within which all philosophers and scientists tried to make sense of their world. And as Mayr (1959; 1976) has subsequently shown, vestiges of these conceptual constraints have continued to hamper progress in the natural sciences. Dewey (1957), below, sets out the contrasting conceptions of the structure and constitution of nature that underpin the ancient and modern cosmologies and elegantly highlights the conceptual difficulties that Darwin would have experienced (p. 54);

> The world in which the philosophers once put their trust was a closed world, a world consisting internally of a limited number of fixed forms, and having definite boundaries externally. The world of modern science is an open world, a world varying indefinitely without any possible assignable limit in its internal make-up, a world stretching beyond any assignable bounds externally. Again, the world in which even the most intelligent of men of olden times thought they lived was a fixed

[57] Darwin ([1844] 1996, p. 83) 'The greatest merit of the *Principles* was that it altered the whole tone of one's mind, and therefore that, when seeing a thing never seen by Lyell, one yet saw it through his eyes'.

> world, a realm where changes went on only within immutable limits of rest and permanence, and a world where the fixed and unmoving was…higher in quality and authority than the moving and altering.

In other words animate and inanimate beings simply did not change, develop yes, but they did not change their fundamental form. Darwin's speculations about animals gradually changing from one form to another were simply impossible within this perspective. What was involved here were the pre-Darwinian basic ontological assumptions, it essentially concerned fundamental questions about 'the realm of *being*, or of *what it is that exists'* (Meikle, 1995, p. 178). Significantly, what is observed here is contrasting foundational views about the nature of reality, in other words contrasting 'metaphysical foundations' or 'ontological commitments' (Quine, 1969). Ultimately it was the ontological commitment to the fixity of types that thwarted Darwin's explanation of change and diversity in the natural world and which he ultimately had to abandon in favour of his population thinking approach.

In the ancient's perception of reality, was a very specific ontological commitment to the idea of change as being 'transformational'. What this means is that the only kind of change in *form* that is acknowledged is when an entity 'matures' into its predetermined type (essentially what we tend to think of as development), for example, an acorn transforms into an oak tree, a child into a man, or a substance changes into its alternate state, for example, water changes from hot to cold.

From Darwin's point of view, a pertinent and limiting assumption of transformational change is that of 'final' or 'formal cause' (it is important to be aware of the peculiar meaning of the word 'cause' here). The final form of an entity is that form which by its nature it is *destined* to become. For example, 'the tiger moth larvae will develop into a tiger moth, if its development is uninterrupted, and this is its final cause' (Meikle, 1985, p. 177). Critically, in terms of the unshakable belief system, the final form, in the view of the ancients was God's creation and it was fixed in type. The only changes, as noted, would be limited to the 'unfolding' of the entity into this final, eternal form.

It is crucial to appreciate the rigidity of these perceptions of entities and change and what they suggested about variety. For example, the ancients did not perceive any overlap between forms; there were *preset* strict demarcations between different kinds of things. The extensive variety of forms that was observed in nature was explained as earthly deviations from an 'ideal' or 'perfect' type. This view is traced back to Plato who believed that the 'ideal' form was the only 'real' form of an entity and that earthly variations of form were mere representations or approximations of this ideal form. All

classes of things were destined to conform to their ideal type and any wild deviations were considered accidents and thus discounted. Significantly, then, it was this ideal type that was considered 'eternal', so that the form or ideal type of all classes of entities were *unchanging*. What we understand as species, for example, were 'eternal types' and they simply could *not* change.

Typological Essentialism

It is now possible to perceive the problem of explaining change beyond a transformational or developmental conceptualization of change. 'Different types', like Darwin's turtles, were not 'changed types', and variety was merely an expression of the incalculable imperfect specimens of the ideal form. The explanatory problem was compounded for Darwin by the Aristotelian desire to *classify* the inevitable multitude of 'types'. And this is where the notion of 'typological essentialism' comes in. The traditional world-view was not only constrained by fixed and finite types but it was also diverted by Aristotle's focus on 'essence', a focus that totally contrasts with that of modern science which aims at discovering *laws*; 'laws of motion', 'of generation' and 'of consequence'. Dewey draws out this critical difference below, and hints at Darwin's reorientation as he grappled with an explanation for the gradual change in species (1957, p. 61. my italics);

> [the modern man of science] speaks of *law* where the ancients spoke of *kind and essence*, because what he wants is a correlation of changes, an ability to detect one change occurring in correspondence with another. He does not try to define and delimit something remaining constant *in* change. He tries to describe a constant order of change.

Typological Essentialism versus Population Thinking

Certainly it would seem that, contrary to his predecessors, Darwin was focused on processes. He allowed himself to drop the notion of fixed types and instead turned his attention to the significance of the *variety* of types existing in populations. And, crucially, Darwin perceived that an explanation for change lay beyond the entity itself and related to its relationship with the environment.[58] So how did he then explain

[58] This realization is evident throughout Darwin's *Voyages of The Beagle* [1839] (1989) where he catalogues at length his observations of 'different' species of, for example, mocking birds, finches, turtles, ostrich, frogs etc., flourishing in different environments.

change in type when he was basically dropping the notion of a fixed type? *What* was actually changing and how? This is where Darwin confronted the inherent constraints of Aristotle's 'classification of forms' and typological essentialism, and came up with his population thinking perspective.

To illustrate, as indicated above, Aristotle's typological essentialism derives from Plato's notion of the 'ideal form'. The critical point here being the view that the 'ideal' form is the only 'real' form – and *not* its various 'representations'. Having firmly incorporated this 'unchanging form' into his understanding of the classifications of organic and inorganic things, Aristotle then used it to inform his strict demarcations between the numerous *classes* of things, between, for example, different kinds of plants and animals. And it was in these efforts to clearly mark the boundaries between 'kinds' or 'species' that he applied himself to the task of discovering their 'essence'.

Aristotle sought to identify the main or 'essential' characteristics of every form to somehow encapsulate exactly what it is that makes something the very thing that it is. And it is this, 'typological essentialism' that plainly articulates the philosophical conundrum that Darwin had to unravel. With this strict demarcation between species, epitomized in the customary Linnaean (1758) classificatory system, Darwin was confronted with a compendium of essential types that do not change. Darwin's incredible and creative insight was to turn away from this one-off fixed type and look to the implications of the 'uniqueness' that was subsumed in diversity. Crucially from a population thinking perspective focused on variety, Darwin was able to perceive how, through selection, change occurred *not* to individuals in the population in their own lifetime but to the *species* that changed over many generations. Those individuals of the population that were best suited (adapted) to the environment would be the 'types' that survived and their particular 'unique' characteristics being favoured by selection would prosper and thus come to 'redefine' or represent the change in the species.

Although, as noted, the population thinking approach is not something that Darwin himself articulated, it is nevertheless the revolutionary and necessary substructure formulated by him that facilitates the important and interconnecting aspects of his comprehensive theory. Praising Mayr's recognition and elucidation of this subtle but critically important metaphysical foundation to Darwin's theory, Hull (1990, p. 43), below, underlines the import of the former's insight;

> According to Mayr, population thinking requires that we view the living world as consisting not of 'types' but of variable populations in which each individual is unique

As Mayr makes clear, for the essentialist, entities are grouped according to a fixed number of typical traits that describe the 'essence' of that entity. For population thinkers, on the other hand, the emphasis is on variable populations of entities in which each is unique. Variations from type are perceived by essentialists as being 'deviations' or 'irregularities', whilst critically, for population thinkers variation is the very fuel of evolution (Mayr, 1988, p. 224);

> The whole concept of competition among individuals would be irrelevant if all these individuals were typologically identical - if they all had the same essence. Variability does not become meaningful in an evolutionary sense until a concept has developed that allows for differences among individuals of the same population. According to this concept, each individual may differ in the ability to tolerate climate, to find food and a place in which to live, to find a mate, and to raise young successfully.

Through the population thinking approach with its emphasis on the importance of variety it is possible to comprehend the explanatory significance of the key interweaving processes, and it is to these the analysis now turns; selection, variation and inheritance.

The Principles of Selection, Variation and Inheritance

As is now well documented, Darwin observed that it was upon reading Thomas Malthus (1798) in 1838 that he hit upon the idea of natural selection. He was impressed by Malthus' discussion of competition over scarce resources and conclusions about population growth and limited food supply. Malthus argued that, if left unchecked, the population would grow geometrically, and because of the law of diminishing returns, food would only increase at an arithmetical rate. Thus he concluded that there would be a food shortage and vast numbers of people would starve and die. Darwin perceived that there seemed to be a kind of 'natural' selection mechanism in operation here. Indeed as he (1958) reports himself, it was through Malthus that he finally found the critical missing piece for his evolutionary theory. His incorporation of the concept is seen below in his description of evolution by natural selection in *The Origins* [1859] (1975, p. 5);

> As many more individuals of each species are born than can possibly survive; and as, consequently, there is a frequently recurring struggle for existence, it follows that any being, if it vary however slightly in any manner profitable to itself, under the complex and sometimes varying conditions of life, will have a better chance of

> surviving, and thus be *naturally selected.* From the strong principle of inheritance, any selected variety will tend to propagate its new and modified form.

From this description the interconnectedness of Darwin's core principles of variation, selection and inheritance are clear. The variation discussed in the above section on population thinking, is seen here in its causally important role of fuelling evolution. The passage clearly articulates what Darwin meant by adaptation and how this was related to variation and selection. Basically variety is assumed to exist from the start, and within that variety there will be individuals who, for any manner of reasons, will be better adapted to the prevailing environment, and, as a consequence will survive the selection process and go on to produce more like themselves.

Clearly variety is critical to the selection process and it becomes evident why population thinking was so crucial to Darwin's theory, for amongst other things selection logically needs variety upon which to work. Whilst Darwin found that he was unable to explain the source of variation or indeed the mechanism of inheritance he nevertheless made it clear that variety was always there and was in abundance.

Another very important aspect of selection theory that Darwin did not draw out, but which is crucial for a clear understanding of the process, is that of it being a 'two-step' process. Again it is Mayr who articulates this subtle complexity and in his elucidation of this below, he elaborates the intricate nature of the relationship between Darwin's core principles (1988, p. 98);

> Natural selection proper is only the second stage of a two step process. The first step consists of the production of variation in every generation, that is, of suitable genetic or phenotypic variants that can serve as the material of selection, and this will then be exposed to the process of selection. This first step of variation is completely independent of the actual selection process, and yet selection would not be possible without the continuous restoration of variability.

Breaking the process down like this enables a fuller appreciation of the causal relationships and it clarifies the significance of the separate strands, such as variety and inheritance. Moreover, reflection on subsequent discoveries in biology offers further clarification. As indicated above, although 'the strong principle of inheritance' was one of the core elements of his theory, Darwin struggled to find an inheritance mechanism or indeed a heritable entity. And undoubtedly, the juxtaposition of inheritance and the 'logically required' variety in Darwin's theory does cause a certain amount of confusion when; 'inheritance implies continuity and constancy; [and] variation implies change and

divergence' (Mayr, 1982, p. 681). This made explanation of the inheritance mechanism very difficult for Darwin. The key to unraveling this, which was obviously not available at the time, is clearly genetics. But, Darwin at least recognised its location in the reproductive system and, significantly, though he did not develop an inheritance mechanism this did not detract from the logic of his theory.

Mayr's passage above alludes to the clarification that eluded Darwin but which was nevertheless finally facilitated in the rediscovery of Mendelian genetics. Mendel's experiments with peas provided the detail of an inheritance mechanism which was able to reconcile variety and inheritance. Finally biologists had a replicating, heritable entity which explained the continuity *and* replenishment of variety in the system. It was identified as the gene. Through sexual reproduction of the organism the gene pool recombined to provide a new variety of organisms each generation. Mayr neatly sums up the processes below (p. 163);

> New gene pools are generated in every generation, and evolution takes place because the successful individual produced by these gene pools give rise to the next generation. Evolution, thus, is merely contingent on certain processes articulated by Darwin: variation and selection. No longer is a fixed object transformed, as in transformational evolution, but an entirely new start is made so to speak in every generation.

In summary, the continuous restoration of variability to which Mayr refers in the first passage, is facilitated through the heritable replicating gene. Thus according to Mayr, the first step involves a replicating process whilst it is at the second step that the actual process of selection is involved. This is where 'selection proper' operates - on the individual organism. It is the second step that acts upon the 'previously produced variation' and, as Mayr points out, 'it is not a process which itself produces variation'.

The analysis now moves into the realms of genotypic and phenotypic distinctions and to the important role of inheritance brought to light in Mayr's two-step process. These will be looked at in more detail below in a review of the important theoretical and conceptual clarifications that emerged in evolutionary biology during the 1970s and 1980s.

Genotype and Phenotype

It is crucial, in understanding the causal 'direction' of the evolutionary process, to be clear about the distinction between the entities that operate in the two stages of the

selection process, in other words the 'dualism' of the genotype and the phenotype. For as Mayr (1976, p. 10) argues, 'we must fully understand this particular dualism before we can hope to understand the process of evolution'. Indeed protracted controversies in evolutionary biology over the Lamarckian notion of acquired character inheritance ('soft inheritance') could not be resolved until this was clarified.

Implicit in the above analysis has been the traditional 'hierarchy' of organic entities. That is, genes are found at the primary 'generational' level followed by the organism and then the species. Following advances in genetics and molecular biology during the 1950s there is now a clear distinction between what are known as the genotype and the phenotype[59] (corresponding to the first two 'levels') and consequentially an advanced understanding of both the inheritance mechanism and the selection process. Essentially, the genotype and phenotype denote the entities that function in the selection process described above. Returning to Mayr's 'dualism', the genotype is defined as 'the total genetic constitution of an organism', and the phenotype is defined as 'the totality of characteristics of an individual' (Mayr, 1982, pp. 958-959). He describes the important nature of this distinction below (1988, p. 16);

> All organisms possess a historically evolved genetic program, coded in the DNA…The presence of this program gives organisms a peculiar duality, consisting of a genotype and a phenotype.

It is important to observe that whilst Darwin himself did not have the genotype phenotype distinction[60] it was nevertheless implicit throughout his writings (Mayr, 1988, p. 100). It is clear, for example, that Darwin perceived that the organism as a whole (the phenotype) was the unit or 'target' of selection (Mayr, 1988; Hull, 1981; Lewontin, 1970; Gould and Lloyd, 1999). To reiterate, the *genotype* is the genetic composition of an organism whereas the *phenotype* is its developed characteristics or capacities. In other words, the phenotype is the physical manifestation of the genotype; the physical or behavioural characteristics or capacities such as blue eyes or nest-

[59] Although the terms were coined as long ago as the beginning of the twentieth century (by the Danish geneticist, Wilhelm Johannsen [1909]), it was not until the 1950s that the fundamental difference between the genotype and phenotype were fully understood (Mayr, 1982, p. 783)

[60] Hodgson and Knudsen (2006b): 'Neither Lamarck nor Darwin used the terms genotype or phenotype, but some such conceptual separation was implicit in their discourse. Writing in a biological context, they both assumed that information related to characteristics was transmitted from generation to generation through such information-carrying entities as seeds, sperm, ova, pollen, or stigma. When Darwin (1859, 1868) wrote of the 'reproductive system' and of 'germ cells' he was referring to the processes of genotypic, not phenotypic, replication. Neither writer believed that replication occurred by the direct copying of characteristics, so that their writing in the biological context embodied an implicit distinction between genotype and phenotype.'

building. The phenotype is thus 'shaped' by the genotype, the genotype controlling its production. So that a phenotype is what we generally understand as the 'visible' organism.

Thus, in terms of the organizational hierarchy, when evolutionists refer to the selection process they are describing what is generally thought of as selection of the organism. In the above terminology then this means selection *of* the phenotype and, *as a consequence*, selection *for* the genotype (Sober, 1984). The genotype is only *indirectly* selected. It is very important to stress that in spite of the apparent awareness of a genotype-phenotype distinction there was considerable confusion and debate in evolutionary biology over the establishment of this hierarchical perspective on selection (Brandon, 1999; Gould and Lloyd, 1999). Indeed, the above consensus on the locus and causal agency of natural selection was not achieved until the 1980s, after the resolution of the infamous 'unit of selection debate'. As will be shown in Chapter 5, as well as confirming the original Darwinian hierarchy this also made the vector of causality much easier to perceive.

Subsumed within this intricate causal story, however, is another theoretical component that has similarly generated a certain amount of confusion and deserves special attention here. This is the important notion of adaptation. The next section will look at how this is conceptualized in Darwinian evolutionary theory and it will then consider the contrasting conceptualization of adaptation in Lamarckian evolutionary theory.

Adaptation

Darwin used the term 'adaptation' to refer to the remarkable symmetry that he observed in nature; organisms appeared to be so perfectly 'adapted' to their environments. His early wonderment at this reality made him acutely sensitive to its cause, and adaptation and its explanation became a crucial part of his theory of natural selection, or what he otherwise called 'descent with modification'. He describes the role of adaptation in a passage from *Origins,* below, [1859] (1975, p. 469) where he is extolling the power of natural selection;

> What limit can be put to this power, acting during long ages and rigidly scrutinising the whole constitution, structure, and habits of each creature, - favouring the good and rejecting the bad? I can see no limit to this power, in slowly and beautifully adapting each form to the most complex relations of life.

It is important to appreciate exactly what Darwin meant, however, when he talked about organisms adapting to or being modified by their environment, since this has often been misconceived (Mayr 1982). The population thinking perspective and 'two-step' process of natural selection again offers clarity here. Darwin did not mean, for example, that individual organisms were continually adapting to their environments and changing as a result (in the Lamarckian sense). As noted earlier (p. 67), it is the species and not the individual organism that changes or 'evolves'. In the above, when Darwin talks of 'each creature' and 'each form' he is speaking of the species, not individual organisms in their lifetimes. In other words, adaptation should be recognized as happening *to the species.*

To be sure, it is selection that 'causes' organisms to be so well-adapted to their environment (Mayr, 1982, p. 358). As Mayr reminds us, 'for the Darwinian, adaptation is the result of natural selection', selection operates on the *existing* variety and it is those organisms that happen to be better adapted to the particular environment which are selected. And through propagation, it is the features of these organisms that will be represented in the next generation, so that the species is continually evolving and fine-tuning its fit with the environment. To repeat, adaptation is a product of selection. This Darwinian conceptualization of adaptation leads finally to 'Lamarckian inheritance' and its contrasting interpretation of adaptation.

Lamarckian Inheritance

Lamarckian inheritance is the evolutionary theory promoted by Jean-Baptiste de Lamarck (1809), which proposes the inheritance of 'acquired' characteristics. According to Lamarck, changes that are acquired during the lifetime of an organism and which result from its interaction with the environment can be passed on to the offspring of that organism. In other words phenotypic changes or 'adaptations' are somehow transmitted to the organism's genotype and then passed on to the next generation in reproduction. Thus for Lamarck the environment was the driving force of change as opposed to any kind of selection process. Indeed, Lamarck did not have a selection theory, so that in contrast to Darwin, he perceived that it was the environment that caused adaptational change within individual organisms and in turn explained the variation amongst organisms (Mayr, 1982, p. 354). Clearly this reflects fundamentally different perceptions of adaptation.

Lamarckism has since been widely discredited in biology, its outright rejection in 1883 being associated with the selectionist, August Weismann (1893), and its 'conclusive refutation' in the 1950s attributed to discoveries of the molecular biologists (Mayr, p. 508). Weismannism essentially denies the possibility of the inheritance of acquired characters.

However, there are three important points that have emerged with regard to the notion of acquired character inheritance and the relationship between Lamarckism and Darwinism. Firstly, Darwinism and Lamarckism are not mutually exclusive; secondly Lamarckism needs Darwinism to work as a theory; and thirdly (particularly relevant to socio-cultural theories of evolution), in contrast to Darwinism, there are considerable problems in generalizing the Lamarckian position. These issues will be elaborated in Chapter 6, which focuses on Lamarckism and the more recent developments of theory, but they are briefly summarized below.

It is important to stress that Darwin (1859) himself did not discount the possibility of the inheritance of acquired characters. Unaware at the time of genetics, his 'elusive inheritance mechanism', he did not perceive Lamarckian inheritance to be irreconcilable with his theory of natural selection. In fact it gained increasing importance in his theory, as evidenced in later editions of *Origins.* However, although the meta-Darwinian framework may accommodate Lamarckian inheritance it does not require it, and thus stands alone as a theory. But significantly, the reverse is not true. In order for Lamarckism to work it requires a selection process and would thus ultimately be dependent on the theoretical foundations of Darwinism. In his exploration of the relationship Dawkins (1988, p. 300), below, vividly describes this dependency of Lamarckism upon Darwinism and clearly underlines the point that the two are not mutually exclusive;

> The Darwinian maintains that the only reason even a minority of acquired characteristics are improvements is that there is an underpinning of past Darwinian selection. In other words, the Lamarckian theory can explain adaptive improvement in evolution only by, as it were, riding on the back of the Darwinian theory.

Lamarkian acquired character inheritance is an important, if controversial, idea in evolutionary biology, and its contrasting conceptualization of adaptation particularly important to establish here. However, when it comes to the generalization of Darwinian evolutionary theory, it is very important to stress that whilst acquired character inheritance has been discounted in biology it is nevertheless *not* inconsistent with

Darwinism. So that, for our purposes here, at a general level the idea of character inheritance is not denied in *other* evolutionary systems, such as socio-economic systems.

Concluding Remarks

In summary, the essential features of Darwin's theory of evolution have been set out. The core principles of variation, inheritance and selection have been explored against the backdrop of the population thinking perspective. With this introduction to Darwinian theory and its basic concepts we are certainly better equipped to appreciate its generic nature. However, before going on to examine the case studies in detail, I propose to enhance this understanding and facilitate a much more incisive evaluation by bringing the Darwinian explanation right up to date. In the following Chapters, there will be a discussion of the key advances in biology and the philosophy of biology which are pertinent to the case studies here under study, as well as to the notion of general Darwinism and the general aspiration for a social theory of evolution. Chapter 5 unpacks the unit of selection debate and introduces the new generalized terminology that facilitated its resolution; Chapter 6 deals with Lamarckism and explains its important relationship with Darwinism; and Chapter 7 moves on to deal with the advances being made towards multilevel selection theory.

5 Units of Selection

Introduction

This Chapter and the next two Chapters focus on the important theoretical developments and conceptual refinements that have recently taken place in biology and the philosophy of biology. They deal respectively with, the units of selection issue, Lamarckian inheritance, and group and multilevel selection. This is very complicated conceptual territory but nevertheless crucially important to a proper understanding of generalized Darwinism, so that it is fitting to divide the Chapters in this way. However whilst they deal with different themes, these are all nevertheless intricately related, and it will be seen that the same concepts and terminology that are introduced in this Chapter are also used to clarify the issues of the subsequent Chapters.

Having set out the modern interpretation and philosophical basis to Darwinian theory in the previous Chapter, here the focus is on the little-known but critically important theoretical and conceptual clarifications that occurred during the 1970s and 1980s which established and articulated the general nature of the theory. Accordingly, evolutionary theory is brought right up-to-date, and the implications of these developments for the social domain are highlighted. The discussion is focused on the important developments around selection theory which followed Mayr's conceptualization of selection as a 'two-step' process. Focusing on the unit of selection debate and an elucidation of its important resolution, the discussion leads inescapably to the role of genotypes and phenotypes, finally unpacking their clarifying and generalized reformulation as 'replicators' and 'interactors' respectively. In addition to providing critical clarification of the selection process, the analysis sheds further light on the role of variation and makes clear the vector of causality in selection processes.

This sets the scene for Chapter 6 which focuses on Lamarckian evolution and issues pertaining to inheritance and the transmission of information. And the culmination of these theoretical refinements is then shown in Chapter 7 where it will be seen that they facilitate the conceptualization not only of group-selection, but also multilevel

selection theory (Lewontin, 1970; Brandon, 1986, 1990; Henrich, 2002, 2004; Sober, 1999; Wilson, 1999), two critical components in the construction of a social theory of evolution.

From the Modern Synthesis to Generalized Darwinism

The previous Chapter essentially summarized what biologists have come to understand as modern Darwinian evolutionary theory, in other words, the synthesis of Darwinism and Mendelian genetics.[61] In this 'gene-based' evolutionary story natural selection operates upon a population of variable organisms and results in the differential survival of those organisms better suited to the common environment, and the inheritance mechanism, and important source of continuity and variety, is explained through Mendel's heritable gene. In this classic Darwinian formulation the organism or phenotype is understood to be the 'unit' of selection. And indeed for most non-biologists with an interest in Darwinian theory, this description roughly sums up their understanding of evolution by natural selection.

Following advances in the fields of genetics, paleontology, zoology and ecology, evolutionary theorists have significantly fleshed out the theory and there is much more consistency in interpretation across the sciences. By the middle of the twentieth century, for example, geneticists had already moved from cryptogenetics (the study of the transmission of hereditary characters) to phenogenetics (the concern with the manifestation of hereditary characters in the phenotype) to the then expanding field of population genetics (Simpson 1944). Paleontologists, meanwhile, had moved beyond their initial concern with the determination and classification of form, to a very real interest in the actual causal mechanisms of evolution. They had finally come to realize, like the geneticists, the importance, amongst other things, of variation and population thinking for the explanation of evolution (p. xvi).

What this meant for evolutionary theory was the beginning of a broad synthesis of ideas from across the sciences. Today, the elucidation of evolutionary theory and its mechanisms has benefited from research in genetics and molecular biology (Dobzhansky, 1970; Monod, 1971; John Maynard Smith, 1975, 1989) and has been considerably enhanced by the recent theoretical and conceptual insights achieved in the philosophy of biology, as well as by the contributions of evolutionary theorists from an

[61] Often referred to in the biological literature as 'neo-Darwinism'

expanding range of natural and social sciences (Boyd and Richerson, 1985; Wilson and Sober, 1994; Sober and Wilson, 1998; Plotkin, 1994; Dennett, 1995; Cziko, 1995; Gould and Lloyd, 1999; Keller et al, 1999; Henrich, 2000, 2002). Darwin's theory of evolution has essentially been unpacked and made far more meaningful and accessible. And, crucially, for the purposes of this study, the outcome of these recent developments is that Darwinism has clearly and convincingly been shown to have general application.

As noted, the key theoretical developments in the articulation of general Darwinism was the crucial unraveling of the 'unit of selection' debate (Lewontin, 1970; Hull, 1980, 1981) and the introduction of generalized terms to describe the evolutionary process (Hull, 1988), developments which are notably now being recognized in the organizational studies and evolutionary economics literature (Baum and Singh, 1994; Aldrich, 1999; Ziman, 2000; Wheeler et al, 2002; Murmann, 2003; Laurent and Nightingale, 2001; Hodgson, 2001b, 2002b; Knudsen, 2001). In the discussion of these developments below, it will be shown that the Darwinian process of natural selection is actually deceptively complex (Mayr, 1976; Dennett, 1995). In addition to revealing its relevance for the socio-economic domain, it will also usefully illustrate why there is continued confusion about units and levels of selection in the socio-economic domain (Galunic and Weeks, 2002; Aldrich, 1999).

Unit of Selection Debate

The issue of the unit of selection, and the level at which selection takes place, presents considerable conceptual problems for evolutionary theorists working in the social realm. And, significantly, this uncertainty has contributed to the conflicting views about adaptation and selection and the vector of causality in evolutionary processes (Murmann and Rivkin, 2003). Consequently, its resolution in evolutionary biology has profound implications for social scientists, a small number of whom are already beginning to explore its potential.

The units of selection debate focused attention on a very important aspect of the process of selection, and that is the vector of causality. What is the biological entity that is being selected in natural selection? What does this say about the cause of evolutionary change? And what are the implications for the important notion of group selection? As suggested in the previous Chapter, during the 1960s and 1970s the traditional Darwinian view of the organism as the unit of selection was seriously

challenged. It became apparent in the biological literature that there were conflicting interpretations of the identification of the unit of selection (Brandon, 1990; Lloyd, 1992). Was it, for example, the gene, favoured by many geneticists (Haldane, 1932; Fisher, 1958)? Or the organism, favoured by traditionalists? Or the group, favoured by the naturalists? A substantial and protracted controversy ensued which was later identified in the literature as the 'units debate' (Brandon, 1982, 1999; Brandon and Burian, 1984; Reeve and Keller, 1999).

It would seem that in spite of the generally agreed Darwinian evolutionary story, considerable ontological and conceptual confusion arose as a result of theorists disagreeing over the actual unit of selection. In the hierarchically arranged biosphere of genes, organisms and species, Dawkins (1976), following Williams (1966), famously promoted the gene as the primary unit of selection. Others promoted the group (Wynne-Edwards, 1962), and even the species (see Vrba, 1984), whilst Mayr (1976, 1997), following Darwin, consistently promoted 'organismic' selection. Evidently there was serious theoretical concern to properly locate the vector of causality and as the philosophical debate unfolded the sheer complexity of the selection process itself became apparent (Mayr, 1982, p. 595).

The selection process appeared to be multifaceted and causally at variance. It was seemingly both deterministic and undirected and appeared to involve much more than 'mere' selection. It did not help matters that the term 'unit' had never been properly defined (Mayr, 1988, p.100) and that Darwin was unable to be more precise about his organism and its heritable entity. Indeed the debate refocused attention on what Mayr (1976, p. 9) calls Darwin's 'two factor explanation' of evolution; of genetic variability and natural selection. It also consequently challenged the intrinsic duality of the genotype (the genetic endowment of the individual) and phenotype (the body into which this genotype has been transformed during development) (Mayr, 1982, p. 781) and caused confusion about the biological hierarchy.

Evidently for some evolutionists, the causally implicated unit of evolutionary change was the gene since it replicated its structure from generation to generation and spawned the successively better-adapted organisms. Whilst for others it was the organism, since through its interaction with the environment, where it competed for survival, it caused the differential replication of the genes. So was it the gene that determined the path of evolutionary change or the organism?

General Characteristics of Darwinian Evolutionary Theory

Evolutionary theorists eventually began to perceive that two distinguishable questions had become conflated within the units of selection debate (Hull, 1980, 1981; Brandon, 1982); 'one has to do with the units of *replication*, the other with the units of *interaction'* (Brandon, 1999 p. 617). Specifically, there was confusion over the identity of the unit of selection and the level at which selection occurred, with some theorists focusing on the 'unit' (the gene, the group or the species) for their analysis, while others focused on the 'level' of the organizational hierarchy for their analysis. Hull outlines his perception of the problem below (1984, p. 145);

> The phrase 'unit of selection' is inherently ambiguous. Sometimes it means those entities which differentially replicate themselves, sometimes those which interact with their environments in ways that are responsible for this replication being differential. Both processes are *necessary* for evolution to occur.

Illuminating the nature of this confusion and the key to its resolution, Hull (1981) reflects on the approach of the geneticist Richard Lewontin (1970), whose important work initiated this theoretical and conceptual shift, observing how the latter begins by first characterizing the evolutionary process and then considering evidence for and against selection at various levels of organization. Hull then explains his own distinctive approach, which in contrast, begins by focusing on the evolutionary process itself, investigating its *general* characteristics, and only then considering which entities have the requisite characteristics to function in the evolutionary process. In so doing he not only helped resolve the units of selection problem but significantly he illuminated the general nature of Darwin's theory. His reasoning for a more *general* theory is summed up in the following passage where he highlights the new generalized terminology (2001, p. 21);

> One reason why evolutionary biologists have been unable to discover universal regularities in the evolutionary process is that they are not comparing like with like. They are dividing up the organizational hierarchy inappropriately. The appropriate levels are not genes, organisms, and species as they are traditionally conceived, but replicators, interactors, and lineages.

The significance of this conceptual insight for the social sciences cannot be overstated. Like Lewontin and others, Hull saw that Darwin's theory could be stated in

an abstract and general way, and he thus sought to clarify the evolutionary mechanisms in Darwin's theory and to articulate its general nature. With his perceptive approach, in extricating the analysis away from biological terminology and their attendant assumptions, he was able to illuminate the theory and show that evolution is 'not uniquely, or even necessarily, a biological phenomena' (Potts 2000). As will be illustrated below, not only does his work make the theory more accessible and facilitate its general application, but it also critically clarifies causality in evolutionary systems (nature of variety, selection, adaptation) and ultimately enables the conceptualization of group and multilevel selection, as well as the clear articulation of 'Lamarckian inheritance' within a Darwinian framework. Clearly, as evidenced in earlier Chapters above, the notions of group selection, multilevel selection and Lamarckian inheritance are all critical components of social theories of evolution, and as will be evidenced in the case studies below, their adoption is often confused and tractability uncertain. The detailed elucidation of Hull's conceptual developments will now resume below, while their implications for the aforementioned topics will be elaborated over next two Chapters.

Selection: a Two-Step Process

A critical factor in Hull's resolution of the selection debate was Mayr's (1978) insightful recognition of natural selection as a two-step process (Brandon, 1996, p. 124). As documented in the previous Chapter (p. 69), Mayr usefully observed that the first step involves a replicating process whilst it is the second step where 'selection proper' operates, on the individual organism interacting with its environment. To reiterate, it is the second step that acts upon the previously produced variation and it is not a process which itself produces variation. *This*, according to Mayr (1997, p. 2091), is Darwinian selection 'as it is fully understood by the evolutionists'. However, because of its theoretical subtlety it is perhaps not surprising that it has been lost on non-biologists.

Essentially in this two-step selection process Hull evidently perceived the organism's 'peculiar duality' and, most importantly, he observed the functional distinction between its genotype and phenotype. Accordingly he decisively shifted the conceptual focus of the units of selection debate and speculated about 'units of replication' and 'units of interaction'. Marking their crucially important functional distinction, Hull thus proposed not units of selection as such, but two interacting 'sub-processes', 'replication' and 'interaction', operating within a single selection process.

This was a substantial development in the clarification of Darwinian theory. Hull's conceptual framework, with its articulation of interacting 'sub-processes', provides greater insight, not only to the deceptively complex selection process, but also to the important interconnecting mechanisms of variety formation and inheritance. It describes what is understood as the basic 'single level' selection process,[62] and as indicated, its elucidation in his universal 'revamped ontology' (Eldredge, 1986) is what ultimately facilitates a credible multi-level selection theory (Gould and Lloyd, 1999; Reeve and Keller, 1999). But for our immediate purposes here, it illuminates the decisive relationship between the genotype and phenotype, crucially demonstrating that it is the interactor and not the replicator that is the 'causal unit of selection' (Gould and Lloyd 1999). And it is to the explanation of this finer point that the analysis now returns.

Replicators and Interactors: A Generalized Darwinian Ontology

The replicator concept was adopted from Dawkins (1976) to distinguish the replicating function of the first entity in Hull's conceptual framework from the second. It should be noted however that in the establishment of Hull's generalized ontology he came into dispute with Dawkins over the appropriate term for the phenotype (Hull, 2001). Dawkins, who notably also extolled the general nature of Darwinism (1976, 1984),[63] promoted the 'vehicle' concept which, for several important reasons, Hull rejected. These will be examined in subsequent sections but it is important to note here that while Dawkins still prefers his vehicle concept he now accepts Hull's important distinction between the replictor and interactor (Hull, 2001 p. 26).

Dawkins (1976) introduced the term 'replicator' to identify the gene and to highlight the nature of its role in evolution. In so doing he rejected the then prominent 'group selectionist' view in biology, that evolution was 'for the good of the species', and famously promoted the gene as the primary unit of selection. Clearly, although Hull was opposed to Dawkins's gene-selectionist viewpoint, he was nevertheless impressed

[62] The relevance and significance of this becomes more apparent in discussions of multiple levels of selection, as will be explained in Chapter 7 below.

[63] It is important to point out that unlike most Darwinians, Dawkins adopts a reductionist perspective. His notion of 'universal Darwinism' embraces genetic determinism, an idea rejected in 'general Darwinism', which in contrast, is not biologically reductionist. Confusingly, however, many theorists continue to identify with 'universal Darwinism', for as Hull (Personal Communication, 6th June 2004) observes, one can be a universal Darwinist without being a reductionist.

by the universal nature of his replicator concept, defined by Dawkins as 'any entity in the universe of which copies are made' (1984, p. 162).[64]

Hull however refines Dawkins's idea of a replicator, emphasising the *directness* of replication. Hull's definition reads 'an entity that passes on its structure largely intact in successive replications' (1988, p. 408). He seeks to emphasise the directness of replication because this marks a crucial distinction between the replicator and interactor, where the later makes *inexact* copies of itself through reproduction.

However, although Hull embraced the replicator term, along with many others (Brandon and Burian, 1984; Eldredge and Grene, 1992; Keller and Reeve, 1999), he rejected Dawkins's misleading 'vehicle' concept, designed as it was to denote the phenotype as 'the gene-carrying survival machine'. Hull argues that in his overemphasis of the role of the replicator Dawkins erroneously downplays the important causal role of the organism, suggesting that replication is not just necessary for selection but also sufficient (2001, p. 22). Hull shows that on the contrary, replication is not sufficient and that another process is also involved which he calls 'interaction'. He defines an interactor as 'an entity that directly interacts as a cohesive whole with its environment in such a way that this interaction *causes* replication to be differential' (1988, p. 409).

Note the careful use of the word 'causes' in the above definition. The biological literature shows that there is a general understanding of selection as the mechanism that results in the differential survival of 'fitter' units; those that are better adapted to the common environment. This is coupled with an appreciation that this logically involves, and is partly determined by 'interactions' with the environment. This process is what Hull wished to unpack and to distinguish from the replicating function of the genotype. He agrees with Dawkins that the gene is a replicator and he agrees that 'in a derived sense' it is a unit of selection. However he also agrees with opponents of gene-selectionism, such as Sober and Lewontin (1982), who argue that any theory that is limited to this single aspect of the evolutionary process is inadequate. Indeed, like Lloyd (1988), he believes that the units of selection debate was misguided and should have been focused on environmental interaction not replication.[65] It is the interactor that is 'selected' in the true Darwinian sense. And this is what needs emphasizing.

[64] Indeed Dawkins (1976) famously promoted the 'meme' concept to denote cultural replicators.
[65] (Hull 2000, p. 54) 'One important difference between Dawkin's analysis of selection and mine is that Dawkin's (1994) introduced his notion of vehicle only to bury it. I argue that environmental interaction is a necessary part of the selection process. It is present at a variety of levels of organizations and cannot be eliminated without serious explanatory loss'.

Essentially Hull argues that Dawkins was confusing the *functions* of his replicator and vehicle, and this has important implications for the understanding of causality. Justifying his own interactor term, below, and stressing the importance of acknowledging the two causally distinct processes, Hull sums up Dawkins apparent oversight in the following way (1984, p. 150);

> Dawkins is running two powers together – the power to reproduce one's structure and the power to do so differentially. These powers are sufficiently different to be distinguished terminologically. As Mayr (1978, p. 52) emphasizes, evolution through natural selection is a two-step process, '(I repeat!), a two-step process.' Thus I think Dawkins's general analysis of replicators needs supplementing with a general analysis of the entities that function in this second step. For want of a better term, I suggest 'interactor'…

Significantly, in terms of this important clarification of evolutionary theory, Dawkins has subsequently acknowledged the import of Hull's criticism, observing his own failure to make a clear distinction between replicators and vehicles, and accepting that genes and organisms play quite disparate roles in selection processes (Brandon and Burian, 1984, p. 87).

Causal Role of the Interactor

In the light of these clarifications, and others, it is now possible to illustrate exactly what is meant when evolutionists talk about the 'causal role' of the interactor (Gould and Lloyd, 1999),[66] and moreover how this might be interpreted in the social domain. Although Hull stresses the importance of the interplay between replicators and interactors, he is still concerned to stress the traditional Darwinian causal hierarchy, with genes which 'code for' the characteristics of organisms, decidedly at the bottom of that hierarchy. In other words he was keen to point out the 'indirect' selection of replicators, and the causal role of the interactor. He was greatly assisted in this endeavor by Sober's (1984) timely observation that evolutionists were often confusing the distinction between selection *of* an object and selection *for* a property. Clearly in Hull's terminology this amounts to the selection *of* an interactor and the selection *for* its replicator. In the social realm, following, for example, Nelson and Winter (1982), this would read as selection *of* the firm and selection *for* the routine.

[66] Also referred to by Hull as the 'primary interactor' (1988, p. 434)

In this widely accepted formulation it can now be seen that the replicator is 'selected' only as a consequence of the interactor being selected. This finally and significantly clarifies the vector of causality. Evidently it was this subtle interplay between replicators and interactors that caused the protracted confusion about causal direction in Darwin's 'two factor' explanation of evolution (Mayr, 1976). It is little wonder, therefore, that social scientists remain similarly confused over these issues.[67]

To be sure, the resolution of the units debate was a monumental achievement in evolutionary biology. Indeed, quite apart from making sense of the selection process, it also served to confirm and to clarify many important aspects of Darwin's theory, including, for example, confirmation of the organism as the 'primary interactor' and unit of selection, and clarification of the Darwinian vector of causality and account of variety creation and adaptation. But, significantly, more than this, these theoretical and conceptual advances had far-reaching implications, for as demonstrated here, they finally confirmed the general nature of Darwinism, and provided the conceptual apparatus for its articulation. Here, at last, in the replicator-interactor terminology, were the conceptual foundations of the Darwinian meta-theoretical framework.

Concluding Remarks

The implications of these major theoretical and conceptual clarifications for socio-economic theories of evolution are substantial. Careful analysis of leading works in organization studies and evolutionary economics has shown time and again that there is deep confusion over units and levels of selection, and at the heart of these confusions is an evident need to distinguish between replicating entities and a unit of selection.[68] Furthermore it is equally apparent that scholars seek to articulate group and multilevel selection, they intuitively realize that selection occurs at multiple levels but its articulation has proven elusive and where it is assumed or implied theories have inevitably suffered problems of tractability.

Significantly, as indicated here, and will become apparent in Chapter 7, the replicator-interactor terminology *also* enables the articulation of group selection and, moreover, facilitates the conceptualization of multilevel selection. Indeed, as will be

[67] Indeed this will be demonstrated in the case studies where the significance of the replicator-interactor distinction will be seen to impact not only on the selection theories but also upon conceptualizations of variety formation and continuity (inheritance).

[68] It is interesting, for example, to observe that Nelson and Winter readily adopt the routines as genes analogy and moreover, that like Hannan and Freeman and Aldrich, group selection is immediately assumed and multilevel selection is implicit in the theory.

demonstrated, there is considerable potential for social scientists to enhance their evolutionary theories by engaging with these important developments. Before moving on to these topics, however, and in order to ensure their comprehension and illustrate their consistency with the Darwinian story, it is important to be clear about the complete 'variation, inheritance and selection' dynamic and thus to similarly consider the modern articulation of the inheritance mechanism and variety creation. Accordingly, in the next Chapter it will be shown how the replicator-interactor distinction is critical to the articulation of *both* Darwinian inheritance *and* Lamarckian 'acquired character' inheritance. In addition, it will also be shown how the Lamarckian inheritance with which social scientists are traditionally associated is actually theoretically dependent on Darwinism in order to work as a theory.

In summary, building on the theoretical clarifications of the selection process illustrated here, the following Chapters, on Lamarckism and multilevel selection, will essentially show how the same conceptual apparatus facilitates the conceptualization and articulation of both Lamarckian inheritance and multilevel selection *within* a Darwinian meta-theoretical framework. And consequently it provides for a comprehensive theory of socio-economic evolution.

6 Lamarckism

> The combination of selection and intentional learning from experience provides a vastly richer evolutionary framework, than when either is taken in isolation. In cultural evolution, so many mechanisms point to endogenous variation of knowledge that to insist on the separation of selection processes from developmental processes is to miss a major element in the evolutionary dynamic of modern capitalism.
>
> J. Stanley Metcalfe (2004)

Introduction

The selection process, as demonstrated in the previous Chapter, is central to an understanding of Darwinian evolutionary theory. However, in order to fully understand its subtle complexities, and thereby understand causality in evolutionary theory, it is also necessary to have a basic grasp of the interweaving processes of inheritance and variety formation. In other words, it is necessary to comprehend the *three* Darwinian principles of variation, inheritance and selection. Only then is it possible to appreciate the 'very different kind of causality' (Hull, 2001, p. 93)[69] expressed in Darwin's cumulative selection process, and to perceive the important implications of biological evolutionary theory for the socio-economic domain. Thus the present Chapter focuses on inheritance, and in particular in the comparison between the Lamarckian inheritance mechanism and that of Darwinian inheritance mechanism.

In the examination of 'Lamarckism' and what it represents to scholars in organization studies and evolutionary economics, it will be shown here how established assumptions associated with a Lamarckian account of evolution actually frustrate a coherent theory of socio-economic evolution. It will be seen here how the theoretical advances and conceptual clarifications discussed in the previous Chapter, recently enhanced by the work of Hodgson and Knudsen (2006b), have also facilitated greater understanding of the inheritance mechanism, particularly the recognition of the 'peculiar duality' of the organism and conceptualization of selection as a two-step process. Whilst confusions

[69] As Hull (2001, p. 93) stresses, it is a kind of causality 'very different from our ordinary conceptions of causation.' B. F. Skinner (1974 pp. 40-41) puts it this way, 'Darwin discovered the role of selection, a kind of causality very different from the push-pull mechanisms of science up to that time.' And Mayr (1988, p. 458) elaborates, 'Natural selection has been particularly puzzling to the physical scientists, because it is so different from physical theories and laws. It is neither strictly deterministic not predictive but probabilistic with a strong stochastic element'.

over the Lamarckian perception of adaptation and variety creation are corrected, and the Lamarckian notion of acquired character inheritance is shown to be impossible without the replicator-interactor distinction, the following discussion will nevertheless also show that Lamarckism and Darwinism are not mutually exclusive, and that the important notion of acquired character inheritance is accommodated in a general Darwinian account; an account which (contrary to widespread misconceptions) also explains intentionality, the other critical component of socio-economic theories of evolution.

Lamarckian Inheritance and Socio-Economic Theories of Evolution

The evolutionary label traditionally borrowed from biology by organizational scholars and evolutionary economists is that of pre-Darwinian 'Lamarckism'[70] (Boyd and Richerson, 1985; Burgelman, 1985, 1991; Nelson and Winter, 1982, Singh and Lumsden, 1990), or more specifically, the idea of Lamarckian inheritance. Lamarckism admits the possibility of the inheritance of acquired characteristics, in other words, within-generation inheritance, as opposed to intergenerational inheritance. Undoubtedly, the process which involves individual organizations adjusting strategy, adapting to the prevailing conditions, changing their form, and going on to reproduce that new form, is 'Lamarckian', as the term is generally understood by evolutionists (Mayr, 1976).

However, as will be demonstrated here, although the Lamarckian 'adaptationist' perspective may be a very apt heuristic and particularly relevant to theories of the socio-cultural realm (McKelvey, 1982 p. 220), whilst employed in isolation from other key evolutionary processes, as has been the tradition in much of organization studies (Cyert and March, 1963; Levitt and March, 1988), where it is effectively employed as an alternative to Darwinian evolutionary theory (Bruderer and Singh, 1996), it nevertheless remains a rather limited paradigm (Hannan and Freeman, 1989; Metcalfe, 2004). Reiterating McKelvey's criticism of the failure to identify an 'organizational generation,' for example, or a 'social vehicle' for transmitting or inheriting traits, Van de Ven and Grazeman (1991, p. 186) argue that 'the Lamarckian view sidesteps (but does not solve) a central impediment to research on organizational evolution.'

Indeed the Lamarckian perspective raises several important conceptual problems for an evolutionary theory of organizations. Some of these relate to its loose interpretation

[70] A theory attributed to the French evolutionist, Jean-Baptiste de Lamarck (1809), because of his popularization of the idea of the inheritance of acquired characteristics. However, the idea of character inheritance, subsequently dubbed 'Lamarckism', represented only one aspect of Lamarck's extensive work in the natural sciences.

by social scientists, and some relate to its theoretical intractability, and most are derived from the widespread but erroneous view in organization science and business economics that Darwinism and Lamarckism are mutually exclusive theories. Theorists have typically seen these as competing or conflicting perspectives (Bruderer and Singh, 1996; Levinthal, 1991), and, having opted for Lamarckism because of character inheritance, and amongst other things, the mistaken belief that Darwinism does not account for intentional behaviour, they have thereby incorporated its conceptual limitations (Hodgson and Knudsen, 2006b) and inadvertently rendered their own theories flawed and incomplete (Metcalfe, 2004). These conceptual limitations include, the lack of a viable inheritance mechanism, with no account of, or distinction between, a conceptual genotype and phenotype (for example, a replicator and interactor); the failure to explain why acquired injurious characters are not inherited alongside the beneficial characters, and; the ultimate, consequential failure to adequately explain adaptive improvement.

These difficult theoretical and conceptual issues raised by Lamarckian inheritance were not, of course confined to social theories of evolution and they ultimately provoked the much needed theory development in evolutionary biology, which had important implications for both biology and the social sciences. Relating to the central idea of character inheritance, for example, it has been demonstrated that Lamarckism cannot stand alone as an evolutionary theory, and that it needs the Darwinian selection process and conceptual framework in order to work (Dawkins, 1983, 1986; Hull, 2001; Hodgson, 2001b; Knudsen, 2001). Furthermore it has been shown that a replicator and interactor distinction must be postulated in order to make sense of its defining inheritance mechanism (Hodgson and Knudsen, 2006b; Aunger, 2002; Hull, 1982). Significantly, a close reading of the organization studies literature reveals these Lamarckian limitations, and evidently some social scientists have finally begun to perceive the incompleteness of the Lamarckian perspective (Astley and Van de Ven, 1983; Singh, House and Tucker, 1986; Scott, 1987; Levinthal, 1991; Bruderer and Singh, 1996).

Theory Development and Research Agendas

Certainly it would seem that the widespread commitment to Lamarckism by social scientists has frustrated both theory development and research agendas. According to Hannan and Freeman (1989), in organization studies Lamarckism has encouraged a

narrow 'focal organization perspective' as well as unrealistic assumptions about the flexibility of firms and the adaptive capabilities of managers. On a more general level, the Lamarckian commitment also partially explains the very slow and tentative steps towards developing the less restrictive and more powerful Darwinian conceptual framework (Campbell, 1965; Blute, 1976, 1979; Baum and Singh, 1994; Aldrich, 1999),[71] a framework which would necessarily include the core explanatory principles of variation, inheritance and selection.[72]

Part of the problem is that the socio-economic research agenda is vast and complex, with inevitable interrelated major foci on entities, processes and events (Baum and Singh, 1994). In addition to explanations of individual organizational change, theorists typically seek to investigate the mechanisms involved in the creation of new firms (Aldrich, 1999) as well as those, like competition, involved in their success or demise (Friedman, 1953; Schumpeter, 1934, 1976; Singh and Lumsden, 1990; Levinthal, 1992). They seek also, increasingly, to understand the role of variety in industry (Alchian, 1950; Downie, 1958; Nelson, 1974; Metcalfe, 1987, 1998) and to understand particularly the relationships between micro-level phenomena, such as routines and firms, and macro-level phenomena, such as the industry, over time (Nelson and Winter, 1982; Singh and Lumsden, 1990; Baum and Singh, 1994; Dosi, Nelson and Winter, 2000). As is becoming increasingly apparent this complex configuration of research questions is proving to overburden Lamarckian theory.

The following sections seek to explain what evolutionists understand by Lamarckism and how this compares and relates to Darwin's theory. Significantly, in terms of theory development, it will be shown how Lamarckism and Darwinism are not mutually exclusive, why Lamarckism needs Darwinism to work as a theory, and how the genotype-phenotype distinction actually enables both the definition of Lamarckism and the articulation of its inheritance mechanism. Through this exploration it is possible to better appreciate the attraction of Lamarckism for those seeking to explain the evolution of cultural entities like organizations, and furthermore, to revaluate its theoretical contribution in this regard. Building on the earlier elucidation of the selection process the discussion thus paves the way for an in-depth analysis of the case studies here under study, whether they embrace Lamarckism (Nelson and Winter), ignore Lamarckism (Hannan and Freeman) or implicitly adopt it (Aldrich).

---

[71] As discussed in Chapter 2, 'Social Darwinism' is almost certainly the main reason for this delay.

[72] In economics it was not until Nelson and Winter (1982) that such an attempt was made. They were the first economists since Veblen (1898) to actually apply the Darwinian principles of variation, inheritance and selection to economic phenomena.

Accordingly, the following involves a brief review of the theoretical developments in genetics with an illustration of how these have informed understanding in biology of the inheritance mechanism, and in turn, the corresponding evolutionary processes of variety formation and selection. The analysis will thus revisit the important sub-processes of replication and interaction and show how the Lamarckian inheritance process, and ultimately the distinction between Darwinian and Lamarckian inheritance, is critically dependent upon a genotype-phenotype distinction.

Lamarckism

'Lamarckism' is the theory named after the French evolutionist, Jean-Baptiste de Lamarck (1809), who is largely remembered for popularising the idea of the inheritance of acquired characteristics. In this view, changes that are acquired during the lifetime of an organism and which result from interaction with its environment are changes that can be inherited by the offspring of that organism. In other words phenotypic changes or 'adaptations' are somehow transmitted to the organism's genotype and subsequently passed on to the next generation in reproduction.

Although Lamarck is widely credited for the notion of acquired character inheritance it is worth noting that this was a view held by most evolutionists at the time. Indeed, significantly (contrary to widespread misconceptions) even Darwin himself did not discount the possibility of the inheritance of acquired characteristics (Mayr, 1976; Hull, 2001, p. 56; Hodgson, 2001, p. 93). Unaware at the time of genetics or the nature of the heritable unit, Darwin did not perceive Lamarckism to be irreconcilable with his theory of natural selection, indeed he fully embraced it (1859, pp. 82, 137, 209). As Hodgson and Knudsen (2006b, p. 12) observe below;

> [Darwin] never denied a limited role for the inheritance of acquired characters and in his later life he gave it increasing rather than decreasing attention and approval. Hence Lamarckism (in this sense) and Darwin's doctrine are not necessarily mutually exclusive.

Thus, in this sense, one can assert that Lamarckism and Darwinism are not mutually exclusive. Indeed, as will become apparent below, the Lamarckian Darwinian relationship is far more involved than even this observation suggests, with the former actually being dependent on the later for its theoretical tractability.

However, following experimental work by the biologist August Weismann (1889, 1893) the notion of acquired character inheritance became discredited in biology. Weismann argued that it was not possible for acquired 'bodily' or phenotypic changes to influence the hereditary material of the genotype or, what biologists call, the 'germ line.' Weismann was essentially saying that it was impossible for the environment to have a direct influence on the genetic material (Mayr, 1976, p. 10), proposing a notional 'barrier' between the organism and its genotype. The argument was that since only the germ plasm or 'genetic code' is transmitted in reproduction, Lamarckian inheritance is impossible (Hull, 1988, p. 48).

Lamarckian Possibilities

Whilst acknowledging that this remains the predominant view in biology, following Hodgson and Knudsen (2006b) it will be seen here that it assists understanding of Lamarckian inheritance in the social sphere to consider that, in principle, there are at least three distinct Lamarckian worlds pertaining to character inheritance. Firstly, reflecting a minority view in biology, there is the empirical claim that acquired properties, such as immune responses, may, after all, be heritable in the biotic domain (Steele, 1979, Steele et al, 1998). Secondly, theoretically, we cannot rule out the possibility of Lamarckian inheritance occurring in some alien system of life on another planet (Dawkins, 1988). And finally, we cannot theoretically rule out the possibility of Lamarckian inheritance occurring in the socio-economic sphere (Hodgson and Knudsen, 2006b; Ziman, 2000). Thus we are compelled to explore the question, 'if Lamarckian inheritance occurred, what would the mechanism look like?'

To answer this question the discussion starts by considering the reasons why Lamarckism was rejected in the biotic sphere and it begins to unpack what evolutionists understand by the term. It is, of course, important to be aware of the implications of Lamarckian inheritance and what it says about causality in evolutionary processes. Significantly, it will be seen that ultimately, in contrast to the Darwinian perspective which sees selection as the main driving force of evolution, Lamarckism suggests that evolution is driven by adaptation.

The rediscovery and subsequent advancement of Mendel's laws of inheritance at the beginning of the twentieth Century (De Vries, 1889; Bateson, 1908, 1909) eventually led to the validation of Weismann's theoretical argument, with its 'conclusive refutation' (Mayr, 1988, p. 508) in the 1950s attributed to the discoveries of molecular

biologists. These scientists evidently demonstrated that Lamarckism could not possibly work because it lacked a mechanism to explain how acquired characters could be transferred, across the 'Weismannian barrier' (1889, 1893), in other words, in the opposite direction from the phenotype to the genotype. And in so doing they also clearly established the very important distinction between the phenotype and genotype, as Mayr (1976, p. 11) explains below;

> The way from the DNA [genotype]…to the proteins [phenotype] is a one-way street. The environment can influence the developmental process but it cannot affect the blueprint that controls it. Changes in the proteins cannot be translated back into nucleic acids [genes].

Notice how the genotype-phenotype distinction is actually required to *explain*, and indeed to discount the notion of Lamarckian inheritance. Thus Lamarckism is discounted in biology.[73] But what about the hypothetical cases alluded to above? In an attempt to explore such Lamarckian theoretical possibilities, following Dawkins (1986), Hodgson and Knudsen (2006b), suggest entertaining the thought that on some other planet supporting biotic life, Lamarckian inheritance *is* possible. How might this work as an evolutionary theory?

Lamarckism and the Need for Darwinian Selection

Hodgson and Knudsen (2006b) highlight the critical point that *even if it were possible* for the phenotype to influence the genotype, so that phenotypic changes were heritable, there remains a fundamental flaw, or missing link in the Lamarckism position. This is because in the Lamarckian story it is assumed that only beneficial traits are inherited and not disadvantageous traits; indeed this is how Lamarckian evolutionary progress is explained. But, the crucial question is, why should only the beneficial characters be inherited? In the Lamarckian adaptationist explanation of successive change, if acquired phenotypic traits are heritable, what is to prevent the inheritance of negative or injurious traits? In other words what is to prevent babies from inheriting their parents' wrinkles, broken limbs or smallpox scars? Basically there is no discriminating mechanism in the Lamarckian model that would ensure that only the beneficial and not the disadvantageous traits are inherited. Consequently, 'even if acquired characters

[73] Notwithstanding a controversial and minority view in biology to the contrary (Steele, 1979; Steel et al, 1998) which would not, in any case, affect the argument about the validity of Lamarckism in the social sphere.

could be inherited, the Lamarckian theory would still be incapable of explaining adaptive evolution' (Dawkins, 1986, p. 299).

And this is where the discussion comes to the somewhat ironic relationship between Lamarckism and Darwinism. Logically, some kind of selection process would need to be assumed to support the Lamarckian assumption of continued improvement. This is the missing mechanism that would ensure that only beneficial characters would be inherited. Without it Lamarckism is unlikely to be efficacious, 'with successive generations becoming more and more decrepit' (Dawkins, p. 299). Thus Lamarckism would appear to be inextricably tied to its erstwhile 'rival' theory, actually dependent upon the conceptual structure and support of Darwinism in order to work as a theory. As Dawkins (1986, p. 300) vividly describes the relationship;

> Lamarckian theory can explain adaptive improvement in evolution, only by, as it were, riding on the back of Darwinian theory … we are forced back to Darwinism to explain the adaptive aspect of evolution.

Evidently, Lamarckism cannot stand alone as an evolutionary theory because it requires the Darwinian selection process. So having first established that Lamarckism and Darwinism are not mutually exclusive, significantly, it is now possible to see that a distinct asymmetrical relationship exists between them. This later point is very important to emphasize, in that whilst Lamarckism is dependent upon Darwinism, effectively 'nesting' in Darwinian theory (Hodgson, 2001b; Knudsen, 2001), the reverse is not true. Darwinism does not need Lamarckian props. However, with its much broader applicability, Darwinism has the advantage of being able to incorporate Lamarckian forms of inheritance within its meta-theoretical framework (Hull, 2001, p. 56). Thus, to reiterate, Lamarckian inheritance *is* possible in the social domain but *only* by 'riding on the back of Darwinian theory'.

From a socio-economic perspective this is a very encouraging development. The much-desired accommodation of acquired character inheritance is thus plausible, nested in a Darwinian account of socio-economic evolution. It now remains to establish what form this inheritance mechanism would take and this is where the conceptual genotype and phenotype come into play.

Conceptual Genotypes and Phenotypes

In spite of its widespread adoption,[74] recent explorations of the viability of Lamarckism in the social domain have revealed even deeper conceptual problems with the tractability of the Lamarckian inheritance mechanism. Hull (1982, p. 309) indicates the source of the problem below;

> In order for sociocultural evolution to be Lamarckian in a metaphorical sense, conceptual genotypes must be distinguishable from conceptual phenotypes and the two must be related in appropriate ways' (Hull, 1982, p. 309).

To illustrate, returning to the theme of the previous Chapter, it has been shown that the selection process is comprised of two sub-processes identified as replication and interaction and furthermore that selection acts directly upon the interacting entity and only indirectly on the replicating entity. This was a very important stage in the development of evolutionary theory, establishing the important *functional* distinction between the genotype and phenotype,[75] and it is this distinction and its explanatory significance for the notion of inheritance or continuity, to which the analysis now turns.

Inspired by Hull above, Hodgson and Knudsen (2006b) take these critical components and examine the logical requirements for each step of a Lamarckian inheritance process. They demonstrate the ultimate dependency of Lamarckism on the genotype-phenotype distinction. And, somewhat paradoxically, they thereby also show that the genotype-phenotype distinction serves to both define and undermine Lamarckian inheritance, whilst at the same time it distinguishes Lamarckian from Darwinian inheritance.

Essentially, a genotype-phenotype distinction must first be established before it is possible to even identify Lamarckian transmission or begin to formulate a plausible evolutionary theory that might accommodate acquired character inheritance. As Hull (2004) explains, 'in order for any process to be considered Lamarckian, we need a genotype-phenotype distinction. Of course in order for a process to count as Darwinian,

[74] Examination of the use of Lamarckism in the social domain interestingly reveals that in most cases a Darwinian selection process is implicitly assumed.

[75] Whilst neither Darwin nor Lamarck used these modern terms, it is evident in their writings that they had perceived some kind of distinction. As Hodgson and Knudsen (p. 4) point out; 'they both assumed that information related to characteristics was transmitted from generation to generation through such information-carrying entities as seeds, sperm, ova, pollen, or stigma. Neither writer believed that replication occurred by the direct copying of characteristics, so that their writing in the biological context embodied an implicit distinction between genotype and phenotype'.

we also need the genotype phenotype distinction'. In other words, in any evolutionary account of inheritance or replication there needs to be a distinction between the information required to produce the entity (genotype) and the entity itself (phenotype). This is a logical necessity.[76]

Replicators Interactors and the Lamarckian Inheritance Mechanism

Indeed, according to Mayr it was 'a failure to make a distinction between genotype and phenotype [that] was at the bottom of many of the great controversies in the history of evolutionary biology' (1982, p. 783). And, as discussed in the previous Chapter, it was Hull and others who eventually untangled these problems and, indeed, Hull (1988) who provided the generalized terminology which facilitated, amongst other things, the clarification and articulation of the inheritance mechanism.

To recap, the genotype is the organism's historically evolved genetic program, encoded in the DNA, and this is the durable replicating entity. This was identified by Hull as the 'replicator', and defined as 'an entity that passes on its structure largely intact in successive replications' (1988, p. 408). The phenotype, on the other hand, is the manifested attributes of the organism, or more specifically, 'the joint product of its genes and their environment during ontogeny' (Dawkins, 1982, p. 292). This entity was identified as the 'interactor', and defined by Hull as 'an entity that directly interacts as a cohesive whole with its environment in such a way that this interaction *causes* replication to be differential' (1988, p. 409). To be sure, this is the entity that interacts with its environment, and upon which selection operates; this is the 'causal interactor'.

Bearing these distinctions in mind, and what they suggest about selection and causal direction, in the discussion of inheritance it is also important to recall the Weismannian barrier, which established in biology that whilst genes may control and influence the development of the phenotype, the reverse is not true. The phenotype cannot impact on its own genotype and pass on phenotypic changes to its offspring. It will be seen below that this has significant consequences for the articulation of Lamarckian inheritance.

No Replicator-Interactor Distinction: Then No Lamarckian Inheritance

The very subtle but nevertheless hugely significant theoretical point that Hodgson and Knudsen (2006b) demonstrate, made earlier by Hull (1982), is that without the

[76] Knudsen (Personal Communication, 31st May 2004)

distinction between a replicator and interactor it is simply not possible to articulate the supposed breech of the Weismannian barrier in Lamarckian inheritance, and thus *explain the notion of acquired character inheritance*. If acquired characteristics are going to be inherited, how is this to be explained without a genotype-phenotype distinction? Clearly there is a conceptual need to speak of information passing from the phenotype to its genotype in effecting subsequent generations of that phenotype. For as Hull (2000, p. 55-56, my emphasis) explains, 'Lamarckian inheritance is the *literal inheritance* of acquired characteristics. The transmission must be genetic, and the relevant effect must be phenotypic'. Hodgson and Knudsen show that without the conceptual distinction the functional roles of the genotype and phenotype become conflated and the characteristically Lamarckian process is ejected from the picture.

Thus the distinction is necessary to explain Lamarckian inheritance and, as a consequence, to distinguish it ultimately from Darwinian inheritance. This is a technical point that impacts on the logic of the theory wherever it might be applied, in other words, as Hodgson and Knudsen (p.18) explain, it impacts on Lamarckian theory as it is applied in the socio-economic domain;

> In order to demonstrate Lamarckian inheritance, a phenotype-genotype distinction must first be established. Adaptations acquired at the phenotypic level must be encoded at the genotypic level and then passed on to new generations. Unfortunately, in the literature on economic and organizational evolution there is no clear conceptualisation of the phenotype-genotype distinction. Without this conceptualisation there is no basis on which to adjudicate whether economic and organizational evolution is Lamarckian or Darwinian.

This is an important and rather ironic point given the observed justifications for allegiances to Lamarckian (acquired character inheritance, 'adaptationism') or Darwinian (selectionist) perspectives. However, although 'no clear conceptualisation' of the phenotype-genotype distinction is articulated, in other words, as rigorous as that outlined above, there are, nevertheless, positive indications in the organization studies and evolutionary economics literature of a movement in this direction. Some of this is explicit whilst much of it is implicit. Certainly there is recognition of a genotype-phenotype distinction, and significantly, it is a functional distinction.

Indeed what the literature reveals is that, as well as implicitly adopting the Darwinian selection process to 'prop up' their Lamarckian accounts, some evolutionary scholars in the socio-economic domain have evidently gone that critical step further in acknowledging the genotype-phenotype distinction and indeed they are already

incorporating it into their analysis (Baum and Singh, 1994; Aldrich, 1999; Ziman, 2000; Murmann, 2003). To illustrate the point, Baum and Singh, are cited at length below, describing their understanding of the distinction and its application, and it is instructive to note their sources of inspiration (1994, p. 4);

> We conceptualize organizational evolution as the complex interplays between two kinds of processes, interaction and replication (Hull 1980, 1988), acting on two kinds of entities, ecological and genealogical (Eldredge, 1985, 1989), at a variety of levels of organization
>
> … We characterize the world of organizations as composed of two hierarchies of entities, one ecological (e.g., jobs, work groups, organizations, populations, and communities), … and the other genealogical (e.g., routines, comps, species, and polyphyletic groupings) … Organizational evolution is the result of genealogical entities replicating, ecological entities interacting, the net effect of these interactions being the differential population persistence of the genealogical entities that produced them.
>
> A theory of organizational evolution – indeed, any evolutionary system – minimally requires these two kinds of processes (i.e., interaction and replication) and two kinds of entities (i.e., ecological and genealogical) (Boyd and Richerson, 1985; Eldredge, 1985, 1989; Eldredge and Salthe, 1984; Hull, 1980, 1988; Salthe, 1985)

These are promising developments both for the illumination of organizational problems and for the acknowledgment and development of a generalized Darwinian theory. As noted, more scholars, by varying degrees, are now recognizing the replicator-interactor distinction. With acknowledgement that the distinction is now 'standard in philosophical discussions of the evolutionary process' (Aunger, 2001 p. 9), its exploration is evidently being urged and acted upon by organization scientists and evolutionary economists alike (Baum and Singh, 1994; Aldrich, 1999; Galunic, 2002; Murmann, 2003; Hodgson and Knudsen, 2006a, 2006b). Moreover, reinforcing the argument made in Chapter 3, regarding the inevitability of Darwinism for socio-economic theories of evolution, it is significant that a replicator-interactor distinction is also *implicit* in many of the evolutionary approaches surveyed here. This is illustrated, for example, in the widespread acknowledgement of some kind of stable information unit (organizational routines, technologies, competencies) and the distinct roles that this plays in the continuity of form.

However, in spite of these developments and the intuitive acceptance of this important distinction, it is apparent that considerable confusion nevertheless remains in its conceptualization and application. Investigation of the issue shows that the confusion

is traced both to this important duality and to the 'units of selection' problem reminiscent of evolutionary biology. As noted in Chapter 5, evolutionary scholars in the social domain are still debating the identity of the unit of selection and the level at which selection takes place, with some, for example, promoting the organizational routine or competence (Burgelman and Mittman, 1994), and others promoting the firm or organization (Nelson and Winter, 1982; Hannan and Freeman, 1989). Clearly, in opting for either this then contradicts the promotion of separate functional roles for these entities in the organizational hierarchy. Indeed this problem is clearly illustrated here in Chapter 8, in Nelson and Winter's theory of evolutionary economics where the authors adopt a 'routine-as-gene' analogy. With the benefit of these recent theoretical developments and conceptual refinements it will be shown how, in Nelson and Winter's attempt to articulate Lamarckian adaptive change at the level of the routine, the units and levels of selection become confused, the replicator-interactor distinction conflated, and the vector of causality ultimately inconclusive.

Undoubtedly the important advances in evolutionary theory that have been discussed in the present and previous two Chapters are key to unravelling the theoretical and conceptual problems that persist in the social domain. However, a survey of the literature in organization studies and evolutionary economics confirms that these developments have not been widely disseminated. Hence it is not surprising that such theoretical conundrums are so widespread. The next few sections expand on the other misunderstandings associated with Lamarckian inheritance. The remaining issues which derive from this and which command attention in socio-economic accounts of evolution are those of adaptation, variety-creation and intentionality. The first two are very closely linked. It will be seen how assumptions about these have similarly had a dramatic impact on perceptions of causality and explanations of evolutionary change.

Adaptation

It is quite clear why organization theorists and business economists are attracted to Lamarckism. In their respective spheres they observe individual organizations responding to the constraints of their environments and adjusting strategy in order to compete and survive. Such changes that occur during the lifetime of an organization are then perceived as being 'inherited' by subsequent generations of the organization through, for example, durable, replicating 'organizational routines'. Replication, or inheritance, is articulated through the Lamarckian interpretation of adaptation to the

environment, which ultimately perceives the changes that occur at the individual level as being the pivotal changes that drive the evolution of the industry.

Such accounts are often referred to in the literature as 'adaptationist' (Bruderer and Singh, 1996), and they are distinguished from what have recently been termed 'selectionist' or selection-based explanations (Nelson and Winter, 1982;[77] Hannan and Freeman, 1977, 1989). Significantly, this division reflects, amongst other things, a difference in the perceived location of causality of industry-level change. Whilst selectionists tend to view organizations as being largely inert and explain evolution through macro-level selection processes, adaptationists instead stress the adaptive capabilities of organizations (Kanter, 1984; Tushman and O'Reilly, 1997) and thus promote adaptation as the main force of evolutionary change. This has been the subject of much debate amongst evolutionary theorists in the social sciences, and, as noted earlier has resulted in the effective polarization of evolutionary theories into two camps and culminated in the 'adaptation versus selection' debate.

However, clarifications are again found in evolutionary biology, where it becomes clear that both adaptation and selection are essential components of the evolutionary explanation. As discussed in Chapter 4 above, the problem lies in the misunderstanding of their relationship and the proper location of causality.

The point is, as Darwin shows, adaptation is a product of natural selection (Mayr, 1982, p. 96), and it refers to the species and not the individual organism. Selection operates on the existing variety; so that those individuals that are best adapted to the prevailing environment are the ones that survive and go on to reproduce their form in subsequent generations. Should the environment change then individuals in the species with different characteristics that are better suited to the changed environment will then be the ones that survive the selection process and this new form will then come to characterize the species. Thus it is the selection process that ultimately 'causes' individuals to be so well adapted to their environment (Mayr, 1982, p. 358).

Significantly, as illustrated in the discussion of the Darwinian population thinking perspective in Chapter 4, it is the *species* and not the individual organism that changes or 'evolves', and this view clearly contrasts with the Lamarckian perspective which focuses on the individual and *its* adaptation to the environment, perceiving this to be the locus of change. As will be shown below, however, whilst individual adaptations do occur, they do not ultimately explain evolutionary change.

[77] Although described by the authors as Lamarckian, Nelson and Winter's account implicitly adopts the Darwinian selection mechanism and indeed the theory is typically described by commentators as a selection- based model (Murmann et al, 2003)

Variety Creation and Causality

A critical implication of Lamarckism is that it essentially amounts to a reversal in the causal direction of evolution. Lamarckism holds that the environment is the driving force of change (as opposed to any kind of selection process); basically meaning that change and variety formation are the direct result of individual phenotypic adaptations to the environment. And this, argues Mayr (1982, p. 354), is the crucial difference between Darwin and Lamarck's mechanisms of evolution, where;

> for Lamarck the environment and its changes had priority. They produced needs and activities in the organism and these, in turn, caused adaptational variation. [Whereas] for Darwin random variation was present first, and the ordering activity of the environment ("natural selection") followed afterwards.

Clearly this is a fundamental difference in explanations of evolutionary change and variety formation, and significantly, this difference is clearly reflected in the organizations and business economics literature. Traditionally, as noted, organization scholars have seen change as being directed by the ever-resourceful innovating firms who adapt to the prevailing environment (Cyert and March, 1963; Levitt and March, 1988; Lawrence and Lorsch, 1967; Child, 1972). Successful innovations, whether technical or organizational, are copied and multiplied and it is *these* that are perceived as bringing about the observable changes at the industry level.

Thus, the Lamarckian reversal of causality, which earlier manifested itself in the phenotypic encoding of the genotype, is played out in a different sense at this higher level of causal explanation; in the assertion that adaptive changes induced by environmental stimuli are both the *source* of variety and the *source* of adaptive complexity and progress. In their perception of adaptive change, these theorists have evidently perceived the Lamarckian explanation as being the one that most closely maps onto organizational phenomena, and consequently the Lamarckian perspective tends to dominate the literature. Before summarizing the implications of this for a socio-economic theory of evolution the discussion resumes here with the issue of intentionality, another misguided reason why social scientists have rejected Darwinism and opted for the Lamarckian explanation.

Intentionality

Naturally, for social scientists, human volition or conscious intention is a central explanatory concept for any account of social evolution. Since it is widely believed that conscious, intentional behaviour is dismissed in Darwin's evolutionary theory, Lamarckism, with its explicit notions of adaptive, purposeful behaviour, is, again, the preferred explanatory schema. However, this reasoning misrepresents the Darwinian position, which, on the contrary, does not overlook intentionality. Because fundamentally, as Hodgson (2004, p.55) explains below, Darwinism holds that there is no such thing as an 'uncaused cause';

> It is part and parcel of Darwin's underlying philosophy that all intention has itself to be explained by a causal process. This causal explanation has to show how the capacity to form intentions has itself gradually evolved in the human species, and also how individual intentions are formed in the psyche. For Darwin, natural selection is part of these causal explanations.

Significantly, as Hodgson goes on to stress, intentionality does remain meaningful in Darwinism, but it too must submit to evolutionary explanation since 'it too has evolved over millions of years'. In other words, human cognition itself has a causal story, it is both the product of natural selection *and* it operates on selectionist principles (Edelman, 1992; Plotkin, 1994). Essentially, as discussed in Chapter 2 above, intentionality in the social domain *is* accommodated in the Darwinian conceptual framework, but, as an 'auxiliary explanation'. The critical point is that it definitely remains a part of the story.

The challenge for social scientists, perhaps, is to acknowledge (what they might perceive as) the seeming relegation of intentionality in the Darwinian explanation of social evolution and to allow the more realistic portrayal of cause and effect sequences therein. This is certainly not to deny the significance of intention in social evolution but to appropriately assign its casual impact. To illustrate, in addressing Witt's (2004) concerns about giving human intentionality and insight their due role, Vromen (2004) makes the point that Darwin's so-called 'blind' or 'randomly selected' variation does not discount or misrepresent phenomena in the social sphere. Referring to Nelson and Winter's concept of 'search', which denotes deliberative behaviour on the part of managers searching for new and better ways of seeking profits, he explains (p. 223);

> Search does not become less blind if firms only start searching if their profits threaten to fall below some critical threshold value. Variation would only not be blind if firms were endowed with providence or perfect foresight so that success

> were guaranteed … [I]t seems, as we just saw, that unless we equate intentional and insightful human behaviour with infallible behaviour displayed with perfect foresight, Universal Darwinism can account for this.

The critical point is that Darwinian selection works on the variation however this might have been produced. As Vromen goes on to clarify;

> When applied to individual human behaviour, '(cumulative) blind variation and selective retention' does not imply that search for better 'variants' is conducted unintentionally, without any conscious thinking or thought, or whatever.

Indeed, as indicated earlier, this subtle theoretical point is born out by empirical observation where researchers stress the relative powerlessness of managers to control the organization's destiny (Arrow, 1974; Hannan and Freeman, 1977). With reference to epistemological evolution, Hull (2001, p.123) below makes the exact same point;

> Once one looks at science as a whole … the effects of intentionality do not look so massive … All scientists are constantly trying to solve problems. Few do. Of those who do, only a very few are noticed. There may well be a difference in kind between intentional and non-intentional behavior, but it is not a difference in kind that results in much of a difference in degree.

In summary, the issue of intentionality is undeniably an important one for the socio-economic domain. And, because like adaptation, variety-formation and acquired character inheritance, its sociological interpretation is not associated with Darwinism, it is easy to see why social scientists have adopted and continue to use the Lamarckian perspective in their evolutionary theories. However, as outlined above, such usage presents conceptual limitations and significant tractability problems, all of which are becoming increasingly evident in the literature. Essentially, the misconceptions surrounding each of these processes have needlessly tied scholars into the Lamarckian perspective, and, a consequential theoretical cul-de-sac. The full implications of the Lamarckian commitment are summarized below.

Implications of Lamarckism for Socio-Economic Evolutionary Theory

A cross disciplinary survey of the literature shows that there is a clear polarization of evolutionary perspectives in the business economics and organizations studies literature. Various selection type approaches have tended to characterize much of the evolutionary economics literature (Alchian, 1950; Friedman, 1953; Winter, 1964; Mokyr, 1990,

2000) reaching a conceptual zenith in the seminal work of Nelson and Winter (1982), and these are complemented by an increasing number of 'ecological' or 'selectionist' type perspectives in organizations studies (Hannan and Freeman, 1989; Burgelman, 1991, 1994; Weick, 1979; Aldrich, 1972, 1979, 1999; Aldrich and Pfeffer, 1976; McKelvey, 1982). However, the dominant approach in organizations studies shows a decidedly 'prescriptive adaptive orientation' (Burgelman, 1994), with few theorists giving much more than token consideration to the environmental context of organizations (Pfeffer and Salancik, 1978). Why this important difference in emphasis by economists and organization scientists? Why the apparent choice in these evolutionary explanations *between* adaptation and selection, and why not an accommodation of both interconnected strands of evolutionary theory?

As has been glimpsed from the above overview of evolutionary theory, and how interpretations of Lamarckism compare to those of Darwinism, it would appear that there are a number of important reasons why theorists have expressed a preference one way or the other. With the organizations literature steeped in the behavioural theory of the firm (Cyert and March, 1963) and its notions of innovative, flexible organizations and purposive behaviour, Lamarckism, with its acquired character inheritance and notion of adaptation, clearly appears to present as the obvious model here. Whereas for business economists and some organizations scholars who prefer the more traditional emphasis on competition and macro-economic phenomena, it is the selection type explanations that have appeared better suited.

Evidently, however, scholars are now recognising problems and limitations with the Lamarckian model, and these have been triggered by empirical as well as theoretical observations. Reflecting the comments of Hodgson, Vromen and Hull above, for example, there appears to be a growing realization that much organizational change is largely uncontrolled and difficult to anticipate (Hannan, 1989 p.23; Murmann et al, 2003). Hannan and Freeman thus led the way in organizations studies with their 'organizational ecology' theory by downplaying the adaptationist perspective in favour of Darwinian selection processes. It was wrong, in their view, to suggest that major changes in organizational form were primarily the result of learning and imitation (p. 22). Fellow sympathiser, Rindos (1985 p.65) goes one step further declaring that;

> The mode of transmission of cultural characteristics ("the inheritance of acquired traits") is irrelevant to the applicability of a selectionist model for evolutionary change.

However, whilst it is quite correct to argue, as Knudsen (2004, p. 160) has acknowledged, that it is possible to have selection without inheritance, the fact remains that the overarching theory is not so good. In fostering the narrower selectionist perspective and focusing only on macro-level phenomena, Hannan and Freeman end up ignoring the inheritance issue altogether and leave their theory impoverished as a result.[78] As Baum and Singh (1994 p. 5) counter, selection is not the whole story, and indeed new studies are providing evidence that organizations can and do change (Amburgey et al, 1993; Baum, 1990; Baum and Oliver, 1991; Delacroix and Swaminathan, 1991). Inevitably such selectionist accounts exclude an important part of the evolutionary story by discounting micro-phenomena.

The question is does either approach offer the potential for a complete evolutionary theory of socio-economic change? The simple answer is no. As outlined in this and previous Chapters, Lamarckism is incomplete as an evolutionary theory, it needs the selection process and conceptual apparatus of Darwinism in order to work. And selection theory on its own is not able to explain change over time without some notion of continuity or conceptualization of an inheritance mechanism. Indeed the literature documents widespread dissatisfaction amongst theorists regarding this issue, with recognition that Lamarckism and strictly 'selectionist' interpretations of Darwinism represent only partial perspectives (Baum and Singh, 1994, Baum and McKelvey, 1999; Metcalfe, 2004; Ziman, 2002). Notably, in spite of their deliberate movement away from the Lamarckian adaptationist perspective towards the selectionist perspective, Hannan and Freeman do acknowledge the latter's important limitations (1989, p. 20);

> We do not have anything resembling a fully developed evolutionary theory of organizational change. Although we have learned a good deal about selection processes, we still know very little about the other side of the evolutionary process, the structures of inheritance and transmission.

Indeed, as indicated, the need to explain the mechanisms of transmission is a concern expressed by others who recognise both the limitations of the traditional Lamarckian perspective as well as those of the recent population ecology approach (Baum and Singh, 1994 p. 8);

[78] Tellingly, however, Hannan and Freeman appear to believe that the two perspectives cannot be reconciled, (1989, p. 69) 'The selection and adaptation perspectives are so different that it is hard to believe they are talking about the same things'.

> by and large organizational ecologists have not attempted to link ecological processes of interaction and genealogical processes of replication. Consequently we still know very little about the other side of the evolutionary process – the structures of organizational inheritance and transmission. How are organizational structures and practices perpetuated through time? What is inherited and how?

As illustrated here and in previous Chapters, resolution of these issues is to be found in a generalized Darwinism informed by developments in evolutionary biology. Significantly, the literature suggests that some social scientists are already moving in this direction.

Towards a Unified Theory of Socio-Economic Evolution

Evidently, inheritance or the transmission process, previous justification for opting for Lamarckian explanation in the social sphere, remains conceptually difficult for socio-economic theories of evolution. A selection process is required as is a conceptual genotype and phenotype. The assumed tension between Lamarckism and Darwinism and erroneous view that Darwinism discounts intentionality, continue to thwart scholars who feel they must choose between 'competing' theories. And the Lamarckian conceptualization of adaptation misrepresents causal direction in evolution as well as the source of variety. Thus the challenge for social scientists, it would seem, is to revisit evolutionary biology, become acquainted with the recent developments in evolutionary theory, and explore the possibility of a Lamarckian explanation nesting in Darwinian theory.

There are important indications that this exploration has already begun. The explicit and implicit incorporation and development of the replicator-interactor distinction has already been noted, as has the widespread and implicit adoption of the Darwinian selection process in Lamarckian accounts. But there are also other significant developments, particularly in the organizations literature, which demonstrate an awareness of the explanatory potential of generalized Darwinism. Indeed, as indicated above, several authors are beginning to speak of Darwinian processes in terms of a general theory which accommodates Lamarckian inheritance mechanisms.

Other movements in this direction are seen in the theoretical and empirical works of scholars who argue that reconciliation of Lamarckism and Darwinism is the only way forward for socio-economic accounts of evolution. For example, some argue that these are not conflicting perspectives but 'complimentary' (Astley and Van de Ven, 1983;

Scott, 1987; Singh et al, 1986). Whilst others venture that they are not 'simply complementary' but are in fact fundamentally interrelated processes of change (Levinthal, 1991, p. 144). Indeed, some see the adaptation versus selection debate as being about their 'relative importance' in explaining organizational change and survival (Miles and Cameron, 1982; Singh et al, 1986). And finally, in another synthesis Bruderer and Singh (1996, p. 1324) go as far as constructing a simple computational model to 'argue theoretically that organizational learning (adaptation) guides environmental selection in a Darwinian framework of evolution'. Evidently for a small, but increasing, number of scholars the perception is that 'a fruitful integration of these ideas is possible in some ways' (Burgelman 1991).

Whilst there are differences in the detail and again in the interpretation of evolutionary theory, clearly the hypothesis of these authors is that Lamarckian inheritance may be accommodated in a Darwinian framework. And, as has been observed here, this is certainly possible within general Darwinism, although its realization and successful articulation is dependent upon the theoretical clarifications and conceptual refinements set out here and in previous Chapters.

Concluding Remarks

As noted at the beginning of Chapter 5, the theoretical advances and clarifications that emerged out of the units of selection debate have served to clarify, not only what is understood as a unit of selection and the important functional roles of replicators and interactors, but they have also served to clarify the vector of causality in evolutionary theory and the important interrelationships between the Darwinian principles of variation, inheritance and selection.

Having used these insights here to demonstrate the impoverishment of a strictly Lamarckian account of evolution it will now been shown in the following Chapter how they have also resolved the issue of group selection and paved the way for the conceptualization of multilevel selection theory. This is a significant development for socio-cultural theories of evolution, where scholars seek to conceptualize groups as units of selection and where there is evident confusion around the existence and articulation of multiple levels of analysis. Essentially it will be seen that clarification about the unit of selection simultaneously offers clarification about levels of selection.

7 Group Selection and Multilevel Selection Theory

> There was a time when individualism reigned supreme both in evolutionary biology and in the human social sciences, creating an image of the individual as the only adaptive unit (or rational actor) in nature and of the group as merely a byproduct of what individuals do to each other. Those days are over…
>
> Evolutionary biology is settling into a middle position that acknowledges the potential for adaptation and natural selection at all levels of the biological hierarchy, especially in the case of human evolution. Group level adaptation is here to stay in evolutionary biology, and the human social sciences must follow suit to remain true to first principles.
>
> David Sloan Wilson (2002)

Introduction

In the discussion here of multilevel selection theory and its relevance for the social domain, this Chapter brings evolutionary theory right to the cutting edge of its development. Essentially it shows that whilst the group selection issue has long since been resolved and its spin-off idea of multilevel selection thinking is quite well established in both the biotic (Gould and Lloyd, 1999; Keller et al, 1999; Eldredge, 1985) and the social spheres (Baum, 2002), the latter nevertheless remains conceptually underdeveloped. Evolutionary theorists are yet to fully understand the mechanisms involved when selection is working simultaneously at different hierarchical levels. Thus in the coverage here of the latest explorations of theory, the key issues pertaining to multilevel selection theory are highlighted.

It will be seen that at the centre of these developments are the recent clarifications about the conditions under which genetic group selection can occur, in other words when between-group selection dominates over within group selection. Theorists have been speculating about the mechanisms involved in sustaining intergroup variation, and posit that there must be some kind of structural constraints that militate against intragroup variation and which thus enable group variation to prevail. And from this emerges the notion of a higher level social replicator. Thus it quickly becomes apparent that group selection provides the important bridge to the conceptualization of multilevel selection theory, and that the replicator-interactor distinction is also key to this development, with the group, for example, being conceptualized as an interactor and higher level unit of selection in a hierarchy of multiple levels of interactors.

From Group Selection to Multilevel Selection Theory

The importance of this continuing theoretical and conceptual work for the socio-economic domain cannot be overstated, for in the organization studies and evolutionary economics literature it is very apparent that group selection is assumed and that there is a fervent need to theorize about multiple levels of selection.[79] Indeed the notion of group selection is of particular importance for theories of socio-cultural evolution where there is a patent desire to explain change in collective entities like organizations, firms and social groups. However, despite been variously invoked by biologists ever since Darwin (Sober and Wilson, 1998), as a result of William's (1966) infamous condemnation of group selection in the 1960s the idea was then derided by biologists who perceived group selection as being unviable or of no consequence to biological evolution. Needless to say, this hampered the development of group selection in the cultural domain, where evolutionary theorists (Campbell, 1958; Heylighen and Campbell, 1995) were dissuaded from its serious contemplation, and where methodological individualism reigned supreme.

Today, however, the situation is quite different. The last fifteen years has witnessed the successful resurrection of the idea of genetic group selection in evolutionary theory, with Elliot Sober (1984, 1985; 1998), David Sloan Wilson (1994; 2002), Richard Boyd (1985; 1990) and Peter Richerson (1990) frequently cited as key architects of the group-selection framework, and David Hull (1988) widely praised for the ontological work that enhanced its articulation. Although, as we are frequently reminded (Dennett, 1994; Reeve and Keller, 1999), group selection nevertheless continues to be misunderstood, it must be stressed that it is now broadly accepted by evolutionary scholars, and even biologists now permit the theoretical possibility of group-level selection in biotic life (Brandon, 1996; Field, 2002; Henrich, 2004). Indeed a significant number of natural scientists have been using group-selection as a working assumption for many years (Keller et al, 1999; Michod, 2000).

And, significantly, in terms of theory development in the social realm, it was assuredly this acknowledgement of group selection that facilitated the movement towards multilevel selection theory, and indeed it resulted in a theoretically productive period in which multilevel thinking became much 'more catholic' (Field, 2002 p. 47). Undoubtedly this is because implicit in the notion of group or higher levels of selection is the idea of selection occurring at multiple levels of the organizational hierarchy.

[79] Indeed this is demonstrated in each of the case studies.

However, as noted at the outset, whilst multilevel selection is recognized as the ultimate consequence of group selection and is increasingly being proffered in evolutionary explanations in both the biotic (Keller, 1999) and the social domains (Baum, 2002; Hannan and Freeman, 1989; Aldrich, 1999; Field 2002, 2004), in contrast to group selection, it nevertheless remains underdeveloped as a theory (Hull, 2001) thus leaving scholars with major confusions over evolutionary theory. Some organization scholars, for example, investigate 'intraorganizational' selection, positing selection at the level of the routine or competence (Weick, 1979; McKelvey, 1982; Burgelman, 1991, 1994; Miner, 1991, 1994), others investigate 'interorganizational' selection, positing selection at the level of the organization (Nelson and Winter, 1982), or even higher, at the level of the population and community (Hannan and Freeman, 1989; Baum and Singh, 1994; Aldrich, 1999). But although there is increasing acknowledgement of the hierarchical nature of these levels and recognition that these are somehow causally related (Baum and Singh, 1994; Baum, 2002), theorists continue to puzzle over how these causal relationships might be explained (Winter, 2003), and indeed for some these uncertainties continue to provoke disagreement over the 'proper' unit of selection and the true level at which selection takes place.

Certainly in organization studies and evolutionary economics, most empirical and theoretical investigations seem to point to multiple levels of selection, indeed the growing sympathy for multilevel selection thinking is implicit in the widespread adoption of the Campbellian BVRS model,[80] with its acknowledgement of a social replicator, and moreover it is even implicit in the confusions that arise over units, levels and the replicator-interactor distinction (Nelson and Winter, 1982). Thus in recognition of the underdevelopment of multilevel selection theory and the obvious need for clarification, the present Chapter surveys the latest developments in evolutionary theory and the contributions from both the biotic and the social spheres to the construction of multilevel selection theory.

Whilst it is acknowledged here that multilevel selection theory is still very much at an exploratory stage, the following discussion will nevertheless demonstrate that important progress has been made. The Chapter will thus begin by drawing attention to the important interactor concept to signal its pivotal role in the conceptualization of both group and multilevel selection theory. This will be followed by a brief introduction to the logical possibilities for multilevel selection the details of which are explored later in

[80] Campbell's (1965) Darwinian 'Blind-Variation Selective Retention' model, the generic model which, 'opened the possibility of a theory of evolution of human systems freed from the constraining assumptions that genes are the only replicators' (Galunic and Weeks, 2002).

the Chapter. And to pave the way for this analysis there will first be a brief summary of the group-selection debate where it will become apparent that this was fuelled by both the 'units debate' and by the related controversy concerning the evolution of altruism. And this will then lead into the important discussion of genetic group selection and its implications for multilevel selection theory and socio-cultural theories of evolution.

The Interactor Concept and Multilevel Selection

There is clearly a growing awareness that implicit in the notion of genetic group selection is selection at higher levels, and that implicit in the notion of multilevel selection is an ascending hierarchy of selectable entities. In the wake of the 'units debate' and resolution of the group selection issue, evolutionary biologists have acknowledged that it was Hull's interactor concept and revamped ontology that at last enabled the formal articulation of the group as a higher level unit of selection, and thus facilitated the conceptualization of a multilevel selection framework (Brandon, 1990, p. 78; Keller, 1999; Eldredge, 1985, 1986). Gould and Lloyd (1999, p. 11904) describe the import of this contribution in the following way;

> Two major clarifications have greatly abetted the understanding and fruitful expansion of the theory of natural selection in recent years: the acknowledgment that interactors, not replicators, constitute the causal unit of selection; and the recognition that interactors are Darwinian individuals, and that such individuals exist with potency at several levels of organization (genes, organisms, demes, and species in particular), thus engendering a rich hierarchical theory of selection in contrast with Darwin's own emphasis on the organismic level.

This was undoubtedly a critical turning point in the development and articulation of evolutionary theory. As well as clarifying the selection process and the nature of the entity being selected, Hull provided a generalized terminology and an accessible way of thinking about these complex conceptual issues. It is clear, for example, that group selection does not deny individual selection, but merely expands the roster of interacting entities that qualify as 'individuals' (Gould and Lloyd, 1999). We recall that in Hull's definition he described an interactor as an 'entity that directly interacts as a cohesive whole with its environment in such a way that this interaction *causes* replication to be differential' (1988, p. 408). Clearly this could be envisaged as applying to a wide range of collective entities. With the replicator, 'an entity that passes on its structure largely intact in successive replications', and following Sober (1984), in a multileveled scenario

where various species are interacting with their environment, there could be, for example, selection *of* a particular species, selection *of* a particular group within that species, selection *of* its corresponding organisms and, consequently, selection *for* its corresponding genes.

Indeed it becomes clear in Hull's schema that in order to make any sense of multiple levels of selection it is crucial to embrace the replicator-interactor dynamic. Selection was defined by Hull as 'a process in which the differential extinction and proliferation of interactors *cause* the differential perpetuation of the relevant replicators' (p. 409) and evidently this process works at multiple levels. As Hull goes on to explain (my emphasis);

> Selection results from the interplay of these two subprocesses. Genes are certainly the primary (possibly sole) units of replication, whereas interaction can occur at a variety of levels from genes and cells through organisms to colonies, demes, and possibly entire species. The units-of-selection controversy concerns *levels of interaction*, not levels of replication.

Undoubtedly, conceptualizing the 'unit of selection' in terms of interaction with the environment was a crucial stage in the conceptualization of the group as a unit of selection. And, as can be seen in the above passage, together with the replicator concept it clearly enables evolutionists to speculate about the formulation of multilevel selection theory, and indeed in the above Hull effectively outlines his own perception of how this might be construed. It is noted here that in Hull's multilevel schema he was careful to point out that selection can occur at any level of the organizational hierarchy whereas replication tended to be concentrated at the primary or genetic level, 'sometimes at the level of the organisms and possibly colonies, but rarely higher' (1980, p. 324). He did not, however, discount the possibility of replication at higher levels, but observed that the relationship was essentially a 'one and many relationship' (Brandon, 1990, p. 98) with one level of replication and several ascending levels of interaction.[81]

This formulation is, in fact, the one that is currently taken as given by evolutionary biologists in their empirical work (Reeve and Keller, 1999, pp. 3-5), but, as will be demonstrated in later sections it is not the only one currently being explored. Indeed it is suggested here that there are five logical possibilities for multilevel selection theory,

[81] As Brandon (1996, p. 127) counsels however, 'nothing in the definitions [of replicators and interactors] precludes one and the same entity from being both an interactor and a replicator'.

and in order to distinguish between them, these are presented below in table (1) in Hull's generalized terminology.

I	Single level of replicators / Single level of interactors	'Traditional', Single level theory
II	Single level of replicators / Multiple levels of interactors ***CONTINUUM BETWEEN BIOTIC AND SOCIAL***	Hull, Brandon, Mayr, Lewontin, Gould, Lloyd, Dawkins, Boyd, Richerson, Field, Henrich, Keller et al.
III	Single level of replicators / Multiple levels of interactors ***SEPARATE SOCIAL ONTOLOGY***	For example, Ziman (2000) and co-authors were 'divided' over continuum between biotic and social realms.
IV	Multiple levels of replicators / Single level of interactors	NOT VIABLE: NO ADHERENTS
V	Multiple levels of replicators / Multiple levels of interactors ***CONTINUUM BETWEEN BIOTIC AND SOCIAL***	Hull, Brandon, Hodgson, Knudsen, Campbell, Nelson and Winter, Boyd, Richerson, Henrich, Aldrich.

Table 1 Logical possibilities of multilevel selection

The five possible positions of 'multiplicity' are identified as, I, the traditional single level of replicators and single level of interactors position; II, a single level of replicators with multiple levels of interactors position, as discussed above in relation to biotic evolution. This is where the social group is conceived as an additional level of interactor above the organism; III, this is exactly the same as position II except that it is perceived as applying 'separately' to the social domain;[82] IV, this suggests a multiple level of replicators and single level of interactor position which is probably not viable; and, finally V is a position of multiplicity at both the replicator and interactor levels.

As illustrated in the table, position I is essentially the traditional Darwinian single level evolutionary theory from which all the others are derived. Position II is the single level replicator and multilevel interactor position described by Hull above, and is the one assumed by evolutionary biologists, anthropologists and indeed most other

[82] In other words *not* in a continuum from the biotic to the social domain.

Darwinians. Position IV is logically not viable and thus has no adherents. And, finally positions III and V are the most interesting and relevant in terms of the social realm. Essentially whilst position III represents the expressed stance of some general Darwinists, position V more accurately represents their implicit position, and indeed the implicit position of most Darwinian accounts in organization studies and evolutionary economics, and indeed this is where the most promising research is currently taking place.

These configurations need a little unpacking but they will certainly become clearer in the discussion about group selection and social replicators. Essentially the difference between III and V highlights a very subtle distinction between interpretations of a generalized Darwinian position. Basically, while some in position III see Darwinian multilevel selection, like variation, inheritance and selection, as ontologically grounded, in the sense that there are Darwinian entities and processes at multiple levels of the social hierarchy, they stop short of seeing them in an ascending continuum from the biotic to the social domain. As Ziman (2002, p. 312) and his co-authors explain 'we were divided amongst ourselves on the fundamental issue of whether or not it is proper to see cultural evolution as a human extension of biological evolution, or as an entirely different type of process'.

In position V, on the other hand, which is essentially an 'extension' of position II, scholars are clear that there *is* a continuum between the two spheres, and that, as a result of recent theoretical work on group selection (Henrich, 2002, 2004) this is now clearly demonstrable. Indeed this position is most relevant to the thesis case studies and is thus the focus of the remainder of the Chapter. Position V basically suggests multiple levels of replication as well as interaction. It is endorsed by Hull (1980, 1981) and Brandon (1996), is implicit in much of the organization studies and evolutionary economics literature, and is currently being explored by Hodgson and Knudsen (2004a, 2004b, 2004c, 2006a, 2006b) in their work on higher levels of replicators in the social domain.
Crucially, the conceptualization and articulation of any multilevel account turns on the critical notion of group selection, and it is to this that the discussion now turns. The following sections trace the important developments in group selection theory and thereby usefully illustrate how it is possible to conceive of the notion of social replicators, and thus demonstrate position V above, and the conceptualization of a hierarchy of multiple replicators *and* interactors. The significance of this exploration for social theories of evolution will be highlighted, paving the way for a demonstration of the import of these clarifications in the case studies.

Units Debate, Group Selection and Altruism

As discussed in Chapter 5, the units debate was born out of speculation amongst theorists about the locus of causality in evolution and identification of the true unit of selection. In the hierarchically organised biosphere evolutionists saw that natural selection could be applied to entities other than the organism, with some arguing that the gene was the unit of selection, others arguing that it was the organism and others suggesting that it was the group. Hull, untangled the units and levels confusion at the centre of the controversy, and presented the generalised terminology which ultimately clarified the roles of entities operating in selection processes.

Hull demonstrated how Dawkins and others were merging two quite distinct sub-processes into one in the selection process, that of replication and interaction, and in this way confusing the role of the individual. Thus, where Dawkins misunderstood and diminished the role of the individual, as seen in his dismissive treatment of the vehicle and prioritization of the gene, Hull, in contrast, emphasized its critical role as an interactor and unit *of* selection.[83] And, moreover, he also proposed multiple levels of interactors.

To be sure, in evolutionary biology the units debate is now a very stale argument, having long since been satisfactorily resolved. Indeed even Dawkins recognizes the significance of Hull's replicator-interactor distinction and has changed his position on the interactor (phenotype) and its role in the selection process. And for scholars who deploy this perspective in their empirical work there is a perceptible irritation with those who continue to suggest otherwise, as illustrated in Keller and Reeve's (1999, p. 3) remarks below;

> This issue emerges in cyclic debates about (a) whether genes or individuals are best seen as the true units of selection, and (b) whether groups of individuals *can be* units of selection. In our opinion, these questions have been satisfactorily answered repeatedly, only to reappear subsequently with naïve ferocity in new biological subdisciplines … The particularly frustrating aspect of these constantly renewed debates is that, even though they seem to be sparked by rival theories about how evolution works, in fact, they often involve only rival metaphors for the very same evolutionary logic and thus are empirically empty.

[83] See Hull (2001, pp. 13-45) 'Interactors versus Vehicles', for an extended critique of the vehicle concept.

Altruism

The conundrum at the heart of the debate about group selection was altruism and the apparent contradiction that this raised between individual and group level selection. Thus whilst theorists might agree about groups being interactors, and therefore units of selection, the issue of reconciling selection processes at different levels in a hierarchy still remains problematic. Critics find it difficult to conceive of selection processes operating at two levels simultaneously. However, this possibility has also been convincingly demonstrated by several evolutionary scholars.

Wynne-Edwards (1962) famously provoked the controversy in evolutionary biology with the suggestion that natural selection was 'for the good of the group' or the species. Through his empirical studies of avian bird species, he demonstrated how behaviour considered detrimental to the individual had evolved to benefit the species. So that for Wynne-Edwards and others (Allee, 1951; Emerson, 1960) altruistic behaviour clearly demonstrated that natural selection operated at the level of the group.

However, group selection was attacked by Williams (1966) who argued that the gene was the primary unit of selection and that selection did not occur above the level of the individual, since individual selection would always militate against any possible group selection force. Moreover, when confronted with the conundrum of cooperative or 'unselfish' behaviour on the part of individuals he argued that a gene-selectionist account could also explain altruism. In what became a widely accepted explanation he proposed 'kin selection' to explain the selflessness observed among family members. In this view selfless acts were attributed to individual selection because individual sacrifices which were made for the welfare of family members ultimately translate to looking after ones own interests by securing the fate of the genetic endowment for future generations. Notably, Williams did not actually deny the theoretical possibility of group selection, however, he saw it as a cultural phenomenon, with no explanatory validity in biology.[84]

In summary, defined as 'behaviours that decrease relative fitness within groups but increase the fitness of groups' (Sober and Wilson, 1999 p. 99), altruism basically alludes to the idea of group-level adaptation or fitness, the idea that groups as individual wholes are differentially adapted to a common environment. And this idea was countered by opponents who believed that the Darwinian explanation was limited to

[84] Significantly, especially given the huge impact he has had on this debate, Williams has since renounced this position in a little known and infrequently cited publication (1992).

explaining behaviour that promotes the adaptive success of individuals only. Accordingly it was argued that cooperative group behaviour could not be reconciled by selection at the biological level where 'within group' or individual level selection pressures would always dominate. Essentially, following William's original position, it was widely believed that there was no continuity between the biological and the social realm.

Genetic Group Selection and 'Trait Group Selection'

However, as suggested earlier, faced with the theoretical challenge of explaining the coexistence of competition and cooperation, scholars came up with a variety of alternative explanations for altruistic behaviour. These included the theory of 'inclusive fitness' (Hamilton, 1964) or 'kin selection' (Maynard Smith, 1964), evolutionary game theory (Axelrod and Hamilton, 1981; Maynard Smith, 1982), otherwise known as evolutionary stable strategy, and selfish gene theory (Dawkins, 1976, 1982). However, as critics continue to point out, while such models may explain cooperation amongst small groups, none were able to explain altruistic behaviour among large groups of unrelated individuals in one-off encounters (Boyd and Richerson, 1990; Sober, 1999; Field, 2002, 2004; Henrich 2004). It has since been recognized that altruistic behaviour could only really be satisfactorily explained by *genetic group selection*. And this is where the analysis begins to more explicitly address the notions of social replicators and social interactors, and, to address the broader question of multilevel selection and how this relates to the socio-cultural realm.

Significantly, the aforementioned scholars and others (Wilson, 1975; Leigh, 1977, 1983, 1991; Dugatkin and Reeve, 1994; Skyrms, 1998) have developed models which have consistently shown that there *are* conditions under which genetic group selection can occur, which would explain, for example, the evolution of altruistic behaviour, or 'pro-social' behaviour. In a recent paper Henrich (2004) offers a very clear statement of these conditions. Using the Price (1970, 1972) equation, which partitions natural selection into individual and group level components, Henrich develops a multi-group model which emphasizes the difference between intergroup and intragroup variation and clearly illustrates how the evolution of 'pro-sociality' can be explained through genetic group selection. He describes his 'culture-gene coevolutionary' approach below (2004, p. 12-15);

> This perspective contrasts *within-group selection*, which acts against altruists who are exploited by free riders from their groups, to *between-group selection* that favors groups with more prosocial individuals because such groups can outcompete groups dominated by free riders …

Group selection or, more accurately, 'genetic group selection' occurs when the between-group component of natural selection acting on gene frequencies overcomes the within-group forces to favor an equilibrium different from that which would be favored by the within-group component acting alone.

Elegantly reiterating the argument of the aforementioned authors, Henrich essentially shows, through the logic of multilevel selection and Price's partitioned selection forces, how the variation between groups can become more important than the variation within groups. And, with his example of the evolution of pro-sociality, he demonstrates the evolution of group-traits and altruism, and thereby underscores the case for genetic group selection. Otherwise known as 'new group selection', 'intrademic group selection' or 'trait-group' selection, these types of models simply partition ordinary individual fitness into within and between group components (Reeve and Keller, 1999, p. 6).[85]

What is noticeable about these models is that there is a focus on the cooperative aspect of evolution as opposed to the competitive (another one of Darwin's 'dualisms').[86] And, notably, according to Henrich, it would seem that compared to other species, the extensive capacity of humans for social learning and cooperative behaviour is what largely explains cultural evolution. Alluding to the mechanisms that bind groups together (ultimately encapsulated in 'group traits' or social replicators) and increase their adaptive fitness, Henrich below, highlights the significance of this cooperative and imitative behaviour for maintaining intergroup variety whilst at the same time limiting intragroup variety;

> I argue that the nature of our cultural transmission capacities, and of human psychology more generally, creates stable equilibria consisting of combinations of cooperation and punishment that are not available to genetic evolutionary processes in acultural species. The existence of these additional, culturally evolved, behavioural equilibria make the group selection component of cultural evolutionary processes much more powerful relative to the within-group component than can occur in genetic evolution.

[85] Reeve and Keller (1999, p. 6) and others point out that these models are mathematically equivalent to individual-selection (i.e., inclusive fitness) models and therefore do not point to a fundamentally different kind of evolution (e.g. Dugatkin and Reeve, 1994; Bourke and Franks, 1995).

[86] Mayr (1976)

Thus, significantly, for evolutionary theory, the two strands of the group selection debate, units of selection and altruism, have both been firmly resolved. The literature reveals that these 'now stale' debates (Reeve and Keller, 1999) have cleared the ground for further research into the relationships between the different levels of the organizational hierarchy. Indeed with this broad consensus amongst evolutionists on genetic group selection, and because its viability is now so easily demonstrable, it is not surprising that multilevel selection is increasingly being invoked in evolutionary explanations (Keller 1999).

To be sure, the above represents significant developments for social scientists working on socio-economic theories of evolution, where individual, as well as group level phenomena, are vital to their analysis and where meaningful explanations of the impact of micro-level phenomena on macro-level outcomes are sought. Indeed, as the remainder of this Chapter will now attempt to demonstrate, these theoretical advances in group selection are key to the conceptualization and development of general multilevel selection theory. With the support of the conceptual apparatus associated with the interactor concept, a multilevel selection framework now becomes much more meaningful.

The Adoption and Development of Multilevel Selection Theory

So what is currently understood about multilevel selection theory and how is it being used? As implied in the above discussion, multilevel selection theory tends to be thought of as an advanced articulation of Darwin's original, 'single-level' theory. Put simply, it is 'the operation of natural selection - the motor of evolutionary history - at more than one level' (Field, 2004, p. 2). The multilevel structure is now widely assumed and is evidently being adopted by evolutionists across the sciences. In evolutionary biology, for example, as Nunney (1998) has recently claimed,

> Such theory is already extensively applied in ways that enhance our understanding of gene frequency change; kin selection and gametic selection are examples that have been recognised for many years.

Indeed, scholars from several disciplines, who are working with the theory, have recently become aware of and are actively seeking to characterise one particularly important type of mechanism. In a recent work (Keller, ed. 1999) leading researchers from the fields of biology, genetics, ecology and psychology explore the juxtaposition

of competition and cooperation at multiple levels and investigating the impact of this on higher and lower levels. And the text is replete with citations of other scholars adopting the same approach. Significantly, what is common to all these accounts, as well as those emanating from the social sciences, is the desire to uncover the *mechanisms* that sustain the intergroup differences; whether this is at the molecular or the cultural level. This is a critical question for the development of multilevel selection theory, and it is basically the question about social replicators. Crucially it is now acknowledged that at several levels of the biological hierarchy, mechanisms have evolved to prevent potential conflict between the different levels in natural selection (Keller, 1999), and scholars are now focusing on this dynamic.

Similarly it can be seen that the multilevel account is already being pursued by scholars in the social domain. Unsurprisingly Hull (1998) was one of the early investigators, with a convincing account of science as a selection process. David Sloan Wilson (2002) produced a stimulating text on the evolution of religion, treating religious groups, like Hull's scientific concepts, as selectable units. Meanwhile, Landa (2004), with her case studies of businessmen in China, offers empirical evidence of social groups operating as adaptive units, through what she calls 'homogeneous middleman groups'. And, Boyd and Richerson (2005), who continue to contribute to the field, recently published a book-length account of the evolution of culture.

It is demonstrated here that group selection theory provides the vital conceptual apparatus to explore such questions. In other words, group selection, via the replicator-interactor distinction, not only provides the bridge to multilevel selection theory but also the crucial key to its further development. This becomes clear on reading Henrich and other theorists, where they underline the point, that for group selection to occur there must be some kind of mechanism that engenders or sustains the difference between the groups, such as the separate development of the groups, or some kind of 'barrier' to migration between the groups.

Thus what group selection theory suggests is that there must be some kind of structure which operates to constrain the variation within groups and at the same time maintain the variation between groups. Clearly, so long as such a mechanism exists then group selection will occur. Accordingly, as is being argued here, establishing the existence of such a mechanism facilitates the assertion of group and multiple levels of selection. The replicator and interactor concepts then guide the exploration of functionality at and between each level.

In the following passage Field (2002) illustrates the same point for the social scientists, showing the link between group and multilevel selection theory, and expressing confidence in the leverage that a multilevel framework offers for the exploration of these evolved mechanisms. Here, for example, he refers to the 'restraints on defection' that will act to maintain variation between groups (p. 46);

> When one recognises in the context of multilevel models, that natural selection can sometimes favor behavioral predispositions not in the interest of the individual organism manifesting them, provided such predispositions give the gene(s) inducing them a fitness advantage, it becomes possible to tell a coherent story about the origin of restraints on defection and other behavioural tendencies essential to the emergence of complex social organization … Multilevel selection models provide a plausible explanation of key human behavioral propensities, an explanation that has proved maddeningly difficult within evolutionary frameworks allowing selection only at the level of the individual organism.

Significantly 'group selectionists' appear uniformly to propose some kind of mechanism that holds the group together and maintains the difference between it and other groups. And significantly, what this suggests is some kind of social replicator. Identify the social replicator and it is possible to identify what is being selected *for* in that particular group; what is the adaptive trait that favours this particular group over others? What binds it together? The mechanism is evident in Keller and Reeve's (1999, p. 154) observation relating to social insect colonies; 'the multilevel approach is useful because it is well-designed for the analysis of how socially mediated mechanisms that restrain within-group selfishness may evolve and remain stable.' And, as Nunney notes, 'because cheats, by definition, are not following rules, we expect group-selected systems to evolve policing mechanisms' (1990, p. 240). And, in the early days of the revival of group selection theory, Boyd and Richerson (1985), proposed 'conformist transmission' (copy the majority) to describe the elusive stabilizing mechanism of the social world, a popular term which continues to be used in the literature (Heylighen and Cambell, 1995; Henrich and Boyd, 1998, 2000).

Current Developments in Multilevel Selection Theory

Linking these insights to the logical possibilities of multilevel selection theory it is now possible to at least categorize the developing formulations. Position II could be used to describe the work of Keller and his colleagues in the natural sciences, where following Hull they acknowledge that 'entities from molecules of DNA, cells, and organisms to

colonies, demes, and possibly entire species interact with ever more inclusive environments in ways that bias replication' (Hull, 2001, p. 61). It could also be used to describe the perspective adopted by Field and Henrich whose work on genetic group selection clearly demonstrates the continuity between the biological substrate and groups at the cultural level. Both theorists talk about the evolution of 'prosociality', perceiving cultural group selection as being instructive in bringing this into existence, and this position admits a single level of replicators, which in their case would be the biological gene, and a multiple level of interactors, which would include their individual organism and the cultural group. Significantly, this is the position that was originally denied by Williams but then later accepted. And notably, its perception of the group in a multileveled account is as an interactor.

Interestingly, however, Henrich's perspective, as well as that of most other theorists commenting on socio-cultural evolution, is probably best described as position V. We recall that Henrich explored the conditions under which between-group selection prevailed over within-group selection, the classic tension between individual selection and group selection. And, with regard to social groups he considered immigrating and emigrating 'free riders' and wondered why more variety was not occurring within the groups as a result. He supposed that there must be something that militated against free riders in social groups and concluded that there had to be some kind of cultural structure that maintained the group within its boundaries. Essentially, once it is established that such a structure exists *and* that it is somehow being maintained, the notion of a cultural group replicator emerges. And this begs the question, are there replicators as well as interactors in the social realm?

It is suggested here that this is indeed the case and moreover that this is what is implied in many socio-cultural evolutionary accounts. In *Science as a Process* (1988), Hull observes that the replicators in scientific change are *not* genes and he posits instead things like, 'beliefs about the goals of science, proper ways to go about realizing these goals, problems and their possible solutions, modes of representation and accumulated data' (p. 434). He goes on to suggest that 'scientists in their conversations, publications, and classroom lectures broach all these topics' and that 'these are the entities that get passed on in replication sequences'. Indeed the idea of a social replicator has been endorsed by several others (Brandon, 1996; Landa, 2004; Wilson, 2002), it was proposed in the 'meme' concept (Dawkins, 1976; Blackmore, 1999) and, as noted earlier, its conceptual viability is currently being explored by Hodgson and Knudsen in their work on 'habits' and 'routines'.

Certainly it would appear that position V is the most logical and promising multileveled framework given current development of theory. Indeed the exploratory work of Hodgson and Knudsen is demonstrative of its potential. Building on Hull's definitions and drawing on the important work of Henrich, they first suggest the firm as an interactor and clearly illustrate how we might conceive of a social group as a interactor and unit of selection (2004a, p. 298);

> Group selection occurs under specific conditions only. The group itself has to be sufficiently cohesive and influential to overcome the adverse effects of immigration and emigration, thus minimizing the possibility of altruistic and other group-oriented behaviours being diluted and undermined by free-riders. There must be differential success of groups, that is due in part to the properties of groups, not merely to their components. In general, a significant degree of group structure and cohesion are required to make group selection meaningful (Henrich, forthcoming). In short, group selection operates when the individuals in the group are bound together in a sufficiently cohesive manner to share a mostly common fate.

It is in a follow-up paper on the replication of habits that Hodgson and Knudsen (2004b) then effectively propose extending the roster of entities that count as replicators, by positing individual habits and organizational routines as social replicators. The justification for this follows from the above logic. Where there is some kind of structure which persists and acts as a restraint on variation within the group, then the structural constraints or factors become the factors that are being selected *for*. The structures are effectively being selected because these are the things that cause the groups to vary between themselves rather than within themselves.

Significantly, for the purposes of this study, in addition to these explicit endorsements of position (V) and its notion of multiple replicators and interactors, there is the implicit acknowledgement of such a position in many of the evolutionary theories in organization studies and evolutionary economics. Indeed it is apparent in two of the case studies here, in the work of Nelson and Winter and Aldrich. Both theories assume group selection, they invoke the replicator-interactor distinction and they involve a multileveled selection account which mirrors the critical 'one and many' replicator-interactor dynamic that ascends from a social replicator (organizational routine). Furthermore, there are increasing numbers of scholars in these disciplines who are recognizing the replicator interactor distinction (Baum and Singh, 1994) and are promoting the idea of multilevel selection (Baum, 2002).

As suggested earlier, however, whilst it is the view here that such accounts implicitly map on to position V, their authors, for the most part, would probably identify more

with position III. That is, with a separate ‘one and many’ replicator-interactor hierarchy which does not run in a continuum from the biotic to the social sphere (Ziman, 2000). In other words, even for Darwinians who acknowledge Darwinian entities and processes in the social world they still see conceptual separation between the two spheres.

In summary, although still very much at an exploratory stage, multilevel selection theory has significant implications for social theories of evolution, where group selection is assumed and multilevel selection is increasingly invoked. Significantly, as well as presenting the possibility of a more advanced and coherent evolutionary account of the socio-economic realm, position V multilevel selection theory and its central notion of group selection is consistent with a raft of work already accomplished in the social sciences. This is because position V essentially postulates ‘social structure’, but in addition, through the replicator-interactor concepts it also provides the tools to articulate change and continuity in such social structures.

Implications for Evolutionary Theories of Socio-Economic Change

A more inclusive theory of evolution which embraces multilevel as well as group selection would certainly have much to offer social scientists. Indeed evidence suggests a pressing need for the conceptualization and articulation of multilevel selection theory and certainly the need exists in the social sciences for its further development. In the case of Nelson and Winter, for example, it could help unravel some of the conceptual confusions around their unit of selection. The role of the firm is unclear in their theory, and further scrutiny suggests that they appear to be inadvertently promoting at least two levels of selection, in the shape of ‘organizational routines’ at one level, and the firm at another level. Following position II, multilevel selection theory would enable them to accommodate selection at the level of organizational routines as well as the firm. Alternatively, following position V, their ‘routines as genes’ analogy could become more ontologically grounded by asserting a higher level replicator at the organizational routine level.

Similarly for organization theorists like Aldrich and others, the multilevel approach and replicator-interactor dynamic, also appears to have a great deal to offer. While a replicator-interactor distinction is implicit in his account and Aldrich clearly assumes multilevel selection, his analysis nevertheless suggests that he is unaware of the most recent developments of theory. Undoubtedly, as will be demonstrated in Chapter 10, these insights would provide him with a much more incisive analysis.

With Hannan and Freeman and the organizational ecologists, there was a decisive movement away from firm-level 'adaptationist' explanations of change towards the development of a population-thinking perspective which instead promotes a 'selectionist' explanation of 'adapting industries'. However, the problem with this perspective is that it is destined to tell only one part of the evolutionary story. Multilevel selection theory, however, would allow organizational ecologists to reinstate the firm in organization theory to a central position, and speak not only of adaptation of the industry but also of adaptation of the firm. Moreover, for the more traditional 'organization-level adaptationists', multilevel selection theory permits a richer explanation of phenomena because, as indicated in the last section, they can hold on to Lamarckian explanations of change within a Darwinian multilayered selection framework. Significantly, multilevel selection theory appears to dismiss the need for analysts to *choose* between adaptationist theories and selectionist accounts, enabling them seemingly to have both.

As suggested earlier, multilevel selection theory remains conceptually underdeveloped and indeed it is still very much at the exploratory stage. Nevertheless it is clear from the above discussion that considerable empirical, theoretical and conceptual progress has already been made and that multilevel selection theory has a great deal to offer evolutionary theorists in the social sciences.

Concluding Remarks

The primary purpose of this Chapter and the preceding Chapters on the units debate and Lamarckism has been to bring evolutionary theory right up to date and to unpack the theoretical developments and conceptual refinements that demonstrate and articulate the general nature of Darwinian theory. The secondary purpose has been to prepare the way for an incisive evaluation of the case studies featured in part III of the study. Equipped with a clear and modern understanding of Darwinism it becomes possible here to make the first in-depth and comparative analysis of the use of Darwinian ideas in the influential evolutionary theories of Nelson and Winter, Hannan and Freeman, and Howard Aldrich.

Through this modern Darwinian perspective, not only is it easier to perceive the implicit adoption of Darwinian ideas in these seminal accounts and interpret the nature of their use, but it is also easier to see where and how the theoretical developments offer important clarifications, plug gaps and enhance the theories. Indeed significantly, for

these particular socio-economic theories, what modern Darwinian theory has helped to reveal is that social evolution is *both* Lamarckian and Darwinian, and moreover that these apparently disparate theoretical perspectives, each with their own rich and vital contributions, may eventually be reconciled in the meta-theoretical framework of generalized Darwinism. Finally, as the following Chapters will continue to demonstrate, the Darwinian perspective has also helped to reveal the important signs throughout the literature that this 'reconciliation' is already underway, even witnessed, for example, in Nelson and Winter's 'Lamarckian' account, which is shown here to be Darwinian.

Thus, it is to the case studies that we now turn and we begin with Nelson and Winter's *An Evolutionary Theory of Evolution Change.*

Part III

Case Studies in Evolutionary Economics and Organization Studies

> In sum, natural selection and evolution should not be viewed as concepts developed for the specific purposes of biology and possibly appropriable for the specific purposes of economics, but rather as elements of the framework of a new conceptual structure that biology, economics and other social sciences can comfortably share.
>
> Sidney Winter (1987)

8 Nelson and Winter's Evolutionary Theory of Economic Change: Hidden Darwinism

> No account of modern evolutionary economics can fail to relate to the authoritative and original work of Nelson and Winter (1982). It is they who provided the catalyst for the subsequent flowering of work in the area: the emphasis on routines, non-maximizing behaviour and the individuality of firms, the central role of markets as selection processes, and the resort to the computational simulation of evolutionary economics has defined the new paradigm framework for many.
>
> J. Stanley Metcalfe (1998)

Introduction: The Darwinian Analysis

Equipped with the necessary insights into Darwinian evolutionary theory, particularly in its formulation updated by recent insights, it is now possible in Part III of this study to focus on the case studies of Nelson and Winter, Hannan and Freeman, and Howard Aldrich, and to conduct an in-depth evaluation of their respective evolutionary theories. Accordingly, over this and the next two Chapters these seminal works will be compared and contrasted in their use of evolutionary theory and attention will be drawn to the Darwinian thread that unites them. Through this generalized Darwinian lens it now becomes much easier, not only to identify the Darwinian assumptions and theoretical underpinnings that are frequently just implied by the authors, but also to perceive the extent of the Darwinian contribution and to illuminate the precise nature of its adoption in their respective theories. Ultimately this perspective permits the incisive appraisal of the validity and potential of these evolutionary theories of socio-economic change by untangling confusions, revealing limiting assumptions, exposing gaps and inconsistencies and pointing the way to their resolution in the meta-Darwinian framework.

Thus through the ensuing analyses the relevance of the previously discussed theoretical and conceptual advances in Darwinian evolutionary theory will be demonstrated. It is shown how this abstract formulation makes sense of the entities, processes and events that these various authors seek to explain and offers solutions to their respective theoretical conundrums. In the unpacking of these case studies, it will be demonstrated, for example, how the resolution of the infamous ‘units debate’ and all the clarifications that subsequently followed, all have a critical bearing on the

articulation, facilitation and enhancement of their theories of socio-economic evolution. It will be shown, for instance, how the 'two-step' selection process and corresponding replicator-interactor duality, provide critical clarifications about the type of entity that counts as a 'unit of selection' in the social arena (organizational routine, group, firm, organization, industry) and at what level, and indeed, at how many levels the process of selection can take place. It is also shown how the same developments address another common stumbling block for these scholars and permit the conceptualization of Lamarckian inheritance within the traditional Darwinian framework. Thus, in the case of Nelson and Winter, and to which the discussion now turns, after establishing its 'hidden' Darwinian credentials, the Chapter proceeds by identifying the inconsistencies at the heart of the theory, and shows how these are manifested out of confusions over the selection process and the handling of Lamarckian inheritance.

The Case of Nelson and Winter

The first case study in evolutionary theory is from the field of business economics where the focus is on the celebrated *Evolutionary Theory of Economic Change* (1982), the seminal work of industrial economists Richard Nelson and Sidney Winter. This evolutionary account shows Nelson and Winter to be amongst the very few economists since Veblen (1899) and Hayek (1967, 1982, 1988) to use the Darwinian principles of variation, inheritance and selection in an analysis of economic phenomena. Indeed Nelson and Winter's authoritative tome represents a dramatic move forward in this regard and has served as a catalyst for the 'flowering field' of evolutionary economics.

Nelson and Winter's remarkable achievement was to construct for the field of economics a dynamic theory which notably directly applies Darwin's core principles of variation, inheritance and selection. In seeking to explain technological and economic change, they skilfully identified parallels between key entities and processes in the complex systems of economics and biology. For example, they equate organizational routines with genes, firms with organisms and the industry with species, and, central to the theory is an economic selection process described as resulting in the differential survival of firms within an industry. Significantly Nelson and Winter have effectively constructed for the economic domain a cumulative *causal* theory of evolutionary change that mimics the complex interweaving Darwinian processes of variety formation, character inheritance and natural selection. And, of equal significance, implicit in the theory is the replicator-interactor distinction and corresponding notions of a 'social

replicator' and ascending levels of interactors. Certainly, as shall be argued here, the theory meets the criteria set down by Dawkins (1983) and others (Plotkin, 1994; Dennett, 1995; Cziko, 1995) for 'universal Darwinism', and what is more it critically offers a dramatic illustration of the feasibility and potential of a general Darwinian theory (Hull, 1980, 1981; Brandon, 1990, 1996, 1999; Hodgson, 2005; Hodgson and Knudsen, 2006b).

Significantly however, in spite of these obvious Darwinian credentials, Nelson and Winter demonstrate a curious reluctance to claim their Darwinian heritage. The name of Darwin is mentioned only once in the text (p. 9) and this is more for the purpose of underlining Darwin's earlier inspiration from the economist Thomas Malthus (1798) and the latter's work on the problems of population growth and scarcity, than it is to acknowledge Darwin's influence on their own thinking. Indeed, it is within this context, of the cross-fertilization of ideas, that Nelson and Winter explain their respective borrowing of evolutionary ideas from the sphere of biology, and where they emphatically state that their own theory is 'unabashedly Lamarckian' (p. 11).

This evident reluctance to adopt a Darwinian label causes a certain amount of confusion however, not only in terms of the characterization of the theory, but also because of important issues it raises regarding the tractability of the theory. Moreover, at a general level it is demonstrative of the widespread tendency of evolutionary scholars in the social sciences to erroneously assume a mutually exclusive relationship between Darwinism and Lamarckism. This misapprehension, discussed at length in Chapter 6 above, has undoubtedly influenced the polarization of evolutionary approaches in the social sciences, where scholars have tended to identify *either* with Lamarck or with Darwin. As argued there, and will be now be demonstrated through the exploration of Nelson and Winter's approach, Darwinism and Lamarckism are not mutually exclusive theories, and, furthermore, Lamarckian accounts are totally dependent on the Darwinian structure for their theoretical viability (Hodgson, 2001b; Knudsen, 2001).

In this Chapter the key strands of Nelson and Winter's evolutionary framework are set out, highlighting both its explicit as well as its implicit assumptions. By focusing on puzzling ambiguities in their use of evolutionary ideas and on a particular confusion around the selection process, it will be demonstrated here that these ambiguities are linked, both to their resistance to the 'Darwinian' label, and to an underestimation of the nature and scope of Darwinism in modern evolutionary theory. In the light of the major clarifications achieved in evolutionary theory in recent years, it will be shown here that

not only is there a 'hidden Darwinism' in Nelson and Winter's theory, but also that it is 'Darwinism' that actually facilitates and enhances their theory.

Following Baum and Singh's (1994) usefully observed categories, the main body of the Chapter will proceed by carefully examining the entities, processes and events that Nelson and Winter seek to explain. And in accordance with the central objectives of the thesis, an evaluation of these will be made from the modern Darwinian perspective, as outlined in the preceding four Chapters. A brief overview of the modes of evolutionary thinking in economics will first set the scene for Nelson and Winter's contribution, and the Chapter will conclude with a reflection on the implications of their work for the further development of an evolutionary theory of socio-economic change.

Evolutionary Economics

Evolutionary economics is a small but expanding field. In its various manifestations, including those strains inspired by the Darwinian evolutionary framework and self-organization theory, it attempts to address the shortcomings of mainstream economics, and to frame a dynamic theory that facilitates analysis of the development of firms and industries as they interact and impact upon each other over time. As discussed in Chapter 2 above, the roots of the Darwinian perspective in economics can be traced back to Veblen (1898). Whilst Veblen promoted the Darwinian variation, inheritance and selection approach from which he derived the notion of 'cumulative causation' (p. 387), others such as Marshall, instead favored a Spencerian and Lamarckian evolutionary approach where he emphasized the adaptive capabilities of the firm.

A significant turning point in the development of evolutionary economics is marked by the important later contributions of Alchian (1950), Downie (1958) and Winter (1964), which highlighted the importance of variety in explanations of change. Their work ultimately informed a different view of selection processes which critically acknowledged that variety drives change[87] and with their shift to a population level analysis and focus on frequencies this opened up a novel way of thinking about competition, firm behaviour and market mechanisms. With the consequent movement towards a distributional view of variation, these scholars rejected the 'typological essentialism'[88] that was imbedded in the thinking up until that time and critically

[87] Subsequently known as 'Fisher's Principle' (1958)

[88] See Chapter 4 above for a discussion on the distinction between typological essentialism and population thinking.

effectively ushered into economics the same revolutionary population thinking perspective that was foundational to Darwinian selection theory.[89] Marshall's (1920) focus on 'representative types' and his dismissal of variety as unimportant was shown to be woefully misguided and a very limiting assumption.

However, the appeal to Darwinian evolutionary selection was heavily criticized, most notably by Penrose (1952) who famously dismissed the use of biological analogies in economics. And while others, such as Schumpeter and Hayek, subsequently developed 'evolutionary' accounts of economics it is important to note that these were not in the Darwinian mode (Hodgson, 1993). Schumpeter (1976), for example, explicitly rejected the use of biological analogy (1954) and instead talked about an evolutionary process in the Marxian (1867) sense of 'development', in the sense, for example, of the unfolding of a predetermined process. And Hayek (1988), building on the concept of group selection, proposed another evolutionary approach based on the concept of 'spontaneous order'. Such approaches are seen to have influenced the evolutionary perspectives of Witt (1997, 2004) and Foster (1997) who are similarly critical of the Darwinian biological analogy, and who build their evolutionary approaches around the concepts of self-organization, novelty, discontinuity and change. Resistance to the idea of using biological metaphors in economics and post-war concerns about Social Darwinism[90] continue to influence the variation in theory. However, as demonstrated here through the analysis of Nelson and Winter's theory, recent efforts by evolutionists to clarify Darwin's deceptively complex selection process and its attendant mechanisms of variety formation and inheritance, have paved the way for more tractable socio-cultural theories of evolution.

Indeed, as discussed in earlier Chapters, Darwinism has been promoted by some evolutionary economists as the only *general* evolutionary theory which comprises a conceptual framework that is easily transferable to the complex socio-economic domains. It enables in economics, for example, the abandonment of orthodox equilibrium and maximization assumptions and the adoption instead of a dynamic approach that embraces more realistic ('routinized') behavioural assumptions. As Hodgson (2004, p. 8) explains, 'Darwinism provides a specific framework for understanding the evolution of all open, complex systems, that have varied and replicating elements with different capacities to survive'. To be sure, the literature

[89] See Metcalfe (1987), who presents a detailed review of the development of thinking that led to its eventual adoption in evolutionary economics.

[90] See Chapter 2 above for detailed discussion of objections to Darwinism in the social sciences

suggests that it is the Veblenian strand of evolutionary economics that is now being most vigorously pursued by evolutionary economists, explicitly by some and implicitly, as argued in Chapter 1, by most other authors.

The impetus behind the above developments is undoubtedly partly due to advances in biological evolutionary theory and its improved articulation and accessibility both within and outside biology. It is also worth underlining the point that economists, including Nelson and Winter who notably inspired this recent flourishing of evolutionary economics, were working in milieu where Darwinian ideas were becoming a frequent part of academic discourse (Laurent, 2001), they were inevitably absorbing the language as well as the value of the biological metaphors and analogies, particularly in relation to adaptation and the selection process. With the population thinking perspective already imbibed, scholars were more receptive to the Darwinian treatment of variation, continuity and change, and it is clear that the notion of group selection was quickly assumed.

Nonetheless, in spite of this and the early Darwinian influences in economics (Veblen, 1898; Campbell, 1965), the development towards a full Darwinian account has been thwarted by confused interpretations, and the varying assimilation of Darwinian ideas often within Lamarkian interpretations of evolutionary change. Adaptationist thinking and Lamarckian explanations of causality appear to have presented certain theoretical obstacles and where the Darwinian perspective has been adopted these have tended to be only partial 'selectionist' accounts.

Consequently Nelson and Winter's work represents a very significant development in evolutionary economics. These scholars were the first economists since Veblen to actually apply the three core Darwinian principles of variation, inheritance and selection to economic phenomena. With the firm at the centre of the analysis Nelson and Winter constructed a comprehensive evolutionary explanation of change which portrayed a plausible micro-to-macro level causal story. They had the critical Darwinian selection process as the dominant evolutionary force and yet, significantly, they also acknowledged purposive behaviour and firm-level adaptation as being causally significant through their adoption of the Lamarckian inheritance mechanism. The detailed investigation of this remarkable work will now follow.

The aim here is to evaluate Nelson and Winter's use of biological evolutionary theory, to illustrate the parities that they draw between the spheres of biology and economics, and to ultimately call attention to the hidden Darwinism in their evolutionary theory of economic change. Beginning with an outline of their theoretical

framework and moving on to an examination of their handling of their key entities and processes, the analysis highlights the ontological similarities that Nelson and Winter identify between the biotic and social spheres, and draws attention to the implicit Darwinism in their theory. Observing the Lamarckian dimension it then goes on to illustrate problems with the theoretical tractability of the theory and to indicate their resolution in modern general Darwinism. It becomes apparent that a replicator-interactor distinction is implied, that Nelson and Winter clearly posit the notion of 'social replicators', and that ambiguities around their selection process are rooted in a confused but implicit multi-level selection theory. The upshot is that as well as demonstrating that the social sphere is both Darwinian and Lamarckian the theory reveals how it is general Darwinism, in its modern formulation, that both facilitates and indeed enhances their theory.[91]

Theoretical Framework of an Evolutionary Theory of Economic Change

Nelson and Winter's underlying objective was to achieve improved understanding of technological change and the dynamics of the competitive process (1982, p. viii). An interest in the processes of long-run economic development combined with dissatisfaction with standard views of economic behaviour led them to explore the potential of the evolutionary viewpoint. For Nelson and Winter this pointed towards a 'more realistic economic theory' which was capable of accommodating important insights from other disciplines on firm behaviour.

The main problems with orthodox economic theory for Nelson and Winter are the maximization and equilibrium assumptions. That is, maximizing behaviour on the part of firms, and equilibrium outcomes at the industry level. In contrast, what they choose to emphasize, through a dynamic evolutionary perspective, is 'routine' behaviour on the part of firms, and the 'development' of industries over time (pp. 4-5). What they sought to highlight through this approach, in contrast to the prevailing view, was the relative *inflexibility* of individual firms in the face of changing economic environments. In an approach that nevertheless does not discount the import of firm level activity, they basically assume a population level perspective which promotes an 'economic natural selection' process that moulds the industry over time.

[91] See Chapters 2 and 3 above where it is shown how general Darwinism accommodates the Lamarckian inheritance mechanism.

Through their implicit population thinking perspective, Nelson and Winter clearly place the firm at the centre of their analysis and portray it as the unit of selection. Thus there is the immediate acknowledgement of the conceptualization of the group as an 'individual' in the selection process. And in a reflection of the genotype-phenotype distinction, this firm is simultaneously portrayed as being comprised of a host of 'organizational routines' which determine its nature and characteristics. And again, in their insightful analysis of the evolutionary paradox of continuity and change, in a representation of the Darwinian model (Mayr, 1976), they identify this organizational routine as being a source of both inertia and innovation for the firm. Clearly, on the face of it, what is being observed here is the classic Darwinian 'single level' selection process.[92]

Organizational Routines

In terms of the construction of their evolutionary account, the organizational routine is highlighted by Nelson and Winter as one of the three 'basic concepts' of their evolutionary theory (p. 400). It is defined by Nelson and Winter below (p.14);

> Our general term for all regular and predictable behavioural patterns of firms is 'routine'. We use this term to include characteristics of firms that range from well-specified technical routines for producing things, through procedures for hiring and firing, ordering new inventory, or stepping up production of items in high demand, to policies regarding investment, research and development (R&D), or advertising, and business strategies about product diversification and overseas investment.

Evidently, and significantly, Nelson and Winter's concept of an organizational routine covers a whole variety of firm level activities. And, as indicated above it is these that define the characteristics of individual firms. Indeed through their courageous and enlightened use of analogy Nelson and Winter explicitly liken the organizational routine to the biological gene in the way that it functions in evolutionary selection processes. The genotype-phenotype duality is clearly implied. As illustrated in the following passage, the routine plays an important role both in the continuity or persistence of traits, as well as in their decisive development or change;

[92] For the purpose of clarity, in the context of this thesis, the description, 'single level', is used to denote the classic Darwinian process of natural selection merely in order to distinguish it from the notion of multi-level selection. See Chapter 7 above.

> In our evolutionary theory, these routines play the role that genes play in biological evolutionary theory. They are a persistent feature of the organism and determine its possible behaviour (though *actual* behaviour is determined also by the environment); they are heritable in the sense that tomorrow's organisms generated from today's (for example, by building a new plant) have many of the same characteristics, and they are selectable in the sense that organisms with certain routines may do better than others, and, if so, their relative importance in the population (industry) is augmented over time.

It is understandable from this detailed definition why Nelson and Winter identify the organizational routine as being one of their key concepts. It elegantly permits a micro to macro causal explanation which acknowledges firm-level activity but nevertheless privileges selection processes. Indeed from the above it is clearly possible to discern the coming together of their evolutionary story, one which, it cannot be denied, looks remarkably similar to the neo-Darwinian synthesis (Darwinism and Mendelian genetics),[93] with the key evolutionary elements of variety, inheritance and selection also being indicated in the last, long sentence. Significantly, the treatment of the organizational routine also appears to anticipate the more recent developments within general Darwinism, specifically multilevel evolutionary theory, which is indicated in their suggestion of multiple social replicators and interactors. Before exploring this point further, however, the analysis will consider what Nelson and Winter identify as the two other defining features of their evolutionary theory, that is the 'search' process and the 'selection environment'. Together with the organizational routine, these usefully serve to indicate the full flavour and scope of the theory.

Search

Nelson and Winter's second basic concept is labelled 'search'. Search refers to all the organizational activities 'which are associated with the evaluation of current routines and which may lead to their modification, to more drastic change, or to their replacement' (p. 400). Search, via the activities of 'higher level' routines, is portrayed as a firm level process that essentially covers the various ways that firms respond to their environments. As Nelson and Winter explain;

> We have stressed that these kinds of activities are themselves partly routinized and predictable, but that they also have a stochastic character both from the point of view

[93] 'Neo-Darwinism' is often used in the biological literature to denote the synthesis in the 1950s of Darwinian evolutionary theory with Mendelian genetics. However, confusingly, it is also sometimes used to refer to the reductionist approach of 'ultra-Darwinists'.

> of the modeler and the point of view of the organization that undertakes them. Routines in general play the role of genes in our evolutionary theory. Search routines stochastically generate mutations.

In other words, 'search' is how Nelson and Winter describe firm-level adaptation, it refers to a sort of selection process, in the sense of choice, a shifting through alternatives on the part of decision makers.[94] It should be noted, however, that the concept of search is key to the theory in another important respect which is not immediately apparent in the above. This is with regard to Nelson and Winter's inheritance mechanism. As indicated in the preceding paragraph, search activities are firm level activities, and they illustrate the various ways that firms change in response to their environment. Through this feedback activity, search thus indicates a Lamarckian inheritance mechanism, or the notion of the inheritance of acquired characteristics. In other words by changing in response to environmental stimuli, Nelson and Winter's firms are essentially changing their routines in the process, routines that will then be passed down to 'tomorrow's organizations'. By analogy the organism is effectively changing its genetic makeup and passing on acquired changes to its offspring; thus this is clearly Lamarckian inheritance and indicates why Nelson and Winter describe themselves as Lamarckian.

Selection Environment

Nelson and Winter's third basic concept is the 'selection environment' and this refers to their selection process. They describe the selection environment of a firm or organization as being (p. 400);

> The ensemble of considerations which affects its well-being and hence the extent to which it expands or contracts. The selection environment is determined partly by conditions outside the firms in the industry or sector being considered – product demand and factor supply conditions, for example – but also by the characteristics and behaviour of the other firms in the sector.

Again the biological analogy is clearly called upon as Nelson and Winter go on to explain that differential growth plays much the same role in their theory as it does in biological theory. Again revealing an uncanny resemblance to the Darwinian

[94] This 'selection' is separate to and different from the selection process that takes place at the level of the organization, and, as will be discussed in later sections, it is key to the ambiguities that arise around Nelson and Winter's elucidation of the selection process.

exposition, an astute awareness of causality in evolution, and thus the framing of their own theory, Nelson and Winter explain that 'it is important to remember that it is ultimately the fates of populations or genotypes (routines) that are the focus of concern, not the fates of individuals (firms)'.

Entities, Processes and Events, and Implicit Darwinism

The above outline of Nelson and Winter's evolutionary theory of economic change has essentially identified its key entities, processes and events as the authors themselves prioritise and summarize them. In an attempt at further clarification and to assist the evaluation of the theory from a Darwinian perspective, these are here briefly summarized and contextualized. The main entities that Nelson and Winter seek to explain are organizational routines, firms and industries. The processes they seek to explain are variety creation, continuity or inheritance processes, and competition or selection processes. And the broad events they seek to explain are change in organizational form and change in industry over time. In summary, these relate to each other in a theory which is structured in a hierarchical fashion, with the organizational routines at the primary level, then the firm and then the industry. Accordingly it can be described as a 'bottom-up' theory, in the sense that Nelson and Winter attempt to explain macroeconomic phenomena in terms of the effects of microeconomic phenomena. In other words, technological change, at the level of the routine, explains economic, or industrial-level, growth.

In this section Nelson and Winter's entities, processes and events will be examined through a modern Darwinian lens to evaluate how they work together as an evolutionary theory. With reference to the theoretical and conceptual insights explored above, in Part II, it will be shown here how such excursions into evolutionary biology undeniably enhances understanding of the peculiarities of evolutionary theorizing (Vromen, 1995). Moreover, they also provide a vantage point that decisively uncovers the *hidden* Darwinism in Nelson and Winter's theory.

Thus, through a careful analysis of Nelson and Winter's work the intention here is to underline the implicit adoption of Darwinian ideas in their theory and thus reinforce the general nature of Darwin's theory, and by implication, the ontological similarities between the biotic and social domains. However, as noted, because of the authors' explicit and insistent identification with Lamarckism, and because of the consequential ambiguities in their use of evolutionary ideas, this assertion and its clarification has not

been without its problems. Indeed the uncovering of a particular confusion with regard to the selection process is to be my case in point here.

Significantly, while Darwin's core principles of variation, inheritance and selection may all be discerned in their theory, Nelson and Winter avoid identifying these as Darwinian. A close reading of the text, however, shows that the authors nonetheless implicitly assume the 'generalizability' of these adopted Darwinian principles. Evidently they recognized in biology a general theory that could help them understand the specificities of the social world.

The important thing to emphasize here is Nelson and Winter's ground-breaking achievement in the application of Darwinian principles to economic phenomena, and furthermore, that this accomplishment presents an incredible irony, given that Darwin is mentioned only *once* in the text. As will be shown below in the unpacking of the theory, in spite of the confusing rhetoric associated with the attachment to Lamarckism, this theory really has moved beyond mere analogies, it is evolutionary, and it *is* Darwinian. And so the analysis now turns to the Darwinian analysis of its construction and demonstration therein of the decisive movement from analogy to ontology (Hodgson, 2002b).

Darwinian Entities: Firms and Organizational Routines

It has been asserted above that Nelson and Winter have constructed a cumulative causal theory of economic change that mimics the complex interweaving Darwinian processes of variety formation, character inheritance and natural selection. We will begin to explore how they achieve this by examining their elementary unit of analysis, the firm, looking at the nature of its construction and its destiny as it functions within these evolutionary processes. Significantly, from a modern Darwinian perspective, in Nelson and Winter's description, below, of the firm, the Darwinian interactor and replicator entities are immediately discernable (p.4);

> Our firms are modeled as simply having, at any given time, certain capabilities and decision rules. Over time these capabilities and rules are *modified* as a result of both the deliberate *problem-solving efforts* and *random events*. And over time, the economic analogue of natural selection operates as the market determines which firms are profitable and which are unprofitable, and tends to winnow out the latter.

In terms of the distinguishable entities that operate in evolutionary processes, the firm, in the above, is likened to the individual organism or 'phenotype' in the biotic sphere. And this is the entity which interacts with the environment and upon which selection operates. In other words this is Nelson and Winter's 'interactor'. The interactor, as discussed in previous Chapters, was defined as 'an entity that directly interacts as a cohesive whole with its environment in such a way that this interaction *causes* replication to be differential'. Throughout the text Nelson and Winter's treatment of the firm is consistent with this definition, as indeed it is with the definition of the corresponding replicating entities. In a recent article, which builds on Nelson and Winter's work in this area, as well as that of other scholars on the concepts of replicator, interactor and selection, Hodgson and Knudsen (2003) demonstrate that there is indeed a case for regarding firms (and similarly cohesive institutions) as interactors.

It is important to note here that in the above passage Nelson and Winter's merging of Lamarckism with Darwinism is both very typical and very clear. The 'deliberate problem-solving efforts', for example, refers to feedback from the market upon which firms act. They respond to market stimuli and change strategy accordingly. This clearly refers to the Lamarckian inheritance mechanism, and indeed 'Lamarckian' is how Nelson and Winter describe their theory. However, as discussed in Chapters 4 and 6 above, Lamarck did not develop a selection process, or a way of explaining why some adaptations survived whilst others did not, thus Nelson and Winter deploy the Darwinian selection mechanism.

Returning to the Darwinian entities, the authors notably describe the firm as having certain capabilities and decision rules, by which they mean 'behaviours' that are comprised of and partly determined by gene-like entities. And this alludes to their second important evolutionary entity, identified by Nelson and Winter as 'organizational routines', likened by them to the genotype, and again easily recognisable as Hull's replicating entity. The replicator, we recall, is defined as 'an entity that passes on its structure largely intact in successive replications,' and from the earlier introduction to the organizational routine, which, for explanatory purposes, is repeated below, the consistency with modern Darwinian evolutionary theory is similarly apparent (p. 14).

> In our evolutionary theory, these routines play the role that genes play in biological evolutionary theory. They are a persistent feature of the organism and determine its possible behaviour (though *actual* behaviour is determined also by the environment); they are heritable in the sense that tomorrow's organisms generated

> from today's (for example, by building a new plant) have many of the same characteristics, and they are selectable in the sense that organisms with certain routines may do better than others, and, if so, their relative importance in the population (industry) is augmented over time.

In the exploration of how Nelson and Winter handle the firm and the organizational routine of which it is comprised, it is then possible to perceive the corresponding Darwinian *processes* of variation, inheritance and selection. For Nelson and Winter evidently the routines act like genes in biotic life; they replicate, mutate and are inherited, differentially, by the next generation. Those routines or capabilities that render the firm best adapted to its environment will be the routines that survive through the selection process into the next generation. In their characterization of the firm they are clearly alluding to the modern Darwinian perception of the organism, as advanced in genetics and molecular biology, and articulated in the generalized replicator and interactor concepts. As discussed in Chapter 4, Mayr (1988) refers to this as the 'peculiar dualism' of the organism, where the organism possesses a historically evolved genetic program which is coded in the DNA.

Thus to reiterate the explanations of earlier Chapters, the *genotype* (replicator) is the genetic composition of an organism whereas the *phenotype* (interactor) is its developed characteristics or capacities. In other words, the phenotype is the physical manifestation of the genotype; the physical or behavioural characteristics or capacities. The phenotype is what is generally understood as the actual organism. Undoubtedly Nelson and Winter's description of routines and their relationship with the firm approximates to this understanding of the organism's duality. The firm is effectively 'shaped' or characterized by the routines which in turn represent the firm's replicating heritable entity.

Accordingly, to summarize the biological parities in terms of *entities*, the firm is the variable interactor that competes with other organisms in a selection process, routines are the replicators, the heritable entities that sometimes make imperfect copies of themselves and are equivalent to the gene, and the industry is clearly the species that evolves over time. To complete the parities and generalized terminology here, the species, denoted as 'lineage', are those entities that do not function *in* selection but which 'result from successive replication' (Hull, p. 409), and they are implicated by Nelson and Winter in their conceptualization of the industry. Lineage is defined by Hull as 'an entity that persists indefinitely through time either in the same or an altered state as a result of replication'. There are evidently clear parallels in the use of the terms with

regard to the entities and, as a result, also it would seem, with the processes. But what specifically do Nelson and Winter say about the nature of their evolutionary processes?

Darwinian Processes: Variation, Inheritance and Selection

Although Nelson and Winter are not explicit about it, *variation* is clearly assumed as part of their evolutionary story, with, in the above quotation (p. 8), for example, differential survival suggested in the reference to the selection of 'organisms with certain routines'. Variety is plainly assumed throughout the text, indeed without variety there would be no selection; variety is implied. As suggested above, they are more explicit, on the other hand, about the existence of an *inheritance* mechanism when they talk, for example, about routines being inherited and routines influencing the behaviour of organisms. Routines are described, for example, as being persistent, durable, copied, imitated and 'passed on' to tomorrow's firms. So an inheritance mechanism is also plainly assumed as part of the theory.

Nelson and Winter are similarly much more explicit about the *selection* process, one of their 'basic concepts', and again, it is emphatically a Darwinian selection process clearly rooted in a distributional mode of analysis or, in other words, the population thinking perspective. Indeed, having described the process by which the operating characteristics of the more successful firms come to define an industry, they describe the mechanism as being 'analogous to the natural selection of genotypes with differential net reproduction rates in biological evolutionary theory' (p. 17).

Darwinian Events: Change and Causality

It would appear then that there are parities with generalized Darwinism both with entities and with processes. But what about *causality* and the overall structure of Nelson and Winter's theory? Through their assumptions about these entities and their interpretations of the core processes, can it be said that there are parities in their explanations of change? Certainly it is clear from the quotations above that Nelson and Winter perceive the Darwinian 'derived' sense of selection applying to the routines, and thus, by implication, the Darwinian explanation of causal direction. Significantly Nelson and Winter are plainly describing the economic equivalent of genes being selected *as a consequence* of the organism being selected.

As discussed in Chapter 5 above, conceptual clarification of this 'indirect selection' of genes, with the properly apportioned location of causality, was greatly assisted by Sober's (1984) observation that there was 'selection of' an object and 'selection for' a property. In the generalized Darwinian terminology this amounts to 'selection of' an interactor and the 'selection for' its replicator. Thus Nelson and Winter also appear to demonstrate parity with the Darwinian evolutionary account in the overall structure of their theory, and, importantly therefore, with its explanation of change at the firm and industry level.

Nelson and Winter's theoretical framework evidently mirrors the classic hierarchical organization of gene-based biological evolution which has genes at the bottom of the hierarchy followed by the organism and then the species. And, significantly, central to this explanatory formulation is the critically important Darwinian conceptualizations of a replicating and interacting entity. They may not acknowledge that they are generalising Darwinism, but in their use of biological analogies this is undeniably what they have achieved.

Thus, whether implicit or explicit, Nelson and Winter's use of evolutionary concepts *is* Darwinian. As indicated above, and will be elaborated below, through Nelson and Winter's use of evolutionary ideas, Darwinian entities and their corresponding processes can be perceived. Nelson and Winter implicitly assume the generalizability of Darwin's core principles. To be sure, they actually *apply* the general principles, and in so doing crucially confirm the ontological similarities between the biological and social domains and demonstrate the significant theoretical shift from analogy to ontology (Hodgson, 2002).

The Lamarckian Dimension

Demonstrating the true Darwinian pedigree of Nelson and Winter's theory, however, presents certain challenges, not least of which is the authors' explicit allegiance to Lamarckism and the confusion that this generates for the articulation of their theory. Before moving on to these tractability problems the analysis looks first at the implications of one important aspect of Nelson and Winter's Lamarckian association that appears to be based on a rather narrow reading of Darwinian theory. It will be shown how the widespread misapprehension about the relationship between Darwinism

and Lamarckism may have contributed to the confusion.[95]

In a rare articulation of their process of variety formation Nelson and Winter suggest that its source and perpetuation is due to the 'Lamarckian' adaptive behaviour of firms. Indeed they describe their theory as being Lamarckian for two important reasons, namely, 'the "inheritance" of acquired characteristics and the timely appearance of variation under the stimulus of adversity' (p. 11). However, significantly, although they appear to have, what they perceive to be an alternative explanation for variety formation (i.e., innovation, imitation, mutation of firms) and evolutionary change, in other words Lamarckism, this does *not* render their theory non-Darwinian (Vromen, 2004). The point is, as explained at length in Chapter 6 above; Darwinism and Lamarckism are not mutually exclusive theories.

The implications of the Lamarckian explanation is that it essentially amounts to a *reversal* in the causal direction of evolution, where in the absence of selection it is the environment that is perceived as the driving force of change (Mayr, 1982); effectively meaning that variations and evolutionary change are the result of phenotypic (firm-level) adaptations to the environment. However, whilst the notion of acquired character inheritance has become discredited in biology, and it will be seen that the Lamarckian dimension presents certain theoretical problems for Nelson and Winter's theory, the important point is that Lamarckian character inheritance *can* be accommodated within the meta-theoretical framework of Darwinism to present a tractable evolutionary theory for the social domain.

Evidently for Nelson and Winter, it is Lamarckism that best explains the processes of variety formation and inheritance in the social domain. And indeed it must be acknowledged that they are certainly not alone in this view. The causal explanation traditionally borrowed from evolutionary biology by social scientists is overwhelmingly that of Lamarckism (Boyd and Richerson, 1985; Burgelman, 1991; Singh and Lumsden, 1990; Pfeffer and Salancik, 1990). The process of individual firms adjusting strategy, adapting to the prevailing conditions and thereby changing their form and then reproducing that new form, undoubtedly reflects Lamarckian 'within-generation' inheritance as opposed to Darwinian intergenerational inheritance.

However, as discussed earlier, although organization theorists and others have tended to perceive Lamarckism as an 'alternative' to Darwinism (Bruderer and Singh, 1996), Darwin himself did not perceive the notion of acquired character inheritance to be irreconcilable with his theory of natural selection. Moreover it was clearly shown in

[95] Discussed in Chapters 2 and 6 above.

Chapter 6 that Darwinism and Lamarckism are *not* mutually exclusive, but that Lamarckism is ultimately dependent on the theoretical foundations of Darwinism. Thus, significantly, for the social domain, whilst Lamarckism cannot stand alone as an evolutionary theory, acquired character inheritance *can* be 'nested' in Darwinian theory (Hodgson, 2001b; Knudsen, 2001). And this is especially clear in the modern articulation of Darwinism, where 'alternate' inheritance mechanisms, or domain-specific mechanisms, are easily accommodated within a meta-theoretical Darwinian framework.[96]

Thus, it would appear again that Darwinism can be demonstrated in Nelson and Winter's theory. Although they identify their processes of inheritance and variety formation as Lamarckian, the theory is nevertheless Darwinian. Lamarckism essentially 'nests' in Darwinism as an auxiliary explanation. Can it therefore be argued unequivocally that Nelson and Winter's theory is Darwinian? In other words do the mechanisms and processes function in the same Darwinian way? As suggested above, this is where it becomes more complex.

Theoretical Tractability

Having set out all the important parities that Nelson and Winter posit with Darwinian ideas (notably mostly implicit), it is now time to turn attention to their interpretation of these, and ultimately to the theoretical tractability of the theory. Indeed, a closer look at Nelson and Winter's selection process, and at how they interpret inheritance and variety creation reveals significant ambiguities and it becomes much harder to discern the degree of equivalence with Darwinian evolutionary theory, much less its tractability. Three interrelated problems become apparent. Firstly, there is a distorted portrayal of the 'organizational hierarchy', secondly there is confusion surrounding the 'level of selection' and thirdly there is the misapprehension about Lamarckian inheritance. Three propositions emerge from this configuration of problems. The first is to suggest that Nelson and Winter's theory is at least a dual level selection theory; the second is to suggest that as a consequence they mistakenly identify it with Lamarck, and the third is to suggest that it is in fact a multilevel selection theory.

These propositions and their implications for a Darwinian analysis will be explored by focusing on Nelson and Winter's process of selection. This appears to be the root of

[96] See Chapters 2 and 3 above where it is made clear that general Darwinism does not claim to be a complete theory, and is dependent on the peculiarities of the mechanisms in the particular domain under study.

the problem for the theoretical tractability of their theory and it generates the three-fold problem referred to above. It is important to be clear about the unit of selection, the selection environment and the level of selection assumed, and to consider whether these correspond with the organizational hierarchy and causal mechanisms of Darwinian evolution. Significantly, as we proceed with this and untangle the problems with the selection process, it will become even more apparent why the theory logically implies a Darwinian framework. And furthermore, it will also be shown that resolution of these theoretical problems resides in the theoretical advances and conceptual refinements achieved in modern general Darwinism. A brief look at Nelson and Winter's own comments on their use of evolutionary ideas will serve as a useful backdrop to these propositions.

Biological Influences

Nelson and Winter openly acknowledge the 'borrowing of basic ideas from biology' (p. 9). Indeed they declare the right of economists 'in perpetuity' to do so, given that Darwin's theory of natural selection was itself inspired by the economist, Thomas Malthus. However, and this point is worth bearing in mind with regard to theoretical coherence, they stress that theirs is a 'flexible' use of biological ideas, which they will adopt and amend to suit their own purposes 'depending on the purpose of the particular inquiry' (p. 11);

> We are pleased to exploit any idea from biology that seems helpful in the understanding of economic problems, but we are equally prepared to pass over anything that seems awkward, or to modify accepted biological theories radically in the interests of getting better *economic* theory.

As already noted, if Nelson and Winter align themselves with any name from biology it is with that of Lamarck, who is mentioned on numerous occasions in the text. Although it has already been established that this does not render their theory non-Darwinian, it would seem that the 'flexible' perspective, adopted through the limited lens of the Lamarckian inheritance mechanism, raises other conceptual problems for the theory. It is argued here that the resulting ambiguities relating to the selection process are the reasons why, on closer inspection, Nelson and Winter's important parities begin to break down.

The Selection Process: Ambiguities

The point is that on the face of it Nelson and Winter's theory hangs together; there *is* a Darwinian story going on - in terms of entities and processes as well as cause and effect relationships. However there is confusion around the use and meaning of the terms. For example, they are ambiguous about what they identify as the 'unit of selection' and, at what level the selection process is supposed to operate. In the quotation below, for instance, Nelson and Winter clearly identify the firm as the unit of selection and they seem to be fairly consistent with this throughout the text (p. 17);

> Profitable firms will grow and unprofitable ones will contract, and the operating characteristics of the more profitable firms therefore will account for a growing share of the industry's activity.
>
> The selection mechanism here clearly is analogous to the natural selection of genotypes with differential net reproduction rates in biological evolutionary theory. And, as in biological theory, in our economic evolutionary theory the sensitivity of a firm's growth rate to prosperity or adversity is itself a reflection of its 'genes'

In the above, Nelson and Winter clearly indicate a Darwinian selection process, suggesting, as they do, the firm's replicator-interactor duality by equating the routines (operating characteristics) with the genotype and the firm with the phenotype. And, moreover, they correctly imply selection *of* the firm and selection *for* the routines.

However, and here we raise the important problem around selection, whilst Nelson and Winter explicitly identify the firm as the unit *of* selection they also confusingly, elsewhere, seem to be suggesting the routines as units *of* selection (as opposed to being a property of the interactor which is 'selected *for*' (Sober, 1984). It is important to note that within their extensive range of routines Nelson and Winter distinguish among three broad classes of routines. These are arranged in an operational hierarchy which they describe below (pp. 16-18);

> We assume a hierarchy of decision rules with higher-order procedures (for example, scrutiny of the currently employed production technique …) which act occasionally to modify lower-order ones (the techniques used to make a particular part …). And there may even be procedures of a still higher order, such as occasional deliberations regarding the adequacy of present research and development policy …

Evidently all of the above firm behaviours come under the general term, 'routine'. And significantly under this umbrella term we can see that Nelson and Winter seek to

embrace techniques and operating characteristics as well as a hierarchy of decision rules. For our purposes here it is important to note that decision rules in Nelson and Winter's theory essentially allude to 'choice' or 'choosing'. It is thus significant that different types of routines appear to play subtly different roles in Nelson and Winter's evolutionary theory. For example, they expressly want to distinguish between techniques and the choosing of techniques as well as to distinguish between 'low order' decision rules and 'high order' decision rules. Clearly some of Nelson and Winter's routines are 'selectors' in the sense that they choose amongst a range of other routines. This effectively means that the firm is doing the selecting and crucially, that routines are thereby also units *of* selection. It is implied that routines are being selected by the firm in the process they describe as 'search', outlined above. Searching for new and better routines is likened, by Nelson and Winter, to the process of 'mutation' in the biotic sphere, the process of change at the genetic level. But search, as indicated, is simultaneously portrayed as a selection process. Accordingly, does this therefore mean that Nelson and Winter are proposing an additional level of selection?

Additional Levels of Selection?

To what extent then could Nelson and Winter's theory be described as a dual or multilevel selection theory? It is suggested here that they unwittingly end up developing, at the very least, a dual-level selection theory. That is, with selection operating at the level of the firm, and of the routine, and possibly at several additional levels of routine. Dual level selection can certainly be discerned, it is implicit and, indeed, as we shall come to see, it makes sense of their theory. This proposition will be examined by looking at how Nelson and Winter explain their 'search process', their economic equivalent of genetic mutation (p. 18);

> These routine-guided, routine-changing processes are modeled as 'searches' in the following sense. There will be a characterization of a population of routine modifications or new routines that can be found by search. A firm's search policy will be characterized as determining the probability distribution of what will be found through search, as a function of the number of variables …

A few lines later;

> Our concept of search obviously is the counterpart of that of mutation in biological evolutionary theory. And our treatment of search as partly determined by the

> routines of the firm parallels the treatment in biological theory of mutation as being determined in part by the genetic makeup of the organism.

In the above passages, Nelson and Winter seem to want to claim *two* roles for their 'search' process, one being 'change' and the other, 'selection'. It is true that genetic mutation in biological theory *is* partly determined by its genetic environment, and genes do interact with each other in a process described as epitasis. But the critical point is that genetic mutation, or change, occurs at the level of the gene *prior* to the selection process which happens at the level of the phenotype and not *as a result of* the phenotype acting on the genotype. This is effectively what Nelson and Winter are suggesting.

In the first passage above, as elsewhere in the text, we are told that the 'the firm' has a search policy. The firm's search policy is activated through the firm's 'higher level routines' which act upon the lower level routines. Although they evidently talk about routines effecting the change, what Nelson and Winter are also actually saying is that the firm is doing the selecting. In other words there is a selection process operating at the level of the routines as well as at the level of the firm.

Selection Process: Confused Causality

The direction of causality clearly seems to be confused here and this has very important implications for Nelson and Winter's explanation of evolutionary change. With regard to the ultimate explanation of cumulative change, on the face of it, the 'routine-guided, routine-changing processes' suggests gene-based causality, with the genotype (partly) determining the phenotype and the selection process operating directly upon the phenotype. But then the 'firm's search policy' suggests the opposite, that change is effected by a selection process activated by the firm, in other words, with the phenotype determining the genotype. They talk, for instance, about a class of routine, notably 'higher level routines', which make the 'search- type', strategic decisions about change in the firm. Nelson and Winter clearly specified a distinction between 'choosing' type routines and other routines, with the former being at a *higher level* than other routines. In other words, some routines are seeking out other, 'better' routines. Thus there appears to be a blurring of boundaries between the interacting entity and the replicating entity because of the way that the 'firm' and the 'routine' have been conceptualized in Nelson and Winter's search process. Is it therefore the case that Nelson and Winter are

introducing additional levels of selection in the organizational hierarchy? If they are, then this is certainly not being articulated.

Confusingly, as suggested, Nelson and Winter explain their search process as though the firm is selecting the routines. In other words, the firm seeks to change in order to improve its performance in the market so it adopts or 'selects' better routines, these become incorporated into its portfolio of organizational routines which are then passed on to the next generation. Clearly, in biological terms this amounts to Lamarckism – the inheritance of acquired characteristics – where changes that occur to the organism during its lifetime are somehow translated back to the genetic material and are then passed on to the next generation.

The critical technical point here, which can again be illustrated through the biological analogy, is that whilst mutation in biological theory is partly determined by the organism's genetic makeup, mutation or 'change' is not simultaneously 'selected' by the organism. This would appear to reverse or certainly confuse the causal direction of evolutionary theory. Thus there is confusion about exactly what entity is being selected which generates further confusion about explanations of change in the firm. As Sober (1984) made clear, the overall structure of evolutionary selection theory dictates that selection happens at the level of the phenotype; there is selection *of* phenotypes, and genotypes are selected *for* as a consequence of the organism being selected. The organism itself does not do the selecting.

The confusion is brought about by the apparent double-meaning of Nelson and Winter's term, 'search'. Search, as demonstrated above, implies both 'change' (mutation) in the Lamarckian sense of variety formation, and 'selection' in the sense of choosing, which is a very different form of selection from the traditional evolutionary sense of selection (Knudsen 2004). Nelson and Winter conflate the two meanings in their term 'search', and then describe this 'process of search' as happening simultaneously with a second higher level of selection, i.e., selection of the firm. In other words, when we consider Nelson and Winter's description of the hierarchy of routines there is at the very least an implied second level of selection, internal to the firm, which is then coupled with the 'traditional' selection process. In fact, as indicated above, it could be argued that they suggest several levels of selection, given that there are several levels of routines that are being selected. As a consequence, does this mean that Nelson and Winter's theory is a multilevel selection theory? Or is it best described as Lamarckian?

The Lamarckian Assertion

In a later passage where Nelson and Winter are discussing the search process, the Lamarckian conclusion is perceptible and it again indicates why Nelson and Winter call themselves Lamarckian, because essentially, in biological terms, what they are describing here is the inheritance of acquired characteristics. Note the relevant passage below and bear in mind that in the above analysis 'search' refers to selection of the routines (a firm activity), and that below the word 'selection' is referring to the selection of firms (p. 19);

> Search and selection are simultaneous, interacting aspects of the evolutionary process: the same prices [routines] that provide selection feedback [to the firm] also influence the directions of search [routine].

In the above, firms are essentially described as responding to the competitive environment of 'other firms' in the industry and changing their operational routines as a result. In other words, they 'acquire' phenotypic changes and these become part of the genotype, the genetic make-up; thus Lamarckian inheritance.

It is argued here that *because* Nelson and Winter found the theory logically implying that the organism is effectively changing the genes, they didn't recognize this as Darwinian and thus labeled it Lamarckian. Because they perceived that theirs is not 'Darwinian inheritance' it had to be Lamarckian inheritance. However, as has been shown in this analysis, they nevertheless also realized that they needed the Darwinian framework, with its selection process, for their evolutionary theory to work. It is thus suggested that this seeming theoretical inconsistency is the root of the problem in the construction of their theory and it explains why multilevel selection processes are implicit in the theory.

Before moving on to speculate about additional levels of selection it is important to be clear about the Lamarckian component of Nelson and Winter's theory and the implications of this for its theoretical tractability. The most important thing to reiterate is that Darwinism and Lamarckism are not mutually exclusive. Thus, the incorporation of Lamarckian inheritance does not detract from their theory. Moreover, in the justifiable effort to put the firm at the centre of their theory and to incorporate 'bottom-up' explanations of change, as characterized in the traditional Lamarckian adaptationist formulation, Nelson and Winter have created a comprehensive evolutionary theory that nevertheless still mimics the explanatory scope of Darwinism. Significantly, the

critically important replicator and interactor entities are present and these not only indicate modern Darwinian evolutionary theory, but they also crucially facilitate the articulation and inclusion of the Lamarckian inheritance mechanism that is central to Nelson and Winter's evolutionary theory (Hodgson and Knudsen, 2006b).[97] In the following section the discussion recalls the other developments in Darwinian evolutionary theory which similarly facilitate a clearer understanding of the evolutionary processes and which ultimately provide reconciliation of Nelson and Winter's theoretical conundrums and enhancement of their theory within the meta-theoretical framework of general Darwinism.

Generalised Darwinism and Multilevel Selection Theory

If, as has been argued above, Nelson and Winter's theory has selection occurring at more than one level, what does this mean for the theory? Can it still be viable? And can it still be Darwinian? The answer to both is a resounding 'yes'. Modern Darwinism now acknowledges that selection can happen at multiple ascending levels of the evolutionary hierarchy. Indeed as demonstrated in Chapter 7, multilevel selection theory is now widely respected in evolutionary biology (Nunney, 1998; Keller, 1999), where Hull's (1988) generalized terminology has greatly assisted its conceptualization and articulation. The relevance of this for Nelson and Winter's theory, as Hodgson and Knudsen, (2006a) have demonstrated, is that it permits the notion of selection happening simultaneously at ascending levels of the organizational hierarchy.

The notion of multilevel selection theory was very much dependent upon the important theoretical leap, in the philosophy of biology, from the traditional single level, to multiple level selection theory, a development which was dependent on the important notion of *group selection*. As discussed in Chapter 7, this was crucial in terms of the relevance of evolutionary theory to the cultural domain. In the wake of an apparent dearth of inquiry in the 1970s and 1980s into the possibility of group level selection, eclipsed by the then influential gene-centred approaches of Williams (1966) and Dawkins (1976), there finally followed a productive period in which multilevel thinking became more accepted (Field, 2002).

This important development, which facilitated the conceptualization of the selection of groups by thinking of them in terms of cohesive units, was preceded by Hull's

[97] Hodgson and Knudsen (2006b) demonstrate how the genotype-phenotype distinction is critical to the articulation of both Lamarckian as well as Darwinian evolution. See Chapter 6 above.

aforementioned modification of ontology in the philosophy of biology; an ontology that emerged out of the considerable debate and confusion within biology in the 1960s and 1970s surrounding the 'unit of selection problem' (Lewontin, 1970). As noted, it eventually became apparent to evolutionists that two distinguishable questions had become conflated in the units of selection debate; 'one has to do with the units of *replication*, the other with the units of *interaction'* (Brandon, 1999 p. 617). There was confusion over the identity of the 'unit of selection' and the level at which selection occurred, with some theorists focusing on the 'unit' (the gene, the group or the species) for their analysis, while others focused on the 'level' of organization for their analysis.

It is perhaps, therefore, unsurprising that such ambiguities as have been discussed here in relation to Nelson and Winter should have arisen. Certainly there is confusion surrounding the unit of selection and the level at which selection operates in their theory. As illustrated above Nelson and Winter's search process is conflated with their selection process. Evidently an imperative exists to identify only one unit of selection, which they identify as the firm, but the tension becomes apparent when one explores the search process and finds a second level of selection emerging at the level of the organizational routine.

As indicated above and elaborated in Chapter 7, the ultimate outcome of the 'units' debate in biology was 'multilevel selection theory' which acknowledges, amongst other things, 'groups' as Darwinian entities and, in the biotic sphere that selection occurs at more than one level. We recall that an early critical stage in this theoretical direction was recognition of natural selection as a two-step process, where the first step involves a replicating process and the second step is where the actual process of selection is involved. This is where 'selection proper' operates, on the individual organism interacting with its environment. As Mayr explained, it is the second step that acts upon the previously produced variation and it is not a process which itself produces variation. I would suggest that in Nelson and Winter's quotation above about search and selection they are unknowingly attempting to articulate Mayr's two-step process. There seems to be an intuitive understanding on their part of this curiously confusing process of natural selection.

Generalized Darwinism

Having unpacked Nelson and Winter's comprehensive evolutionary theory, illustrated its hidden Darwinian heritage, and revealed its complex theoretical challenges, it now

remains to demonstrate resolution of the later and further advancement of the theory through the general Darwinian perspective. Here we revisit the key developments discussed in Part II and show their relevance for the clarification and enhancement of Nelson and Winter's theory.

Following Mayr, it has been shown that the next crucial stage in the development of Darwinian theory was the further refinement of terms, and as will be demonstrated here, this bodes well for Nelson and Winter's theory. It has now become much clearer to evolutionists what happens with the entities at each level of the evolutionary hierarchy. Hull (1981) essentially set out a more accessible general hierarchy, indeed, a much needed 'revamped ontology' (Eldredge, 1986). As noted, his distinctive approach to evolutionary theory was to focus on the evolutionary process itself, to investigate *its* general characteristics and then to consider which entities had the requisite characteristics to function in the evolutionary process. In an important passage (repeated from Chapter 5 above) Hull points to the source of the confusion, and in his reference to the generalized evolutionary terminology, he shows how an abstract general theory of evolution is released from the constraints of biological assumptions (2001, p. 21);

> One reason why evolutionary biologists have been unable to discover universal regularities in the evolutionary process is that they are not comparing like with like. They are dividing up the organizational hierarchy inappropriately. The appropriate levels are not genes, organisms, and species as they are traditionally conceived, but replicators, interactors, and lineages.

This approach enabled Hull to endorse Mayr's interpretation of the selection process as being a two-step process and then to skilfully take the analysis further, by marking a functional distinction between the two steps. Hull perceived not units of selection as such but two different entities with different roles within a single selection process. He basically identified the causally significant distinction between a replicating entity and an interacting entity and, with the focus on functionality, as opposed to any predetermined view of organizational hierarchy, he demonstrated their relevance to a general evolutionary selection theory.

Hull's carefully constructed conceptual framework admirably addresses the question of causality in the selection process and evidently resolved some of the anomalies that precipitated the unit of selection debate, all of which have an important bearing on the conceptualization of selection processes in the social domain. Ultimately, as elaborated in Chapter 7, through the conceptualization of the group as a unit of selection, it also facilitated multilevel selection theory. Specifying, the nature and role of entities in a

selection process enabled speculation about their operation at ascending levels of the organizational hierarchy. Hull proposed, for example, the idea of a single level of replicators with multiple ascending levels of interactors. Indeed, as noted, this is a position 'taken as given' by many evolutionary biologists in their empirical work (Keller, 1999). And, significantly, this would certainly give plausible expression to Nelson and Winter's firms (interactors), their implicit foundational level of replicating routines (replicators) and, their ascending levels of interacting, 'higher order', routines (interactors).

Thus, it would appear that advances in evolutionary theory, and multilevel selection theory, have the potential to both clarify and extend Nelson and Winter's theory. Darwinian individuals can certainly be perceived in their theory; it is easy to conceive of their firms as interactors and the routines as replicators. It is then also possible to conceive of a hierarchy of interactors with individual agents at one level, firms at another and additional institutions at other higher levels. Indeed, with the aid of a multilevel perspective and the clarifying functional roles of replicators and interactors it may be more appropriate, as indicated above, to conceive of Nelson and Winter's 'higher level' 'search' routines as an *additional* level of interactors, operating between the foundational level routines (replicators) and the higher level firm (interactor). They clearly want to include the activity of 'choice' in their range of routines and this, as we have seen, causes problems for their (single-level) selection theory. Thus, in terms of evolutionary causality, following Sober (1984), this translates Nelson and Winter's position as, selection *of* a particular firm and in consequence selection *of* a particular set of higher order (strategic) routines, and in consequence the selection *of* another set of lower order (operational) routines, and in consequence the selection *for* a particular set of foundational organizational routines. In other words, a multilevel position that identifies with position III on the table of logical possibilities, above in Chapter 7 (p. 113), that is, a single level of replicators and multiple levels of interactors.

Alternatively, as suggested in Chapter 7, in a slightly different formulation, it also permits speculation of Nelson and Winter's schema in terms of *multiple* levels of replicators as well as multiple levels of interactors. In other words, position V on the table. Their proposed additional levels of routines could be perceived as multiple levels of replicators in a framework which again posits individuals, firms and other higher level institutions as interactors, but significantly, this is in a continuum from the biotic to the social level. This position has recently been explored by Hodgson and Knudsen (2004a) in a conceptual refinement of Nelson and Winter's approach, where they

observe that in addition to genes, both individual habits and organizational routines can be regarded as replicators. They describe this scenario below (p. 299);

> Selection *of* firms in a competitive environment results in the selection *for* some of the replicators associated with the involved firms. The selection *of* firm-interactors leads to replicators, such as routines and habits, being selected *for*. That is, the current properties of the firm determine whether its routines, and possibly the habits of its individual members, will be more common or more rare in the next time period. If we further acknowledge that, at an intermediate level, teams are replicators, the selection *of* firms can help explain the selection *for* the generative structure that gives rise to the attributes of alternative professional teams.[98]

The significance of these developments for Nelson and Winter in particular, and the social sciences in general, cannot be overstated. Certainly the interactor and replicator concepts clarify causal direction and, with the notion of group selection and the possibility of interaction going on up and down the organizational hierarchy (Hull, 2001), it becomes theoretically possible to accommodate selection at multiple levels. However, as observed by Hodgson and Knudsen, the development of such a multiple level evolutionary theory is the critical keystone of a *non-reductionist evolutionary economics* (2004). Evidently, through Hull's generalized terms, critically associated more with the function of the entity as opposed to that of the entity's first biotic namesake, Hull and others have demonstrated the general character of Darwin's theory. And clearly, as evidenced in this analysis, such refinement of theory and clarification of definitions crucially facilitates understanding and application beyond the biotic sphere (Brandon, 2001).

Indeed the implications of a modern general Darwinism for Nelson and Winter have been clearly demonstrated here, where the confusion over units and levels of selection and the replicator-interactor distinction undermine its theoretical tractability. Evidently their 'flexibility' with evolutionary ideas from biology seems to have involved an over-emphasis on Lamarck, but, as suggested here, the theory arguably has much greater potential in explicitly and wholly adopting general Darwinism, where it is now

[98] Hodgson and Knudsen (2004, p. 19) also usefully go on to observe the continuity of this schema with the biotic domain. In order to prevent misunderstandings and charges of 'greedy reductionism', given the implied continuity in the above between the biotic and the cultural spheres (which incidentally most group/multilevel selection theorists acknowledge) it is worth repeating this in full (my italics & emboldening in last two sentences); 'In addition, descending the hierarchy, the selection *of* firms can also have a slight effect in the selection *for* human genes, given that employment opportunities in the firm can have an effect on the survival opportunities for human individuals. The selection *of* firms has effects that cascade down to the selection of individuals, and in turn to selection *for* genes. *But selection* for *these lower-level, biological replicators can be* ***ignored*** *for purposes of analysing economic evolution. It is too slight to be of significance, given the much slower evolutionary processes involved.*'

theoretically possible to accommodate interactors and selection at multiple ascending levels (and moreover to accommodate Lamarckian inheritance).

Conclusion

It has been my intention here to draw attention to the 'hidden' Darwinism in Nelson and Winter's theory, and show how, through their use of Darwinian ideas they confirm key ontological similarities between the biotic and social spheres and demonstrate the general application of Darwinian theory. Through the detailed analysis of their theoretical framework and explanatory mechanisms it has been shown here that from their foundational assumptions (i.e., population thinking, group selection) to their deployment of Darwin's core principles of variation, inheritance and selection, to their subtle recognition of the replicator-interactor distinction, Nelson and Winter's theory is decidedly Darwinian.

Without speculating on the reasons for their apparent hostility towards Darwinism, I have demonstrated here how their resistance to Darwinism is ill-founded and that Lamarckian inheritance is nevertheless accommodated within general Darwinism as an auxiliary assumption. Indeed in this and other important ways it has been shown here how modern Darwinism, in fact, resides in (social replicator, group selection, replicator-interactor distinction), facilitates, and enhances their theory (clarification on, units of selection; the replicator-interactor distinction; multilevel selection theory). Indeed, in spite of their reluctance to claim a Darwinian heritage I have illustrated how Nelson and Winter implicitly assume the generalizability of Darwin's core principles. Thus, to suggest, as I have done here, that Nelson and Winter's theory is Darwinian is to acknowledge that it is Darwinian at its most general level.

Indeed, significantly, through the evaluation of this important case study via a modern Darwinian perspective, it has also been shown here that Darwinism is unquestionably a general theory. Through the exploration of Nelson and Winter's core and implicit assumptions, its generic quality and explanatory range have clearly been demonstrated. And through examination of their tractability problems it has also been shown how clarification and resolution is logically implied in the recent theoretical and conceptual advances in Darwinian theory. Certainly, paradoxically, one of the subtle, but nevertheless critically important, messages to emerge from the study of Nelson and Winter's work is the *inevitability* of Darwinism for the socio-economic realm. It would

seem that in spite of themselves, Nelson and Winter have intuitively imbibed the inevitable logic of Darwinism.

Darwinian theory clearly has extensive and powerful explanatory potential with the capacity, particularly in its modern generalized formulation, to explain complexity, diversity and change in the social domain. However, as Nelson and Winter's work has also crucially highlighted, Darwinian theory has the seductive appeal of a beguilingly simple theory when it is, in fact, deceptively complex (Dennett, 1995). Thus, although a valuable heuristic device, it must be used with caution. With this thought in mind we now turn our attention to the subject of the next Chapter and follow the Darwinian thread to Hannan and Freeman. Interestingly, whilst it will be seen that, in contrast to Nelson and Winter, these authors explicitly identify with Darwinism, it will also be seen how, for different reasons, their ecological perspective is similarly compromised by the seeming lack of engagement with modern Darwinian theory.

9 Hannan and Freeman's Organizational Ecology: A Partial Darwinian Theory

Introduction

The second case study in this work features the sociologists Michael T Hannan and John Freeman and their widely acclaimed treatise *Organizational Ecology* (1989). This influential work offers an important and interesting comparison with Nelson and Winter's evolutionary theory of economic change, representing for the field of organization studies a similarly prominent contribution on the evolution of organizations (Singh, 1990; Burt, 1992; Zald, 1994; Baum and Singh, 1994). Unlike Nelson and Winter, Hannan and Freeman explicitly claim their Darwinian heritage asserting that 'the view that selection processes govern the dynamics of organizational diversity shades naturally into a Darwinian evolutionary position' (p.17). Whilst from a Darwinian perspective they have much in common with Nelson and Winter's position, for example, their population thinking perspective and Darwinian selection dynamic, in one important respect, regarding inheritance and transmission, Hannan and Freeman's work marks a significant departure from the formers theoretical approach, arguably rendering it only a 'partial' evolutionary theory (Metcalfe, 1987; Levinthal, 1991; Bruderer and Singh, 1996). This has important implications for the development of evolutionary theory in the socio-economic domain, with many scholars now concerned about the chasm that has emerged between such prominent evolutionary accounts.

The Case of Hannan and Freeman

The point of departure centers on Hannan and Freeman's treatment of organizational 'inertia' and the associated rejection of adaptational explanations of change. As they explain, 'the issue of structural inertia is central to the choice between adaptation and selection models' (1977, p. 931). Significantly, this translates as the theoretical assertion that selection is the primary force of organizational change and not adaptation, and this issue lies at the heart of the perennial debate in organization science, the 'adaptation versus selection' debate (Murmann, 2004).

Here I shall examine Hannan and Freeman's evolutionary influences and draw attention to the Darwinian ideas that they adopt as well as the important ones they eschew. I show how the authors, by accentuating one particular strand of evolutionary theory, population ecology, inevitably end up presenting a rather distorted view of organizational phenomena (Baum and Singh, 1994). I illustrate how their shift in focus, away from the individual organization in its local environment to their 'population of organizations' level of analysis, neglects the important causal story generating from the lower level of the individual. In the light of theoretical advances in evolutionary theory, particularly recent ones around the selection process (Knudsen, 2001, 2002, 2004), as well as empirical and theoretical developments in business economics (Teece et al, 1997; Dosi, 2000; Metcalfe, 1987, 1998; Saviotti and Metcalfe, 1991; Hodgson, 2001b, 2002b; Hodgson and Knudsen, 2004a, 2006a, 2006b) and organization studies (Astely and Van de Ven, 1983; Scott, 1987; Burgelman, 1991; Ziman, 2000; Baum, 2002) I speculate about an implicit replicator in Hannan and Freeman's theory, and about possible modifications to their approach, finally signaling the potential resolution of the 'adaptation versus selection' debate within the meta-theoretical framework of general Darwinism.

Theoretical Framework of Organizational Ecology

Hannan and Freeman are concerned with explaining organizational change and organizational diversity. In pursuance of the question 'why are there so many (or so few) kinds of organizations'[99] they examine differential rates of entry or 'births' (new founding, mergers, division of an existing organization) and exit or 'deaths' (disbanding, acquisition) for organizations, notably because they perceive that most of the variability in the core structures of organizations comes about through the creation of new organizations and the demise of existing ones (1989, p.12). The prevailing variety for Hannan and Freeman is thus traced to the variety of organizational forms at founding. Following Stinchcombe (1965) and the idea that cohorts of organizations are imprinted with social, cultural and technical features common to the environment at founding, and moreover that these 'imprinted' characteristics are highly resistant to change, Hannan and Freeman observe, in an extreme version of the Darwinian position, that 'current characteristics of populations of organizations reflect historical conditions at the time of founding rather than recent adaptations' (p. xiii).

[99] The question originally poised by the authors in *The American Journal of Sociology* (1977)

Accordingly and significantly, change in organizational form is thus seen as the result of selection processes operating on populations of essentially 'inert' organizations, so that the exploration of vital rates has become the dependable research strategy of organizational ecologists (Haverman, 2000) in what has now become an active field of research (Carroll 1988). Thus, significantly, in contrast to Nelson and Winter, Hannan and Freeman propose a 'top-down' explanation of evolutionary change that does not account for firm-level adaptational change. In other words, whereas the former acknowledge that population level changes are also influenced by the variety brought about through mutations (learning, imitation, random errors), Hannan and Freeman see evolutionary change explained principally through the selection and retention of new species.

Macro-Social Processes

Hannan and Freeman focus on organizations and social structures, exploring economic, political and social institutions, or what they call 'macro-social processes', and the constraining impact of these on the structures of organizations. Firms certainly constitute a large body of their research, though the organizational ecologists' remit extends beyond that of economists to include all kinds of organizations, such as, universities, voluntary associations, government agencies and social movement organizations (Hannan, 2005). What they want to understand is 'the dynamics of organizational diversity, how social changes affect the mix of organizations in society and vice versa' (p. 15).[100] Hannan and Freeman seek to explain these important processes through their theory of 'organizational ecology', an approach which is derived from human population ecology (Hawley, 1950, 1968) and niche theory (Hutchinson, 1957, 1978). Drawing on biological models of how populations survive and prosper on the resources of specific ecosystems, they speculate about the survival and growth of populations of organizations (Burt, 1992). Niche theory, as they point out, usefully expresses in a general way 'how environmental variations and competition affect the growth rates of populations' (p. 95). Given its approach, organizational ecology is what we might call a 'macro-theory', a theory that, contrary to traditional organizational theory, shifts the analysis away from the individual organization up to the level of *populations* of organizations.

[100] Vice versa in this context meaning the effects of *other* organizations

Organizational Inertia and Environmental Selection

For Hannan and Freeman organization theorists have been misguided in their fixation with the individual organization. The traditional adaptation explanations of the evolution of organizational forms (Simon, 1957; March and Simon, 1958; Cyert and March, 1963), which emphasize strategy and the flexibility of firms in changing environments, are considered problematic and unrealistic. Hannan and Freeman argue that whilst much has usefully been learnt about the internal structures and behaviours of organizations, the analysis has been stymied by its lack of contextual environmental considerations, thus, causality has been misconstrued. In their view the adaptation perspective erroneously suggests that organizations have a 'unitary stable preference structure' and thus can respond speedily to changing environments.[101] Accordingly this perspective overlooks both the internal politics of organizations, which forestall quick and decisive action, and the causally important, powerful *inertial* forces acting upon organizations and constraining their options. These are critical omissions and this is what prompted the formation of their population ecology approach (1977, 1989).

Hannan and Freeman sought to redress the balance in the organizations literature by, amongst other things, portraying organizations as complicated systems which in reality have strong limitations on flexibility and speed of response. They set out to construct a theory that takes into account the important competitive environment of other organizations and to explain how forces external to these organizations impact on their changing structures. In framing their agenda they (p. 13) posed the important and currently pressing question; 'does change in major features of organizations over time reflect mainly adaptation or selection and replacement?' Organizational ecology argues unreservedly that it reflects selection and replacement.

The Research Agenda and its Impact

This important question shapes the whole research agenda where there is undoubtedly a heavy focus on the selection process and clearly a movement away from, what Hannan and Freeman (p. xii) call, a 'focal-organization perspective.'[102] Indeed, through the population ecology approach the authors claim to bring about an important

[101] For Hannan and Freeman such assumptions are largely due to the tendency for social scientists to think anthropomorphically about organizations (pp. xi-xii)

[102] The 'focus on action of individual organizations faced with specified environmental problems'

'reorientation' of organization theory.[103] And their theoretical and academic objectives they address in a number of ways (p. 331); firstly, by 'shifting the focus to the population level'; secondly, by 'moving from a static to a dynamic approach'; thirdly by 'recognising the strong limits on the speed with which existing organizations can adapt to rapidly changing environments'; and finally by 'examining change in diverse but internally homogenous organizational populations over their full histories'.

Significantly, Hannan and Freeman's organizational ecology model has had a major impact on organization science (Carroll, 1988; Burgelman, 1991; Levinthal, 1991; Zald, 1994; Bruderer and Singh, 1996). The authors (1977) are credited with introducing niche theory[104] or 'contextual causation' into the mainstream of organization science and with pioneering the field of organizational population ecology (McKelvey and Baum, 1999). Moreover, organization ecology has been noted for its successful application to all kinds of organizations (Sandell 2001), including semiconductor manufacturers, breweries, banks, newspapers, and social movement organizations (Hannan and Freeman, 1989; Singh and Lumsden, 1990). Organizational ecology is undoubtedly one of the most important and influential evolutionary theories in the social sciences, frequently cited beyond the sociological or organizational disciplinary boundaries. Indeed, often cited alongside Nelson and Winter, Hannan and Freeman present a particularly interesting case-study here, as much as for what they share, in terms of the 'Darwinian thread', with the former, as with how they differ in their use of Darwinian evolutionary ideas. And so, it is to this exploration that we now turn.

The Evolutionary Approach

How do Hannan and Freeman construct their dynamic organizational ecology theory? And what are the evolutionary ideas that they employ? In point of fact, in many respects organizational ecology resembles Nelson and Winter's evolutionary economics, which explains why they are often linked together in the literature.[105] There is, for example, the 'population thinking' approach that emphasizes the importance of

[103] Hannan and Freeman felt that organizational theorists became detached from a concern with the 'classic problems of the relations of organizations to society and the effects of organizations on social change and levels of inequality' (p. 11).

[104] Derived from Hutchinson's (1957, 1978) 'fundamental niche', Hannan and Freeman (1989, p. 96) describe the fundamental niche as consisting of 'the set of all environmental conditions in which the population can grow and at least sustain its numbers'

[105] Linked, for example, as 'selection-based' explanations (Murmann et al, 2003). Similarly they are described as 'population' or 'system' level approaches.

variety for selection and evolutionary change; there is the population or system level of analysis which features an organizational form that is differentially selected and retained; in accordance with the notion of group selection, the organizational form has a collective, cohesive character; and there is an emphasis on both inertial (continuity) and competitive (change) forces operating at the intersection between the organizational form and the environment.

For our purposes here, it is, of course, important to establish the way in which these evolutionary ideas have been deployed in the theory. For example, to what extent are the entities, mechanisms and processes Darwinian? Is there a coherent evolutionary explanation? Is the theory complete? And what is the explanatory potential of the theory? We shall begin to address these questions by looking in more detail at the various strands of the theory indicated above. From this review the differences between Hannan and Freeman and Nelson and Winter's respective accounts will then become apparent. What we will discover is that in spite of many corresponding assumptions, these two approaches diverge in quite significant ways, the most important of which relates to causality and the notion of adaptation.

Explicit Darwinism

The first notable difference between Nelson and Winter, on the one hand, and Hannan and Freeman, on the other, is that where the former declare themselves Lamarckians in spite of their evident use of Darwinian principles, the latter are unambiguous and immediately identify their theory as Darwinian (p.xii). Indeed they are quite explicit about their use of the 'promising' analytical structure of evolutionary models of population and community ecology. They acknowledge the Darwinian 'population thinking' basis to their theory and describe the inspirational role of population ecology derived from Hawley's (1950, 1968) work on human population ecology. Moreover, they openly acknowledge the 'implicit taboo' in the social sciences of using selection theory, and unperturbed, they go on to spell out their own 'modeling strategy' based on this.

They stress that they do not adopt a reductionist approach by using biological theory to explain organizational change, and explain that they do not use metaphors between the spheres of biology and sociology, but instead utilise 'models' from population ecology, since for them, these 'clarify the social processes of interests'. With echoes of Campbell (1965), they go on to explain (p. xiii-xiv);

> The model is an abstraction that will lead to insight whenever the stated conditions are approximated…we use ecological models as frameworks within which to study *sociological* processes.

Thus Hannan and Freeman evidently see the *general* applicability of Darwinian evolutionary ideas, a point they clearly make several times throughout the text. Indeed, they are refreshingly, conceptually very precise, there are few ambiguities. They usefully devote several pages (pp. 17-23) to a discussion of the term 'evolution' and its various manifestations in the organizations literature, and carefully explain their own interpretation, which is explicitly 'Darwinian' (p. 20);

> Our work approximates a Malthusian-Darwinian position on the nature of change in organizational population over time. We think that the current diversity of organizational forms reflects the cumulative effect of a long history of variation and selection, including the consequences of founding processes, mortality processes, and merger processes.

Having explicitly identified with Darwin it becomes interesting then to observe how the separate strands of theory are treated by Hannan and Freeman, particularly, for example, the variation – selection – retention dynamic. We begin to explore this below with a discussion of Darwin's population thinking perspective and how this is assumed in the theory.

Darwinian Ontology: Population Thinking and Population Ecology

Hannan and Freeman ground their theory very firmly in the population thinking perspective. However, there are two senses in which population thinking may be discerned in their theory, one implicit and the other explicit and to avoid confusion, it is important to stress that these are consistent and that they both derive from Darwinism. The first implicit sense is the population thinking perspective which is notably attributed to Darwin and which famously replaced typological thinking and the treatment of variety in terms of ideal, representative types (Mayr 1959). The second is explicitly associated, by Hannan and Freeman, with population ecology and the population *level* of analysis. The first implicit sense is usefully illustrated by Metcalfe (1987, p. 56), below, where he highlights the benefits to economics of the

Darwinian population thinking perspective and explains its role in making sense of variety in economic behaviour;

> In typological thinking species are regarded as fixed and identifiable in terms of a few distinct characteristics which represent the essence of the entity. In this view all variations around the ideal type are accidental, and are to be interpreted as aberrations … By contrast, in population thinking, species are described in terms of a distribution of characteristics and, whereas in typological thinking variation is a nuisance, in population thinking it is of all-consuming interest because it is the variety in the system which drives the evolutionary process.

The deployment of this Darwinian population thinking perspective is implicit throughout Hannan and Freeman's theory. However, rather confusingly, although Hannan and Freeman head up passages on 'population thinking' (1977, p. 933; 1989, p. 15), signalling its importance for evolutionary theorising, this is not to explain it in the terms outlined by Metcalfe above; instead, this is to elucidate the second sense in which population thinking resides in the theory, which is expressed in terms of 'population ecology', and emphasizes the population *level* of analysis and the notion of aggregates of organizations and shared fate with respect to environmental constraints. Crucially, as suggested, one *is* nevertheless derived from, and is consistent with the other. The population ecology (Hawley, 1950, 1968) which inspires Hannan and Freeman's theory is built on Darwin's population thinking perspective and indeed its inherent assumptions about the existence and persistence of variety. The question of the source of that variety is a different matter, to which we shall return in due course, but, importantly, its characterization within the selection process is positively drawn from the population thinking approach.

Population Ecology

Ecology is the branch of biology that deals with the relations of organisms to one another and to their physical surroundings (Pearsall, 2001). As noted, Hannan and Freeman derive their theory from the human ecology associated with Hawley. Specifically this seeks to explain patterns of adaptation of human communities to ecological settings (Hannan, 1989, p. xii). At its heart is the principle of 'isomorphism', which states that, in equilibrium, 'units subjected to the same environmental conditions, or to environmental conditions as mediated by a given key unit, acquire a similar form of organization' (Hawley, 1968, p. 334). They saw that by

modifying Hawley's approach, to deal with dynamic populations within environmental settings that are spatially and temporally heterogeneous, they could facilitate a population level analysis of organizations.

Hannan and Freeman are evidently focused on the environment and a population *level* perspective. In order to make their evolutionary schema tractable, following the ecologists, they deliberately take the analysis up to the level of the population. What they are essentially discussing then is a species-level approach; in a Darwinian sense they are looking at outcomes at the species level or, in other words, at Nelson and Winter's industry level. This is what they mean when they say they are moving away from the 'focal-organization perspective' and the tendency in the organizations literature to think 'anthropomorphically' about organizations. In this way they explain, they can look at the impact of 'selection and replacement in *populations* of organizations.' Controversially, in terms of causality, this means no longer thinking in terms of organizational outcomes shaped by individual intentions but rather outcomes that are shaped instead by impersonal forces. For Hannan and Freeman this approach provides a more complete and realistic picture, and it facilitates the ultimate goal of understanding the forces 'that shape the structures of organizations over long time spans.' They summarize the population ecology perspective below (p. 13);

> The population ecology perspective concentrates on the sources of variability and homogeneity of organizational forms. It considers the rise of new organizational forms and the demise or transformation of existing ones. In doing so, it pays considerable attention to population dynamics, especially the processes of competition among diverse organizations for limited resources such as membership, capital and legitimacy.

The above indicates both the flavour and focus of Hannan and Freeman's work. They clearly seek to explain the diversity of organizational forms and understand the implications of such diversity, and indeed this has characterized all their research studies (1977, 1978, 1984, 1986, and 1987). In justifying this approach, they explain the methodological reasoning behind its higher-level perspective and in so doing they signal the precise nature of their selection process as well as the relatively minor role that they cast for adaptive causality (p. 339);

> We have tried to develop theories at the population level that are robust with respect to assumptions about individual motivation. In this respect, our goal is to develop theories like Darwin's theory of evolution, which continues to have value despite great changes in our understanding of the detailed genetic processes upon

> which processes of biotic evolution depend. A macro theory is robust with respect to assumptions about individual motivations if the theoretical structure does not have to be reassembled each time a micro assumption is changed.

As will become apparent in the discussion of their selection process, while such an approach does indeed accord with a tractable general selection theory it cannot strictly be described as a modern 'neo-Darwinian' selection process,[106] and thus has major limitations for a socio-economic theory of evolution (Knudsen, 2004). In order to unpack this, the analysis will continue with the population thinking theme, looking more closely at variation, its composition and its source. This will then lead to their treatment of selection and inheritance, and hence to adaptation and the question of causality in evolutionary processes. The notion of variation begs the question about evolutionary entities, thus we begin by briefly highlighting what Hannan and Freeman identify as their key entities.

Evolutionary Entities: Organizational Forms and Populations

Whilst criticized for their vagueness about boundaries of form (Young, 1988) Hannan and Freeman (1989, p. 48) nevertheless do offer a definition of their central evolutionary entity, the 'organizational form', and significantly this takes the form of a collective group entity and its treatment corresponds with the modern Darwinian definition of an 'interactor' and thus a unit *of* selection (Hull, 1988; Sober, 1984);

> We have suggested (1977) that organizational forms be defined analogously, as instructions for building organizations and for conducting collective action.

It is clear throughout the text that this is the primary entity that interacts with the environment and is differentially selected. The other key entity in Hannan and Freeman's theory is the 'population', and interestingly, from a modern Darwinian perspective, while this serves as the competitive environment for organizations, in accordance with their explicit promotion of additional levels of selection (populations, communities) this too has the features of an interactor;

> Populations can be defined in such a way that they have a unitary character, which means that the members of the populations have a common standing with respect

[106] 'Neo-Darwinism' here refers to the synthesis of Darwinian selection theory with Mendelian genetics which articulates an inheritance system based on the replicator-interactor distinction.

> to the processes of interest. The most salient kind of unitary character for our concerns is common dependence on the material and social environment.

Thus, in a sense, we have the original Darwinian selection hierarchy of the organism and the species. Notice however, that in Hannan and Freeman's evolutionary hierarchy there is no attempt to include a 'gene-like' replicating entity. This is a very important and somewhat contradictory point, given the obvious assumption of continuity of form in their theory. However, as will become more apparent below, this corresponds with their view of inheritance; for as they observe, without knowledge of the gene, Darwin could only assume some kind of heritable entity, and this did not prevent him from constructing *his* theory of natural selection. Through the following discussion of Hannan and Freeman's evolutionary processes the implications of this omission for their socio-economic selection process will be examined.

The Principle of Variation

Hannan and Freeman's theory builds on the foundational ontological assumptions of population thinking, and in most respects their discussions of variety bear the hallmarks of this critical Darwinian underpinning. For example, their populations are not limited to the largest and most successful organizations, but to 'entire populations of organizations over the full histories of the populations', and, significantly this includes all those organizations on the 'fringes'. In other words, those enterprises attempting to enter the industry, for without their inclusion we would 'miss the main source of organizational diversity: the creation of new organizations on the 'fringes'' (Hannan, 2005, p. 53). Indeed, there is no attempt in the text to define a 'typical' or 'standard' organization (p. 63-64);

> We have not always used the conventionally defined forms directly in analysis; rather we have usually arrayed the forms along some analytic continuum and focused on variations along the continuum.

To illustrate, in the same passage they discuss their research of restaurants and highlight the fact that thirty three different types of restaurants were noted in the study and, significantly, that;

> We were less interested in the precise forms than in underlying differences in specialisms with respect to segments of the market. Because we were interested in

> the evolutionary dynamics of specialism versus generalism, we classified the 33 forms into specialist and generalist types and conducted our analysis of the dynamics of niche width using this distinction.

Interestingly, this approach was criticized by Young (1988) who observed that Hannan and Freeman's 'boundaries' between organizational forms were vague and confusing and that this detracted from their theory. However, Hannan and Freeman (1989b), underlining the importance of variety in Darwin's population thinking perspective, responded by arguing that the emphasis in their theory is in *explanation* as opposed to that of Young's cited theorist, McKelvey's (1982), whose emphasis is on *taxonomy*, and moreover that;

> The connection between creating useful theories of change and correct classification is a loose one. In fact, what matters are that classifications accurately reflect discontinuities in nature. All that mattered for Darwin is that he understood the main distinctions among species of finches and among species of barnacles.

This perception of variety and the ontological commitment to its population thinking foundation is very important for the elucidation of evolutionary theory in the natural and the social sciences, and Hannan and Freeman have grounded it well in their theory. Within this framework, variety is an acknowledged precondition for selection. And, Hannan and Freeman offer an explanation of *its* existence through birth and death rates of organizations.

However, this is where the Darwinian similarities begin to break down, Hannan and Freeman notably also argue that selection is the primary *cause* of organizational variety and evolutionary change, basically ignoring the role of an inheritance mechanism, and eschewing any notion of inherited adaptations. This is a very controversial point, from a theoretical as well as an empirical perspective, and it lies at the heart of the adaptation versus selection debate. Indeed the issue clearly highlights Hannan and Freeman's rather different treatment of the Darwinian trilogy, of variation, selection, and inheritance. Hence, having introduced variation, the analysis now turns to the principle of selection where it will be seen that an incisive evaluation of Hannan and Freeman's approach has been usefully enhanced through very recent developments in selection theory (Knudsen, 2002, 2004). In terms of theory development in the socio-economic spheres, it will also be interesting to observe that some of the related issues will already be familiar, particularly those associated with 'units' and 'levels' of selection.

The Principle of Selection

The selection process, in Hannan and Freeman's population ecology perspective, is promoted as the primary motor of change. Significantly, they thereby draw distinctive theoretical conclusions about the relative roles of different evolutionary processes in explanations of change. And this sets them apart, not only from most of their colleagues in sociology and organization studies but also from Nelson and Winter, and moreover from modern Darwinian theory. Essentially this perspective amounts to a reversal in causal direction, with 'top down' causality. Unlike Nelson and Winter who, more conventionally (in a Darwinian sense) see change as being generated from the bottom up, percolated through the firm, Hannan and Freeman see change being determined by their higher 'macrosocial processes.' As they explain below where they contrast the Lamarckian adaptationist approach with their own selection approach (1989, p. 22);

> The line of theory we develop builds on the assumption that change in core features of organizational populations is more Darwinian than Lamarckian. It argues that inertial pressures prevent most organizations from radically changing strategies and structures.

In fact, although they call their theory Darwinian, it appears that in significant respects it is not. The implications of their selection 'bias' is that it discounts other explanations of variety such as mutation and adaptation, and it avoids articulation of an inheritance mechanism, all of which features do appear in Nelson and Winter's theory.

Indeed, the Darwinian 'label' and causality is further confused in a comparative analysis of these socio-economic selection processes because of the different articulation of 'units' and 'levels' of selection. Nelson and Winter, for example, concerned with technological and economic change, focus on the firm as their unit of analysis, whereas Hannan and Freeman, concerned with 'organizational ecology', describe an analysis at the level of populations. Superficially, it is difficult to discern the organizational hierarchies and to know that we comparing like with like. Indeed this is an important and common problem in socio-economic theories of evolution. However, the apparent difference in focus[107] intriguingly masks a strong degree of

[107] Which essentially amounts to a difference in the level of analysis.

convergence between these two theories. Indeed, significantly, it recalls the 'unit of selection' debate in evolutionary theory which stifled theoretical progress but was subsequently shown to be a dispute about semantics (Hull, 1981; Brandon, 1982, 1999).

Units and Levels of Selection

As demonstrated in Chapter 5 above, much of the controversy arose as a direct result of confusions or misunderstandings about whether theorists were talking about the *unit* that was being selected or the *level* of the organizational hierarchy at which selection took place. The 'unit' and 'level' of selection appeared to merge in conceptualisations of evolutionary processes; and until these became disentangled, the 'unit of selection' debate persisted.

The point is, Nelson and Winter and Hannan and Freeman have similarly approached their evolutionary theories from a 'units' and 'levels' approach, respectively. Establishing this point at the outset is very important as it goes a long way towards explaining both the superficial differences in these socio-economic theories as well as their foundational similarities. It also usefully highlights here how confusions arise and appear intractable in evolutionary theorising in the social realm, and illustrates what is still a common misunderstanding amongst evolutionary theorists in the social sciences.

Basically the immediate and obvious difference in approach could suggest different evolutionary interpretations. Nelson and Winter clearly identify the firm as the unit of analysis and, moreover, as the unit *of* selection. Whereas, Hannan and Freeman talk about 'shifting' the analysis up to the level of populations of organizations and indeed they emphasize this contrast with tradition in organization studies. Does this mean, therefore, that Hannan and Freeman are talking about selection occurring at this higher level? Are populations the unit *of* selection?

A close examination of the two approaches shows that in fact the evolutionary hierarchies are the same. Hannan and Freeman in their basic articulation of the selection process are not suggesting that populations are the primary units *of* selection, what they mean is that selection occurs at the level of the organization but that *the effects* are manifested at the population level – the level at which they make their analysis. This is confirmed by their characterization of their two key evolutionary entities above. Their primary unit *of* selection is the individual organization, and their

second key entity is the population which is comprised of multiples of similar organizations. Their definition of populations perhaps adds to the confusion because of its stated 'unitary character', and as noted earlier, they propose that populations also act as units *of* selection.

However, taken together with their treatment of the 'organizational form', it is clear that Hannan and Freeman do concur with the basic Darwinian selection hierarchy. Indeed, notably, both case studies allude to the traditional single-level selection process [108] where, paraphrasing Sober (1984, p. 100), there is selection *of* the organization and selection *for* its properties, the later of which ultimately then characterises the population or industry. Thus, the selection process is essentially the same in terms of the units and levels of selection. Hannan and Freeman are essentially being very explicit about their population level of *analysis*, something that tends to be only implied in Nelson and Winter's work. However, conversely, while organizational 'properties' are merely implied in Hannan and Freeman's account, Nelson and Winter are very explicit about their routines-as-genes analogy.

With these clarifications now made, the analysis finally turns to the handling of inheritance and transmission, and, as indicated, this is where the contrast with Nelson and Winter becomes most apparent. Hannan and Freeman make no attempt to incorporate or create an inheritance mechanism, an omission that clearly impacts on their selection process and goes some way towards explaining the absence of anything resembling a replicator in their theory, or indeed a replicator-interactor duality.

The Missing Principle: Inheritance

In their failure to articulate an inheritance mechanism, Hannan and Freeman acknowledge that their evolutionary treatment of organizational change is 'partial at best' (1989, p. 20);

> We do not have anything resembling a fully developed evolutionary theory of organizational change. Although we have learned a good deal about selection processes, we still know very little about the other side of the evolutionary process, the structures of inheritance and transmission. Sociology does not have a simple, well understood transmission process analogous to Mendelian genetics.

[108] See table 1 above in Chapter 7, where the traditional single level selection process is depicted as 'position I'

Thus, whilst explicitly identifying themselves as Darwinian they have nevertheless omitted to include this core Darwinian principle in their evolutionary framework. Indeed, from a Darwinian perspective we might judge this to be the missing link in their theory. The exclusion of Lamarckian inheritance from Hannan and Freeman's theory is quite deliberate and twofold and is informed by empirical as well as theoretical findings. It reflects their long standing criticism of adaptive explanations of change in the social arena and it also reflects a concern, common amongst social scientists (Aldrich, 1999), with the difficulty in organization theory of coming up with the equivalent of a biological inheritance mechanism.[109] On an empirical basis they believe that in the socio-economic realm selection is, in any case, the overriding evolutionary force and endeavour to show how social changes affect the form of organizations and how competition influences the diversity of those forms (1989, p. 11). In a summary of the widespread and contrasting position in the organizations literature, where they notably cite Nelson and Winter as typifying the flawed Lamarckian approach,[110] they note (p. 22, my parameters);

> Most organizational theorists assume that change is Lamarckian, that major changes in the forms of organizations come about through learning and imitation [adaptation]. Many kinds of organizations commit resources to learning; organizations often seek to copy the forms of their more successful competitors. In a rough sense, organizations make copies of themselves [inheritance] either by setting up new organizations, by losing or expelling personnel with the requisite knowledge to copy the form, or by invoking imitation.

In contrast, Hannan and Freeman explain that their own theory assumes that 'change in core features of organizational populations is more Darwinian ['selectionist'] than Lamarckian' (p. 22). And, in justifying the dominance of the selection approach they present the argument that is often cited in defence of selectionist accounts in response to critics concerned about human intentionality (p. 22);

[109] Hannan and Freeman (1977, p. 930) 'It is not possible to specify a simple transmission mechanism by which the ability to construct organizations of a given type is passed along among individuals and social groups' (p. 21).

[110] Indeed this raises another interesting point of comparison between Hannan and Freeman and Nelson and Winter, for while the former certainly do declare themselves 'Lamarckian' referring, for example, to changes being 'passed on' to 'tomorrow's firms', it is noticeable that the actual transmission processes are nevertheless underplayed in their theory. Indeed there are no 'generations' as such in Nelson and Winter's theory and like Hannan and Freeman, it is the selection process that is emphasized at the firm level. Thus it could be argued that there is a notable degree of convergence between these theories at the firm level.

> Even when actors strive to cope with their environments, action may be random with respect to adaptation as long as the environments are highly uncertain or the connections between means and ends are not well understood. It is the *match* between action and environmental outcomes that must be random on the average for selection models to apply. In a world of high uncertainty, adaptive efforts by individuals may turn out to be essentially random with respect to future value.

Hannan and Freeman argue that it is mistaken of adaptationists to place so much emphasis on the intentional actions of organizations. They believe that the adaptation or 'focal-organization perspective' is an inadequate explanation of change in form or organizational structure, because it fails to properly account for environmental effects and the powerful inertial pressures on organizations. As a consequence, however, they end up presenting a theory that effectively denies that organizations learn or that managers might make consequential choices.

Earlier (1977) they highlighted how the adaptation perspective dominated the literature on organizations; the management literature, sociological literature and indeed the literature emanating from the influential behavioural theories focused on decision making (March and Simon, 1958; Cyert and March, 1953). They argued that these theories place far too much confidence in the ability of managers and organizations to plan and adapt to the environment and thus shape the organization.[111] Whist acknowledging that adaptive behaviour or learning is bound to be partially reflected in the relationship between structure and environment, significantly they concluded (p. 930) that 'there is no reason to presume that the great structural variability among organizations reflects only or even primarily adaptation'.

Adaptation Versus Selection

Thus Hannan and Freeman essentially offer the population ecology perspective as 'an alternative' (p. 29), and position themselves on the selection side of the adaptation versus selection debate. In so doing, they elevate the effects of the environment on organizational change. The 'environmental' or 'systems' view is clearly best expressed for Hannan and Freeman in an ecological perspective which focuses on interactions with the environment and competition, and thus selection processes.

[111] In *Organizational Ecology* (1989, p. 69) they cite March (1989, p. 563) to illustrate the point; 'Organizations are continually changing, routinely, easily, and responsively, but change within organizations cannot be arbitrarily controlled…What most reports on implementation indicate…is not that organizations are rigid and inflexible, but that they are impressively imaginative.'

Patterns in nature are more appropriately attributed to the action of selection processes.

Thus for Hannan and Freeman diversity of organizations is to be explained not through the strategic decision making of managers at the top of organizations but through recognition of inertial pressures on organizations (Burns, 1961; Stinchcombe, 1965), and the measurement of 'vital rates'. Organizational diversity, they argue, depends on several of these rates; 'the rate of founding and entry into a population, the rate of change in strategy and structure, and the rate of failure or mortality' (p. 201). They conclude that 'a broad social change can shape organizational diversity by affecting any one of these rates'. And this is what leads to their argument that macro-social processes determine the success or failure of organizations, and thus the characteristics of the population or industry. Organizations are subject to internal and external 'inertial forces' and as a result 'the dynamics of diversity depend mainly on the rate at which new and diverse organizations are created and the rate at which organizations of various types disappear.'(p. 201) In other words, inertial pressures prevent changes at the organizational level from impacting at the population level.

In terms of the important question of causality, it appears then that unlike Nelson and Winter, Hannan and Freeman effectively promote a 'top-down' explanation of organizational change. In the former's Lamarckian explanation of change, they promote the idea of firms adapting and changing in response to their environments. Thus, where they work from the micro-level up, and see change as being generated primarily from routines, Hannan and Freeman see change being determined by macro-social processes. This is clearly an important difference in terms of causal explanation between the two theories, and it evidently hinges on the latter's reluctance to acknowledge adaptationist explanations of change. Indeed, in Hannan and Freeman's terms it would seem that Nelson and Winter have the more 'complete' theory; one that combines adaptation and selection.

As has been highlighted throughout this study, there is increasing concern about the theoretical chasm that now exists between the two dominant models of industrial change (Zald, 1994; Murmann, 2004, 2003; Baum and McKelvey, 1999). And as a consequence each account is deemed to be lacking in explanatory scope (Haverman, 2000; Baum and Singh, 1994; Murmann et al, 2003). Furthermore, as Murmann (2004) observes, 'even those scholars who acknowledge the importance of both selection and adaptation tend to

favour one over the other.'[112] Although a few theorists are attempting to bridge the divide (Bruderer and Singh, 1996; Levinthal, 1991), suggesting that 'there need not be a fundamental opposition of ecological and strategic perspectives, and that a fruitful integration of these ideas is possible' (Burgelman, 1991 p. 239), and others (Baum and Singh, 1994) are praised for their efforts in bringing these perspectives together (Zald, 1994), it is clear, even from these works, that without the necessary theoretical tools the gulf will persist.[113] So where does this leave Hannan and Freeman's selection theory? Is it, from a Darwinian perspective, only a partial theory?

A Partial Darwinian Theory?

Are Hannan and Freeman presenting a partial, and thus flawed, evolutionary theory? Evidently they want to present a selection theory without the Lamarckian inheritance mechanism, and by their own admission (referring to the modern synthesis)[114] they do not even attempt to discuss a Darwinian inheritance mechanism or posit a replicating entity. Surely their selection theory is flawed without some kind of inheritance mechanism? Indeed, is it even possible to have an evolutionary selection process without an inheritance mechanism or a replicator-interactor distinction?

From a Darwinian perspective critics argue that this is simply not possible. For example, Hull (2000, p. 54) explains that any adequate understanding of selection requires specification of the mechanisms that bring about correlations in cultural traits in successive generations; Metcalfe (1987, p. 57) and others suggest that it would be a 'crude error' to interpret the evolutionary argument solely in terms of Darwinian selection, and indeed, notably, Hannan and Freeman's account is singled out as 'inadequate' for this reason. As Metcalfe explains, it is very important to account for upward causation, and by separating selection from developmental processes theorists risk missing a major element of understanding (2004).

[112] To a certain extent this can even be said of Nelson and Winter who are also concerned about inertial forces and who do place greater emphasis on selection in their theory. More recently Nelson (1991) vividly summed up their position, 'economists are interested in the game and its outcomes, rather than in the particular play or performance of individual firms'.

[113] While significant advances have being made in terms of acknowledgement in empirical works of, for example, a replicator-interactor duality (Baum and Singh, 1994) and Lamarckian inheritance within a Darwinian framework (Ziman, 2002), as suggested earlier, the units and levels confusion and continued widespread perception of a Lamarckian-Darwinian rivalry continues to thwart progress.

[114] In this context Hannan and Freeman make it clear that they are referring to modern 'neo-Darwinian' theory which is informed by Mendelian genetics.

However, through further clarifications of the concept of selection, which are derived from its general mathematical definition in the Price Equation (1995),[115] it has recently been demonstrated that it *is* possible to have an evolutionary selection theory without specifying a meaningful principle of inheritance (Knudsen, 2002, 2004).[116] In an important paper where Knudsen discusses the significance of the Price Equation for a general selection theory he summarizes below the critical insight it provides for evolutionary theorists (2004, p. 155);

> For conceptual purposes the Price Equation can be used to distinguish between the bare minimal requirements of a valid evolutionary explanation. In any recent definition, evolution occurs by selection, and selection is only defined when a minimal principle of continuity (including the possibility of inheritance) is in place … For empirical purposes, the Price Equation allows a distinction between selection and transmission effects, which is useful when identifying the actual sources of evolution.

This is undoubtedly an important theoretical development, particularly for the socio-economic domain. Knudsen shows how it is possible to distinguish between the change that is caused by selection, and change that comes about when information is transferred through, for example, learning, experimentation or development at the individual level (Hodgson and Knudsen, 2004c). Significantly, as well as showing how adaptation may be reconciled with selection, for our purposes here, general selection theory also usefully demonstrates that selection without inheritance may also well occur (Knudsen, 2004 p. 158). To illustrate, Knudsen cites a useful example offered by Price (1995, p. 389);

> In palaeontology and archaeology, selection especially favours stones, pottery, and teeth, and greatly increases the frequency of mandibles among the bones of the human skeleton'. In this example, there is no obvious meaningful replicator/interactor distinction, and there is no meaningful principle of inheritance involved. Yet there is selection, variety and continuity.

[115] Knudsen (2004, p. 152) 'Price's (1970, 1972) equation … offers an exact and complete mathematical description of evolutionary change under all conditions … this description includes evolution by selection, as well as change in population properties that occurs because of transmission.'

[116] Elsewhere (Hodgson and Knudsen, 2004c, p. 4), Knudsen offers a full definition of the concept of general selection: 'Selection involves an anterior set of entities, each interacting with their environment, and somehow being transformed into a posterior set, where all members of the posterior set are sufficiently similar to some members of the anterior set, and where the resulting frequencies of posterior entities depend upon their properties in the environmental context'

Thus, selection without inheritance can clearly occur. So is this how we would categorize Hannan and Freeman's theory? They stress that their theory is a selection theory and acknowledge that it is thus only partial, and they clearly seem to want to make claims about the real world based on how it presently stands. Their view is that that we can tell a satisfactory evolutionary story without a 'definition of forms based on organizational genetics' or indeed the articulation of an inheritance mechanism, and they even cite the authority of Darwin to support their selectionist position.[117]

Nonetheless, it is argued here that in spite of Hannan and Freeman's failure to articulate an inheritance mechanism, their theory could *not* be described as strictly selectionist in the terms outlined above. In other words, a selection process without inheritance or replication. Indeed Knudsen makes it clear that such processes are most unlikely in the social domain (2002, 2004). The important point is textual analysis confirms that at the very least Hannan and Freeman are describing undirected heritable variation, that is, modern neo-Darwinian selection (Darwinian Mendelian synthesis). The fact is that through their inertial principle, continuity or 'inheritance' is clearly implied. A replicator is *implicit* in their theory. And furthermore, a replicator-interactor distinction can even be discerned in their theory.

General Selection Theory and Implied Inheritance

Knudsen observes that there are two senses in which Darwinism is adopted in the socio-economic sphere, one metaphorical and the other analogical. In the first case theorists use natural selection to model a competitive struggle that results in the survival of the fittest (2002, p. 443), and in the second, analogical sense, it is implied that the process of selection in the economic domain is very similar to neo-Darwinian selection in biology (p. 444). He goes on to stress that the two senses are often confused in the literature. Hannan and Freeman, as we saw above, describe their theory as 'Darwinian' though they resist articulating an inheritance process. In order to perceive their implied inheritance and indeed to clarify the true nature of their selection process we need to observe Knudsen's above distinction and to consider his clarifications below about the relationship between general selection theory and Darwinian evolution.

The definition of selection based on the Price Equation can be applied to anything that evolves (Knudsen, 2004, p. 148). Thus, general selection theory covers the two

[117] (1989, p. 50) 'Darwin relied less on a complete set of species classifications than on his own naturalistic observations … Darwin built a successful theory of evolution using the wrong theory of genetics – a theory of blending inheritance – and an inaccurate set of species classifications'.

quite different concepts of selection that tend to be employed in science (p. 151). The first is 'subset selection' (Price, 1995) and refers to the selection of a subset of elements according to a criterion of preference or excellence,[118] and the second is Darwinian selection which refers to 'replicating populations in which continuity is secured by inheritance'. Knudsen observes that general selection theory includes Darwinian natural selection as a special case, which in turn includes 'neo-Darwinian' selection as a special case, as well as other types of selection like Lamarckian selection. Clarification of the selection process provides clarification of variety and continuity in each of these scenarios and thus enables useful distinctions to be drawn between them and, thereby, the easier identification of evolutionary accounts, such as the case study here under review.

For example, it is suggested here that Hannan and Freeman would probably cast themselves in the first category, that is, what we might call 'pre-Mendelian' Darwinian natural selection, alluding as they do to Darwin's broader notion of natural selection which concerned replicating populations but which did not, in their view, invoke a replicator-interactor distinction. Alternatively, they might be persuaded to the view here, that they are better cast in the second category, that of neo-Darwinian selection. Whilst Nelson and Winter, on the other hand, would most likely fall into the third Darwinian / Lamarckian selection category.

To illustrate, Knudsen (p. 160) demonstrates that although replication and the replicator-interactor distinction are not *necessary* for evolution to take place, because the replicator-interactor distinction is a feature of 'particularly persistent evolutionary systems', there are nevertheless good reasons why we would expect to see it at the core of social and economic selection processes. And this relates to the 'protection' of the hereditary mechanism in replication processes (Maynard-Smith and Szathmáry, 1999), as he goes on to explain;

> The hereditary material is encoded in the replicator. When the replicator and the interactor are ontologically distinct entities, and a barrier separates the two, it follows that the hereditary material is protected. By contrast, if the hereditary material was altered in each and every instance, it would simply reflect the noise of the environment, and evolution would come to a halt. Unless a separation actually exists between replicators and interactors, evolutionary processes would be very erratic and very limited. This contradicts the remarkable endurance of, at least some forms of cultural evolution (Durham, 1991; Boyd and Richerson).

[118] Knudsen offers examples of a manager's selection of a subset of applicants for vacant positions and a housewife's selection of a subset of apples on display at the market.

And relatedly, another important implication of the ontological separation of the replicator and interactor in the social domain is stressed by Knudsen, which underlines the argument here that Hannan and Freeman's account is closer to neo-Darwinism, and thus returns the analysis to the subject of an implicit replicator-interactor duality. Essentially, as Knudsen (p. 161) explains, a replicator-interactor distinction in the social realm would suggest that 'genotypic' features of social organizations would change more slowly than the 'phenotypic' features, in other words, the routines would change more slowly than the actual behaviours. And, significantly this is precisely what Hannan and Freeman express through their concept of structural inertia (core features change more slowly than peripheral ones), and what they demonstrate in their empirical studies (Carroll and Hannan, 1995; Hannan and Freeman, 1989).

Structural Inertia

In spite of Hannan and Freeman's omission and contrary to what they claim, modern neo-Darwinian inheritance is nonetheless assumed in their theory. It is expressed in their concept of structural inertia and in the definition and treatment of their central interacting entity, the 'relatively inert' organizational form.[119] Hannan and Freeman (1970, 1984, and 1989) are consistent in their recognition of 'faithfully reproducing structures that resist transformation' (Hannan, 2005, p. 59). Indeed the inertial principle logically implies replication or transmission,[120] and replication is perceived in their concept of fitness and focus on 'vital rates'. Essentially the details of replicating processes are subsumed in the rates of foundings and mergers, those rates that indicate fitness. Fitness denotes the ability of organizations to improve their numbers or grow, and in a selection process we are naturally talking about this 'fitness' in competition, as Hannan and Freeman illustrate (p. 20);

> We do think that selection in organizational populations is systematic, that various kinds of organizations differ in their survival chances, and that selection capitalizes on such differences.

[119] They do not claim that organizations never change, rather, that they respond relatively slowly to the threats and opportunities in their environment (1989, p. 70); 'The concept of inertia, like fitness, refers to a correspondence between the behavioural capabilities of a class of organizations and their environments'

[120] Richerson (Personal Communication, 8th October 2005) 'The inertial principle is described as the inheritance or continuity that generates a certain inertia in the population so that if nothing else happens the population stays the same from one time period to the next'.

Furthermore, picking up on Knudsen's points above about the likelihood of the replicator-interactor distinction in the social realm, and the view here of its implication in Hannan and Freeman's own empirical findings and core assumptions, it is perhaps not surprising to find that they do, in fact, acknowledge the existence of some kind of genotypic equivalent in the organizational world, in other words, some kind of social entity able to pass on encoded information. Significantly, returning to their definition of the organizational form, there appears to be a clear conflation of the replicating and interacting entities. Note that in their description below, organizations are both the instruction set and the outcome (p. 48, my italics);

> We have suggested (1977) that *organizational forms* be defined analogously, as instructions for building organizations and for conducting collective action.

Thus, not only is there Darwinian inheritance in Hannan and Freeman's theory but it is implicitly a modern Darwinian inheritance which embraces the replicator-interactor duality.

As noted at the outset Hannan and Freeman never deny the inheritance process they simply declare their inability to explain it. And we are reminded here of their comments regarding the robustness of a macro theory that does not have to be reassembled each time a micro assumption is changed. Indeed we can see how this effectively releases them from the analytical obligation to explore the detailed mechanisms of replication and inheritance. Nevertheless, through the careful analysis here of Hannan and Freeman's selection process their latent Darwinian inheritance mechanism has usefully been revealed. Hence it just remains here to ponder the question of their rejection of Lamarckian inheritance, and the implications of this for their evolutionary account of organizations.

Towards a More Complete Evolutionary Theory

Whilst neo-Darwinian inheritance may be demonstrated in Hannan and Freeman's 'partial' theory it is clear that the same cannot be said for Lamarckian inheritance. As noted earlier, many commentators see this as a major flaw in their theory. Baum and Singh (1994), for example, cite a host of studies that provide evidence that organizations can and do change, and furthermore that these changes are important to understanding what organizations do as individuals, as populations, and as communities

(p. 3). Indeed they see this as a major area of research for evolutionary theorists in the socio-economic domain (p. 6);

> By and large, organizational ecologists have not attempted to link ecological processes of interaction and genealogical processes of replication. Consequently we still know very little about the other side of the evolutionary process - the structures of organizational inheritance and transmission (Baum, 1989). How are organizational structures and practices perpetuated through time? What is inherited and how?

Metcalfe (2004) underlines the crucial point that we cannot separate selection processes from development processes, stressing, for example, that variety drives economic evolution and that technological innovation is what feeds variety. Indeed, in praise of Nelson and Winter's (1989) models of search behaviour he (1987, p. 64) observes that their theory usefully accounts for the behaviours that generate the very variety on which selection operates, and applauds their insightful micro-to-macro style Darwinian account, which clearly and appropriately embraces Lamarckian inheritance (2003);

> One of the central lessons of the Nelson and Winter world view is the need to build a theory of growth in a bottom up fashion with due attention paid to the emergence of constraints at higher levels of aggregation.

In summary, although Hannan and Freeman reject Lamarckian inheritance it is very important to note that their work represents an empirical rather than a theoretical rejection of Lamarckism (Hodgson, 2001, p. 113). Indeed significantly there is nothing in their theory that suggests that Lamarckian inheritance is impossible in principle. Moreover, as indicated above they do not *deny* that organizations change, only that the change cannot account for the evolutionary change manifested at the population level. The point is there is clearly scope for the productive development of their theory. Ultimately reconciliation between Hannan and Freeman's Darwinian selection and Lamarckian inheritance is theoretically possible. For as demonstrated in earlier Chapters and exemplified in the analysis of Nelson and Winter in Chapter 8, Lamarckism can assuredly be accommodated within the meta-theoretical framework of modern generalized Darwinism.

Conclusion

Clearly the modern Darwinian perspective, enhanced by recent clarifications of the selection process, has usefully enabled an incisive evaluation of Hannan and Freeman's evolutionary theory, and indeed provided the conceptual tools for a useful comparative analysis. Evidently the Darwinian thread is even stronger than its characterization as a partial theory suggests. As demonstrated here, implicit in this well-crafted Darwinian selectionist account is the crucial replicator and interactor distinction, and significantly, its development would not appear to be inconsistent with the existing theory. Indeed in their recognition of their selection bias the author's acknowledge inheritance as a gap in their theory and signal this as an important area for future research. Certainly empirical research is currently fueling the need for the theoretical accommodation of transmission processes (particularly 'Lamarckian') adding voice to the call for reconciliation between selectionists and adaptationist perspectives.

The implications are that for a complete and more realistic account of social theories of evolution, theorists need to incorporate the Darwinian idea of a social replicator. This is powerfully demonstrated in Nelson and Winter's account, it is evident here, and it will be now be underlined in the analysis of Howard Aldrich's *Organizations Evolving* below.

10 Howard Aldrich's Organizations Evolving: The Complete Darwinian Account?

> Evolutionary theory applies to many levels of analysis: groups, organizations, populations, and communities. Variation, selection, retention, and struggle are processes occurring within all social units and across all levels of analysis.
>
> Aldrich (1999)

Introduction

This Chapter presents the final case study and the most recent evolutionary theory here under review. As well as underlining the inevitability and potential of Darwinism for the socio-economic realm, the work of Howard Aldrich (1999), in terms of its scope, also represents the closest approximation to a 'general Darwinian' approach. Again, the philosophy of biology and recent theoretical and conceptual clarifications provide access and careful evaluation here. And interestingly, it is noted that although this *is* emphatically a Darwinian perspective and the Darwinian thread is never far from the surface, explicit references to Darwin, Darwinism or Darwinian are curiously absent from the text.

Broadest in scope and receptive to the most up-to-date developments in evolutionary theory, Aldrich's approach essentially contemplates the origins or 'emergence' of organizations; the evolution of organizations via Darwinian selection; the units of selection issue; the replicator-interactor distinction; 'Lamarckian' inheritance and; group and multilevel selection.

The Case of Howard Aldrich

So do we yet have an all-encompassing or complete evolutionary account in the socio-economic domain? On the face of it, compared to the preceding case studies, Howard Aldrich in, *Organizations Evolving* (1999), presents the most 'Darwinian' and, most inclusive account of the evolution of organizations. Embracing Darwinism as a 'meta' theory, Aldrich promotes a unifying schema for the social sciences which intuitively follows in the footsteps of the latest theoretical advances in evolutionary theory.

Following Campbell (1965), Aldrich explicitly adopts Darwin's principles of variation, selection and inheritance. He implicitly promotes the organization as the primary unit *of* selection and organizational routines or competencies as the enduring gene-like entities which are selected *for*. Moreover, he wholeheartedly endorses multilevel selection theory, promoting the idea of intra-organizational selection as well as selection at the levels of the organization, the population, and beyond. Finally, in a decisive leap forward, Aldrich implicitly addresses the adaptationist and selectionist polarization and encourages a general Darwinian perspective which acknowledges the causal influence of both organizational routines *and* industrial selection environments.

Notably, however, in a book entitled 'Organizations Evolving', where the author admits to being more focused on the *emergence* of organizations, the reader looking for the 'Darwinian imperative' could, as Buenger (2000) argues, be disappointed. Despite setting out his evolutionary approach in Campbell's (1965) popularly revised formula of variation, selection and retention, there is little expansion of these mechanisms at the expected junctures, so that their application is mostly implied and operation not always clear.

And relatedly, with regard to the underlying theme here of implicit Darwinism, it is surprising how few references there are to 'Darwin', 'Darwinian' or 'Darwinism' in the text. Having acknowledged Darwin as the source of Campbell's inspiration (p. 21) and underlined the generic nature of Darwinian theory, it would seem that Aldrich is more comfortable thereafter using the broader term 'evolutionary' when referring to his own approach. Indeed in an early observation of the negative reactions of social scientists towards evolutionary theory, particularly Darwinian theory, in the same passage endorsing a general Darwinism, Aldrich hints at the reasons for his own reticence about explicit references to Darwin (p. 21);

> Many [social scientists] have been reluctant to consider the evolutionary approach because of misunderstandings caused by authors who confuse old fashioned social Darwinist ideas with modern evolutionary ideas … As evolutionary applications become more common, I expect such misunderstandings to diminish in frequency and intensity.

This Chapter offers an evaluation of how Darwinian evolutionary ideas have been deployed in Aldrich's schema. Beginning with a summary of Aldrich's approach and its Darwinian ingredients, this will serve as a review of the evidence proposed to support the assertion that Aldrich presents the most inclusive Darwinian perspective.

We will then take a closer look at the various strands of theory, evaluating how they relate to each other and impact on the viability of Aldrich's evolutionary argument. Here it will be shown that within Aldrich's approach are the same type of problems that became apparent within the 'units debate' of evolutionary biology, and thus an implicit limitation on his multileveled account. This will be assessed in the light of Aldrich's overarching framework, empirical observations and implicit assumptions, leading to a concluding section on the scope for further development of an evolutionary theory of organizational change.

Aldrich's Evolutionary Approach: The Darwinian Ingredients

An accomplished organization theorist whose pioneering work (1979) inspired many investigations of organizational change in the evolutionary mode (Wade, 2002), Aldrich (1999) here offers the first stab at a much more inclusive Darwinian evolutionary approach with an attempt to explain organizational origins as well as organizational evolution. Moreover, bringing the theory up-to-date theoretically and conceptually, it grapples with the units and levels issue, discusses the replicator-interactor distinction and explicitly promotes a multileveled evolutionary account. Notably, this is an approach that is thoroughly Darwinian in character. And yet crucially (in common with Hannan and Freeman (1989, p. 428) and Nelson and Winter (1982, p. 11)), Aldrich is careful not to allow the peculiarities of the biological domain to dictate or skew his analysis of socio-economic phenomena (p. 21), but in an insightful way he illustrates the full range of its general applicability. Comfortable and fluent as he is with the evolutionary approach he is unapologetic about its use and indeed asserts that in the last few decades it has become a much more taken-for-granted generic approach (p. 21).

Darwinian Processes: Variation, Retention and Selection

In keeping with the Darwinian approach, Aldrich immediately signals his adoption of its three core principles (p. 20). Inspired by Campbell's variation and selective retention model, he adds an interesting fourth principle, which he refers to as 'struggle'. Variation is described as 'change from current routines and competencies' or 'change in organizational forms'. Significantly, in terms of a more inclusive approach, variation, for Aldrich, is pre-existing and, moreover, has many causes which include the *intentional*; 'when people actively attempt to generate alternatives and seek solutions to

problems', and the *blind*; which 'occurs independently of environmental or selection pressures (p. 22). Selection is defined as the 'differential elimination of certain types of variations', whilst retention, is described as 'selected variations [that] are preserved, duplicated, or otherwise reproduced'. Finally, Aldrich's additional principle of 'struggle' is defined as the 'contest to obtain scarce resources because their supply is limited'.

The Fourth Principle

In the passage below Aldrich indicates the interconnectedness of these core principles in the evolutionary process. Evidently the fourth principle is meant to illustrate the point that units subjected to the selection environment are not the passive entities portrayed by organizational ecologists (Hannan and Freeman, 1989) since in their 'struggle' to prevail they respond to their environment and adjust strategies accordingly. Thus, I would suggest, that through Aldrich's principle of struggle we also perceive the inclusion of adaptive or Lamarckian explanations of change (p. 33);

> Variation generates the raw materials for selection, by environmental or internal criteria; retention processes preserve the selected variation. But retention processes also restrict the kinds of variations that may occur, and competitive struggles as well as cooperative alliances may change the shape of selection criteria.

Aldrich presents these four 'necessary and sufficient' (p. 21) processes as the key mechanisms of evolutionary theory. Then, to emphasize their generic nature and explanatory value for organization theory, he explains that such evolutionary models do not specify the engines driving variation, selection and retention, but depend upon ideas from other approaches. In other words, Aldrich underlines the point that domain specific, auxiliary explanations are required to give these Darwinian mechanisms their meaning and relevance. And this is where Aldrich admirably brings the concepts to life and illustrates his eclectic approach. In a comprehensive survey of organizational research he provides a wealth of 'domain specific' theoretical and empirical observations that typify the engines that drive these mechanisms in the socio-economic world. Underpinning the view, that the evolutionary approach serves as an overarching theory within which others are recognised, he suitably reviews several organization science perspectives illustrating their contribution and relevance. These include, the

ecological, institutional, interpretive, organizational learning, resource dependent and transaction cost economizing approaches.

Emergence

Notably, in contrast to Nelson and Winter, Hannan and Freeman, and indeed most other organization scholars who study *existing* organizations, Aldrich's main pre-occupation is with the genesis or *emergence* of new organizations.[121] As a result, some commentators see it as somewhat inconsistent that his agenda is explicitly framed by Campbell's (1965) model of variation, selection and retention which addresses transformation, whilst his explanations appear to be derived from a different set of ideas which address emergence (Strang, 2002). However, I would suggest that this apparent inconsistency reflects both the ambitious scope of Aldrich's scheme - to uniquely attempt an evolutionary explanation of both organizational change *and* founding - and the subtlety of his argument. The point is, having devoted a Chapter to the evolutionary approach, where he discusses his interpretation and use of these mechanisms, he is rather remiss thereafter at signalling their role or significance. It is fair to say that whether we are talking about emergence or transformation, much of Aldrich's evolutionary argument, in terms of variation, selection and retention, is implied, and each of these processes of evolution (and others, like mutation and learning) appear to be subsumed into, what he sees as, the 'selection logic'. This will become clearer when we take a closer look at Aldrich's treatment of selection.

Unusually within the organizations community (with the exception of the organizational ecologists) and reflecting a Darwinian population thinking perspective, Aldrich really emphasizes variety. Indeed, his aim is to 'ground the book in the substance of organizations in all their diversity, rather than to write as if the Fortune 500 were the only creatures in the organizational zoo' (p. 1). For Aldrich, our understanding of the source of variety is crucial to our understanding of existing organizational diversity. As he explains, 'without understanding why and how new social units emerge, we miss the connection between the on-going creative ferment in human

[121] It is not always clear what Aldrich means by the term 'emergence' and how this is understood by his reviewers. He uses the words 'founding' and 'emergence' interchangeably to refer to the creation of new organizations. Their frequent use reflects Aldrich's deliberate avoidance of the word 'birth' which fails to describe the process he wishes to explain. As he makes clear, 'I used the term *foundings* rather than 'births' to convey a sense of the process-driven, emergent nature of organizational creation' (p. 260). Nevertheless, emergence appears simultaneously to relate to the philosophical meaning of emergence in terms of 'emergent properties'. This second sense, however, where Aldrich treats higher level entities as emerging from lower level entities in the organizational hierarchy, tends to be assumed in his analysis.

societies and the particular realizations of it in organizations.'[122] Thus he extends the range of organizations to be studied beyond the medium and small to include the actual genesis of organizations. Accordingly his analysis focuses on the activities of nascent entrepreneurs and their creative role in founding organizations.

Multilevel Selection

Again, indicating the inclusiveness of his Darwinian perspective, in a significant advance on the previous case studies, Aldrich elaborates a multileveled selection analysis. This is central to his approach and is in keeping with his focus not only on the genesis and transformation of organizations, but also on that of organizational populations and communities. For Aldrich this means the application of variation, selection and retention 'across levels', with selection occurring simultaneously at all levels of the organizational hierarchy (p. 40). Evidently, in this comprehensive schema, Aldrich seeks to address the links between micro and macro processes and focus attention on the important dynamics within and between units and levels. Again we can perceive advancement on Hannan and Freeman, and Nelson and Winter's respective accounts, where the former have little to say on the internal activities of the firm and the latter, whose attempts to show the influence on industrial characteristics emanating from this lower level were somewhat confused in their ambiguous 'search' concept where units and levels of selection became muddled.

Unit of Selection

Linked to the multilevel selection approach, is the considered attention Aldrich pays to the unit *of* selection in organization science (pp. 35-41),[123] that crucial entity in Darwinian evolutionary theory, the nature of which clearly determines the very tractability of the theory. Indeed the book is structured such that Aldrich's Chapters deal in turn with the emergence, then evolutionary transformation, of organizations, populations and communities; all of which he treats as potential units *of* selection. However, Aldrich's multileveled approach hinges on his treatment of the units at the

[122] It is interesting to observe similar sentiments expressed recently by Hannan (2005); 'If one pays attention only to those organizations that have succeeded in moving from fringe to centre, then severe problems of sample selectivity arise in explaining how specific organizational characteristics affect success and failure. Such a focus will also miss the main source of organizational diversity: the creation of new organizations on the "fringes."'

[123] That is the unit *of* selection as expressed by Sober (1984)

foundation of this hierarchy, and it is here where we begin to detect a problem for the development of his theory.

Aldrich fittingly highlights the important and unresolved issue amongst organization scholars over the preferred unit of selection, noting a general demarcation in the literature between the 'routine' and the 'organization'. In his analysis of the debate he observes the nature of this distinction and notes the units being favoured by opposing sides (p. 35);

> We can distinguish between the bounded entities that are engaged in competition and cooperation (groups and organizations) from the organizational competencies (routines, operating procedures, competencies) that are carried by the entities.

In Aldrich's own analysis it is clear that he favours the organization as the primary unit *of* selection[124] and in his discussions of multilevel selection, in addition to populations and communities, he also implicitly promotes entrepreneurs, routines and competencies as units of selection. However, embedded in his distinction between the various units of selection, is the important functional distinction that actually defines the unit of selection; namely the replicator and interactor distinction (Hull, 1988). Whilst it is significant, from a Darwinian point of view, that Aldrich discusses and recognises this distinction, with routines and competencies, for example, featuring in his portrayal of retention (p. 30), it is similarly important to note that these replicating entities are simultaneously featured by Aldrich as units *of* selection. As previously noted, this subtle and oft-repeated confusion has since been clarified by Sober's (1984) useful distinction. Expressed in Aldrich's terminology Sober explained that there is selection *of* the 'bounded entities' and selection *for* their corresponding 'organizational competencies'.

Aldrich's merging of unit of selection distinctions with functional distinctions essentially amounts to a duplication of the same confusions that became apparent in the fraught 'units debate' of evolutionary biology and indeed there are echoes of the theoretical problems encountered in Nelson and Winter (1982). However, as will be demonstrated in due course, there is clear potential for its similar resolution through the explicit adoption of the generalized replicator and interactor concepts. This would certainly enhance the articulation of Aldrich's theory and crucially, it would not deny the prospect of routines and organizations simultaneously being treated as units of selection.

[124] That is to say the 'primary interactor' (Hull, 1988, p. 434)

Group Selection and Social Replicators

On a closely related topic, and significantly advancing the scope of his evolutionary account and its Darwinian credentials, subsumed in Aldrich's argument about additional units of selection, and in his treatment of emergence, is the implicit adoption of the modern understanding of group selection (Henrich, 2004). Much of Aldrich's analysis and empirical observations bolster this theoretical imperative, particularly his discussions of 'organizational boundaries' (pp. 113-140). In his discussions of group formation and maintenance, Aldrich implicitly recognises the within-group and between-group selection dynamic, in other words the simultaneous operation of internal and external selection processes. Accordingly he acknowledges that there will be conditions under which group selection will swamp individual selection (Henrich, 2004).

As discussed in Chapter 7 above, this is a critical development for socio-economic theories of evolution for it logically invites the notion of a social replicator,[125] and, the possibility of multilevel selection. For example, citing the work of Keisler and Keisler, Aldrich explains (p. 336);

> Homogeneity increases among the members of fledgling organizations because of selection processes at two levels. Inside new organizations, members' attentions are increasingly biased toward sampling shared information, and they tend to ignore non-shared information. This frequency-dependent bias amplifies the majority's views and further suppresses those of the minority, reducing intra-organizational variation (Keisler and Keisler 1969).

Essentially this expresses the idea of 'partitioned selection' (Price 1970, 1972) which accommodates the inherent tension between competition and cooperation in individual versus group selection scenarios, and enables the articulation of multiple levels of selection (Henrich, 2004). Indeed without the idea of group selection it would be impossible to conceptualize selection above the level of the individual and this would naturally prevent the conceptualization of multilevel selection, and thus significantly curtail an evolutionary theory of the social domain. Significantly Aldrich's group selectionist assumptions facilitate his multileveled approach.

[125] The establishment of group selection in the social arena logically implies the existence of some kind of social replicator. In other words, some trait, that improves the group's fitness and enables it to flourish in competition with other groups, is being selected *for*.

Indeterminacy and Intentionality

Finally, in another reinforcing demonstration of the Darwinian outlook, Aldrich highlights the 'indeterminacy' of evolutionary theory and thus, for him, its perfect suitability for an evolutionary theory of organizational change (p. 33). In the socio-economic domain change is viewed as being stochastic with chance playing a large role in evolutionary outcomes. Aldrich thus pushes the controversial point (for many organizations scholars) that the organizational world is 'inherently dynamic and vigorous but *not* inherently modernizing' (Dobbin, 2001 p. 1523, my italics).

Observing the resistance to indeterminacy and what it means for theorists, Aldrich acknowledges that 'the most difficult premise to convey is that selection derives from the consequences of action, [and] not the intentions of actors' (p. 336). Human intentionality, as noted in previous Chapters, is a very important issue, and it continues to cause problems for social scientists. However, importantly, Aldrich shows that Darwinian selection does not deny intentionality but inevitably operates on its outcomes. He thereby underpins the subtle but important empirical point that intentional and insightful human behaviour cannot be equated with 'infallible behaviour' or 'perfect foresight' of future economic conditions (Vromen, 2004 p. 223), as is otherwise being suggested.

Towards an Inclusive Darwinian Approach

From a Darwinian perspective, it is apparent from the above overview that Aldrich has all the essential ingredients of a viable evolutionary theory. Whilst he acknowledges that the work in itself does not lead to a 'well wrapped ending point' (p. 331), it nevertheless arguably provides a promising theoretical framework for a credible evolutionary theory of organizational change. Aldrich proposes the core Darwinian principles of variation, retention and selection, he assumes the replicator and interactor duality, accommodates adaptive change, and promotes group and multilevel selection. In a major leap forward Aldrich admirably synthesizes the oft-criticized 'multi-paradigmatic' field of organization studies under the unifying framework of modern Darwinism.

The following analysis will now consider the aforementioned anomalies relating to Aldrich's replicator and interactor distinction and how this compromises his multilevel schema. This begins with a discussion of the unit of selection and the problems that this

presents for Aldrich and his organizations colleagues. Reflecting on theoretical and conceptual developments in evolutionary theory relating to the process of selection, the discussion then points to the resolution of the theoretical problems raised in Aldrich's theory, moving on to a renewed evaluation of the possibilities for his multileveled account. Building on this evaluation, the remainder of the Chapter then offers a more detailed investigation of the key strands of Aldrich's evolutionary theory, illustrating its Darwinian and much more inclusive nature. This incorporates the examination of emergence, group-selection and intra-group dynamics, as well as inter-group dynamics and adaptation. As we shall see, Aldrich's discerning research agenda curiously mimics the current theoretical agenda in evolutionary biology and the related theoretical and conceptual developments in generalized Darwinism.

Units of Selection: 'Activities and Structures' and 'Bounded Entities'

As noted, Aldrich promptly draws attention to the important and unsettled issue of the unit of selection and suggests that a multileveled approach is key to its resolution (pp. 14, 35). However, unwittingly, in setting out the points of disagreement amongst organization theorists he also manages to duplicate the classic confusion over units and levels of selection. And this is in spite of an excellent discussion in Chapter 2 of the replicator-interator distinction.

Aldrich observes the two most favored units of selection in the organizations literature which he notes are characterized either by the 'activities and structures' on which evolution operates, or by the 'bounded entities' that carry those activities and structures (p. 21). In the first case he shows that scholars are focused on routines, competencies and jobs, whereas in the second they focus on groups, organizations, populations and communities. Aldrich states that he reviews these options without offering a strong defense for either point of view (p. 35). Indeed he seemingly relieves himself of this task by virtue of his multileveled selection approach. In point of fact this oversimplifies the position. Significantly, Aldrich wholly embraces both types of 'units of selection' within his multileveled hierarchy. But, as indicated above, this is not a straightforward hierarchy of similar entities. Indeed, it is his conflation of different types of entities that ultimately causes problems for his theory. In order to illustrate this theoretical ambiguity, we will first consider the influences on his thinking about units from the organizations literature.

To illustrate the 'routines and competencies' as units, Aldrich (p. 35) cites theorists who have explored evolution inside the organization, who have studied, for example, the differential survival of strategic initiatives (Burgelman and Mittman, 1994), managerial actions (Miner, 1991, 1994), and hiring rules and personnel (Warglien, 1993). These equate with Aldrich's organizational routines and competencies, which he describes as being 'carried' in bounded entities. Interestingly, in view of the discussion above in Chapter 8 about the units confusions, Aldrich identifies Nelson and Winter (1982), along with organizational learning theorists (March, 1991), for favouring routines and competencies as units *of* selection. However, as I argued, Nelson and Winter explicitly posited selection *of* firms, and only implicitly, through their 'search' process, suggested selection *for* routines.

To illustrate the alternative view of 'organizations' as units of selection, Aldrich contrasts the approach of the population ecologists, Hannan and Freeman, who, as he reminds us, perceive changes in organizational form as occurring 'through the selective elimination of certain organizations and the survival of others' (p. 37). He describes below how population ecologists perceive these organizational entities, or what Aldrich calls 'bounded entities';

> To be a unit of selection, an entity must have the characteristics of a bounded system and have boundary-maintaining processes organized around the persistence of the unit and the perpetuation of its activities. Work groups, departments, divisions, organizations, and populations have this character, although in varying degrees.

Aldrich then cites other theorists who advocate even higher units of selection such as populations (Aldrich and Fiol, 1994; Astley, 1985), communities and ecosystems (Baum and Singh, 1994; Hodgson, 1993), but notes that these are very few in number.

Return to the Problems of the 'Units Debate'

Reflecting on this delineation in the literature Aldrich is clear that the distinction indicates for him, two distinguishable or alternative units of selection as well as two distinguishable levels of selection. However, what is also evident in Aldrich's characterizations above is a replicator and interactor distinction, a functionally related distinction that he is notably equally keen to stress.[126] Elsewhere, he observes and

[126] Aldrich (Personal Communication, 18th June 2004) 'In my 1999 book, in Chapter 2, I took on this issue and argued for distinguishing between organizations as 'carriers' or 'vehicles' for routines versus

reiterates these functional distinctions, with routines, for example, being acknowledged as the drivers of the fate of the organizations, and the organizations being portrayed as their 'carriers' (pp. 40-41). It is clear that Aldrich sees the organization as the 'interacting' unit and it is apparent throughout the text that routines are understood as the enduring entities of which organizations are comprised.

Aldrich thus invites confusion when (having acknowledged routines and organizations as separate units of selection) in his explanation of the process of selection, as it operates on the routine, he actually identifies the group as the unit of selection. As can be seen in his summary of the 'routines as units of selection' position, which he later explicitly endorses (p. 40-41), Aldrich effectively manages to merge two 'units of selection' into one selection process (p. 36 my italics);

> From this perspective, evolutionary processes affect the course of change – at whatever level – by their selective effects *on the entities embodying routines and competencies.* Organizations, then, are the temporary repositories of competencies and routines that are held by their members and embedded in their technologies, material artifacts, and other structures. The distribution of these competencies and routines in a population depends on the selective survival and growth of organizations that contain different combinations of them. Analysis should therefore focus on conditions favoring the selection of routines and competencies, with organizational survival a secondary consideration.

Notice that in this explanation of the routine as the unit of selection, it is only 'vicariously' selected, via the organization. Thus what we actually see here is a description of the traditional single level selection process where, in a nested hierarchy of entities (routines, organizations and populations) there is selection *of* organizations and selection *for* their particular routines. In other words these routines are selected as a consequence of their host organization being selected, so that the organization is the unit of selection and not the routine.

Aldrich evidently needs to be clear about which unit he is nominating as the primary unit of selection. His expressed concern to embrace both ('I also believe that both modes of selection – routines and competencies, and entire organizations – have a place in evolutionary analysis' (p. 40)) is unfortunately not supplemented by a satisfactory explanation of how this is to be achieved. Indeed, his account at times is reminiscent of Dawkin's (1976) gene-selectionist position where genes (routines) are primary and the phenotype (organization) is merely the temporary carrier of routines. Dawkins had

---

the routines themselves. This is the distinction in other words between interactors and replicators, although I didn't use these terms'.

exacerbated the debate amongst evolutionary biologists with his gene selectionist position. We recall, however, from Hull's (1980, 1981) elucidation of the selection process, which was subsequently endorsed by Dawkins (1982),[127] that the classic formulation essentially describes a single level selection process which crucially is *comprised* of the sub-processes of replication and interaction.

Thus, although Aldrich explicitly promotes a multileveled evolutionary approach, which embraces the various levels favoured by researchers, his failure to unpack the selection process and the functional role of the replicator has rather curtailed his argument on this front. With confusion at this primary level, over which unit actually functions as the unit *of* selection, it makes it difficult to envisage an orderly hierarchy of ascending units of selection. As already elaborated, however, the untangling of the various elements of the selection process for evolutionary theorists was no easy task, causing prolonged disagreement in the philosophy of biology. It is thus not surprising to see how it has clearly presented similar challenges for those applying Darwinian selection to socio-economic evolution.

Aldrich's Social Replicators and Interactors

Notably, according to Aldrich's own definitions, routines and organizations are very different kinds of entities. Indeed, as he observes, this is key to the justification of theorists opting for different units of selection. The routine is portrayed as the enduring, replicating entity (resistant to change), whilst the organization is portrayed as the carrier of routines which interacts with and is selected by the environment. Thus Aldrich is clearly recognising and embracing a replicator-interactor distinction. As demonstrated in previous Chapters, this is a very significant distinction when it comes to articulating the process of selection, not only as it operates on one unit of selection but particularly when it comes to expressing multiple levels of selection.[128] Indeed, the confusion and its resolution lie in this critical functional difference between the replicator and interactor, in other words between Aldrich's alternatives of 'organizational routines' and 'bounded entities'.

[127] It is worth noting that Dawkins (1982) also recognized organisms and higher-level units as being interactors, in other words, the units directly confronting selection.

[128] See Chapter 7 above on multilevel selection theory

Significantly, whilst Aldrich may not have fully unpacked the modern articulation of the selection process, all the critical ingredients and foundational assumptions are nevertheless present in his theory. As has been established, selection is a 'two-step' process comprised of the sub-processes of replication and interaction, and it is only after establishing the 'peculiar duality' of the unit of selection that it is possible to go on to articulate multilevel selection. Crucially, this same duality is very evident in Aldrich's portrayal of routines and organizations, for example (p. 4);

> I use the term *routines* as a generic term, following Levitt and March (1988, p. 320): 'the forms, rules, procedures, conventions, strategies, and technologies around which organizations are constructed and through which they operate'.

Aldrich, in the following passage, reinforces this duality and, moreover, appears to recognise its foundational role (as the primary interactor) in a multileveled account of selection, such as that described in Chapter 7 above (p. 113) as position V (p. 41, my italics);

> Organizations constitute the key site for the replication of routines and competencies. Organizations are at the intersection of many forces: the competencies carried by experienced members, accumulated understandings within a work group, competitive and cooperative pressures from a population, and normative and regulatory obligations from a community and society. *The persistence of entities at all levels therefore depends heavily upon reproduction and retention processes at the organizational level*. The significance of organizations as carriers of routines and competencies and as bounded entities probably explains why most evolutionary analyses are still carried out at the organizational level (Baum and Singh, 1994).

Indeed, the 'dual aspect' notion of the organization can clearly be seen in the above exposition. There the idea of a self-contained unit (interactor) which is somehow imbued with a mechanism which ensures its own persistence (replicator). And the multileveled organizational hierarchy (of interactors) is indicated in the description of the interconnection between members, groups, populations and communities, which clearly has the organization as primary interactor. The critical point is that this characterization of the 'unit' that operates in an organizational selection process is clearly consistent with the dual aspect nature of the unit of selection, with its replicator and interactor sub-processes. And significantly, it also implicitly concurs with Hull's

requirements for a generalized multileveled account. Thus although Aldrich does not attempt to elaborate the specific roles of the replicating and interacting entities *within* the selection process, it would appear that his theory would nevertheless be receptive to this modern Darwinian articulation.

Viability of Aldrich's Multilevel Selection Theory

To be sure, what I have endeavoured to emphasize above is that firstly, Aldrich posits a replicating entity and that secondly, he firmly acknowledges a replicator and interactor distinction.[129] Having shown this to be the case, after highlighting the anomaly he presented in the portrayal of these same entities as a 'merged' unit of selection, we can now move on to show that, from a modern Darwinian perspective, the latter does not, in fact, compromise his multilevel analysis. Reflecting on Chapters 5 and 7 above, we will recall that Hull's explanation of the selection process accommodated multiple levels of selection. That is, in acknowledging the viability of a social replicator (1988, p. 406),[130] his conceptual apparatus permits the possibility of a social hierarchy comprised of a primary level of replicators and multiple levels of interactors, a scenario described as position V on the table of multilevel selection possibilities, in Chapter 7 above.

What this essentially means for Aldrich, is that he can continue to have the important routine and organization distinction, in other words, the functional distinction now generalized as the replicator and interactor distinction. And, yet at the same time he can continue with the idea of routines *and* organizations being units of selection. In other words these and other units higher up the organizational hierarchy can also be considered as interactors, or units *of* selection, as demonstrated in the Nelson and Winter Chapter above.

Significantly, in terms of the viability of Aldrich's theory, through the adoption of Hull's generalized terminology, its consequential modification lends greater support to Aldrich's claim that variation, retention and selection apply 'across levels'. Indeed, it does away with the need for Aldrich to confusingly invoke each of the three principles

[129] Refer to footnote 126 above.

[130] In this case Hull gives the example of Dawkin's 'meme' (1976). Later (p. 434) in his discussion of science as a selection process he gives the example of 'ideas' acting as social replicators; 'What functions as the replicators in science? The answer is not very surprising: elements of the substantive content of science-beliefs about the goals of science, proper ways to go about realizing these goals, problems and their possible solutions, models of representation, accumulated data and so on. Scientists in conversations, publications, and classroom lectures broach all these topics. These are the entities that get passed on in replication sequences … As in biological evolution, each replication counts as a generation with respect to selection.

at every level, for as Hull (1980) observed, while replication tends to be concentrated at the lower levels, interaction [selection] occurs at a much wider variety of levels.[131]

Interestingly, in view of the argument being presented here, in a recent work (Aldrich and Martinez, 2003) where the focus is on the constructive role of the entrepreneur, Aldrich does not repeat this tripartite supposition but is much more clearly invoking multiple levels of selection only. Here the authors present an evolutionary explanation which is quite evidently structured on the interconnected principles of variation, retention and selection, and yet only stresses *selection* at multiple levels. Indeed in some respects this work arguably represents a clearer articulation of Aldrich's multileveled position and a more fitting summary of *Organizations Evolving*. Note, for example, in the following passage that selection forces are operating at multiple levels but implicitly also on the routines, which represent the variety generated from the lowest level via the entrepreneur (2003, p. 359 my italics);

> The purpose of our chapter is to review and analyze the multi-level selection processes that apply across three different levels of entrepreneurial social constructions: organizations, populations and communities. We emphasize the inexorable tension between *selection forces at the three levels that affect variations generated by entrepreneurs.*

To be sure this work is more focused on the idea of selection (thus interaction) occurring across multiple levels, with the variation, selection, retention trilogy being mentioned only once (p. 383), and that is to explain that it is this trilogy, acting in concert with the foundational level of the replicating routine, that brings about the organizational forms that are seen at the industrial level.[132] Evidently at the heart of their entrepreneurial story is the critical replicating and innovating organizational routine.[133] Aldrich and Martinez's portrayal of the nascent entrepreneur, as the major source of organizational variations (p. 360), involves the portrayal of entrepreneurs as 'carriers' of these routines. Thus implicitly, in their organizational hierarchy, the entrepreneur is an interactor and unit of selection.[134]

---

[131] This is not to suggest that in the continuum from the organic to the social domains that an additional replicator cannot then enter the hierarchy at a higher level (i.e., multiple replicators and multiple interactors, position V in Chapter 7 above), but merely to stress that the designated replicating entity tends to have a 'one and many' relationship between its primary and ascending levels of interactors.

[132] Aldrich and Martinez (2003, p. 383) 'technological innovation typically involves a cumulative series of interrelated acts of variation, selection and retention that might culminate in commercial applications'.

[133] In a thirty two page chapter the word 'routine' features eighteen times.

[134] Indeed this mimics Hull's (1988) characterization of science as a selection process where the scientist is portrayed as the primary interactor (p. 513); 'Selection processes are complicated because they are the

Logical Possibilities of Aldrich's Multilevel Selection

We might now consider Aldrich's multileveled account in terms of the various logical possibilities of multilevel selection set out in the table above in Chapter 7. The impression gained here is that Aldrich presents two logical possibilities. It would appear that in some places Aldrich corresponds with position I on the schema, the basic 'single level replicator, single level interactor' position. He repeatedly states that the same evolutionary processes occur at each level, 'across levels'. However on examination of how he explains variation, selection, retention, often he is linking back to the variation, retention and selection that occurred at lowest level and merely relating it to outcomes at the higher levels (like an organism within its population). In terms of the schema, he is effectively describing one replicator, one interactor and one species. Thus he is effectively describing a single level process.

On the other hand, most explanations, and indeed the main assertion of the book, correspond with the 'multilevel replicator and multilevel interactor' position, which is 'position V' on the schema, and which reads, in a continuum from the organic to the social domain, as the introduction of an additional replicator at the social level with its own corresponding hierarchy of interactors. This essentially translates at the social level, to a single level of replicators and multiple levels of interactors.[135] For example (p. 112), 'selection forces at the cultural, population, and interpersonal level constrain most variations into a reproductive mode'. For Aldrich, this is what explains the empirical observations which suggest that nascent entrepreneurs tend to reproduce (select) existing routines, and hence 'inertia'. In other words, the *multileveled* selection pressures effectively conspire to limit the variations emanating from the lower levels. Thus we have a single level replicator with multiple levels of selection having an influence on the continuity of that replicator.

The point is Aldrich consistently talks about variation, retention and selection occurring across multiple levels, when in fact what he means is that *selection* is happening at these multiple levels. These important conceptual clarifications clearly thereby resolve a subtle but significant theoretical problem at the heart of Aldrich's

---

result of the interplay through successive generations of two processes-replication and interaction. Conceptual change in science is even more complicated because it is the result of the interplay of at least half a dozen processes that intersect at the level of individual scientists. They are the most important vehicles for both replication and interaction'.

[135] Indeed Aldrich's multilevel account could also map onto position III of the schema, which conceptually amounts to the same thing except there is no continuum between biotic and social worlds.

analysis, and breaths new life into a fertile and empirically well-informed theory. As suggested above, through the generalized replicator and interactor terminology, we can conceive of multiple levels of interaction and consequently multiple levels of selection.

Indeed, this clarification decisively resonates throughout other strands of Aldrich's theory, such as group selection, and the dynamics between different levels of selection. It clearly becomes possible through this modern formulation to conceive of Aldrich's key agent, the 'nascent entrepreneur', as an additional interactor and unit of selection. And, as a result, there is facilitation of a smoother theoretical linkage between Aldrich's articulation of the founding and emergence of organizations and their evolution.

For example, Aldrich states that he uses the evolutionary approach to 'portray how new organizations emerge as people mobilize resources in pursuit of opportunities' (p. 2). In his analysis of the creation of new organizations he features the entrepreneur as the critical intermediary. The Darwinian principles are posited to explain how organizations emerge from selection processes which, it is implied, are effectively operating through the entrepreneur on existing and new routines. The entrepreneur is thus the agent who reconfigures routines and competencies in such a way as to present a new organizational form to the selection environment. While Aldrich is criticized for not elaborating on these three principles as they relate to the founding or emergence of organizations (Strang, 2002; Buenger, 2000), it can nevertheless *now* be perceived how, in a generalized multileveled account, the entrepreneur may simply be conceived of as another interactor. The entrepreneur, in other words, is an interactor at a lower level - between the replicating routine and the organization.

Significantly, the careful deployment of the replicator and interactor concepts not only clarifies and enhances Aldrich's Darwinian conceptualization of emergence (founding) and multilevel selection, together with recent developments of selection theory, they also shed light on other important and related questions that Aldrich himself identifies as deserving of more attention (p. 336);

> First, can we identify the conditions under which different units of selection are most likely to be favored by selection forces (Sober and Wilson, 1998)? Second, to what extent can supra-organizational levels of analysis be used not only as contexts for action in our models but also as units of selection in their own right? Third, are levels of analysis merely an analytic device, or do they represent selection filters?

Implicit in the preceding analysis is affirmation that supra-organizations, as interactors, *can* be units of selection in their own right, in a multileveled Darwinian

selection process. Similarly, through the notion of 'partitioned selection' (Price, 1970, 1972) as articulated by Henrich (2004), it is possible to identify the conditions under which different units of selection (individual and group) are likely to be favoured by selection forces, and, moreover to perceive ascending levels of interactors as effective selection filters. And, this is precisely what is alluded to, by Aldrich (p. 36) in the quote above (p. 199) where he talks about competencies being carried by members, groups and populations and so on, in an ascending hierarchy.

Against this backdrop of possibilities we will now take a closer look at Aldrich's treatment of the Darwinian principles of variation, inheritance (retention) and selection. Aldrich holds that these occur 'within all social units and across all levels of analysis' (p. 40). In view of the above evaluation, which suggests that Aldrich's account points to selection only at multiple levels, it is fitting that we now consider how each of these principles are employed by Aldrich.

Variation, Retention and Selection 'Across Levels'

Aldrich's assertion that variation, retention and selection occur within all social units and across all levels of analysis, appears, at a superficial level, to stand up. There is a sense in which the evolutionary theory applies to multiple levels. However, as indicated above, from a modern Darwinian perspective this assertion is problematic, and even from an examination of the text, Aldrich does not appear to follow the assertion through. Although he spends time in Chapter 2 (pp. 23-33) describing the incidence of variation, retention, selection and struggle at each level, fleshing this out with empirical studies, he does not adequately explain how the mechanisms operate at each level, either here or in subsequent Chapters. Indeed, in keeping with the above analysis of multilevel selection, on close examination, what we find is that we are talking about outcomes at these higher levels which are caused by the initial operation of these interweaving causal processes at the level of the organization.

This is a very subtle point. It is true that Aldrich identifies variation, retention, selection and struggle at each level, but most significantly, the actual entity being discussed comes from a lower level. When we look, for example, at his description of retention at the level of the organization and population, we see that Aldrich continues to talk about retention of the routine or competence – the primary entity; he is *not* talking about retention of the organization (p. 30);

> At the population level, retention preserves the technological and managerial competence that all organizations use, collectively, to exploit the resources of their environments.

We can see the same causal story when he talks about selection processes occurring at organizational and population level, he is again referring us 'back' to routines (p. 28);

> At the organizational level, organizations founded through maladaptive variations in technology, managerial incompetence, non-conforming normative orders, or other problematic acts are likely to draw fewer resources from their environments and therefore are more likely to decline in performance.

Again, in the word 'characteristics,' below, in his description of variation at the organizational and population level, we can perceive the enduring entity as being the routine or competence (p. 25);

> Variations are potentially introduced into populations and communities whenever new organizations are founded. Intentions play a pivotal role in the goal-directed activities involved in organizational foundings … Most founders apparently intend to reproduce the characteristics of organizations perceived as successful.

It is misleading, I would argue, to suggest that these core processes occur at all levels, and it compromises his analysis. It would be far less confusing to say that *selection* occurs at all levels, which is, after all, what his argument implies. The point is, to claim that variation, retention and selection all occur at multiple levels logically implies that at the social level there are multiple replicators as well as multiple interactors. However, as Hull explains, the replicator-interactor relationship is a 'one and many relationship', with replication concentrated at the primary level and interaction at multiple ascending levels (1980, p. 324). Indeed, in spite of Aldrich's suggestions to the contrary, this is implicit in his own analysis above, and throughout the text, where the organization (and sometimes the entrepreneur) is the primary interacting entity, and the routine is the only entity that is referred to in terms of preservation, or in the evolutionary sense of replication. Accordingly, in every case, Aldrich refers to the routine being replicated throughout the hierarchy. In other words, organizations are not replicators and populations are not replicators, they are always interactors. So, what does this say about his Darwinian theory?

At this stage it is clear that the anomalies around units and levels can be put down to semantics. It is evident that Aldrich supposes the replicator and interactor dynamic,[136] and it is also evident that the 'dual-natured' organization is his central unit of analysis (p. 5), and furthermore that he proposes multilevel selection. Retention is associated throughout with the 'primary level' routine and variation is apparent at every level of the hierarchy where selection is operational. Referring back to the multilevel analysis in Chapter 7, we can see that Aldrich implicitly promotes position V, the multilevel replicator and multilevel interactor position. Thus in modern Darwinian terms, in a multilevel continuum from the biotic (where genes are the replicators) to the social sphere, Aldrich is describing selection *of* the population, the organization and the entrepreneur, and consequently, selection *for* the routine, and ultimately, selection *for* the gene.[137]

Thus, significantly, the approach, implicitly at least, appears to be consistent with current evolutionary thinking and is thus viable in the modern Darwinian formulation. In addition to the replicator-interactor dynamic of the unit of selection, Aldrich employs the traditional principles of variation, retention and selection *within* a multileveled selection framework.

It should be stressed however, that the concept of multilevel selection, remains underdeveloped in evolutionary biology, thus the problems highlighted, in the above two sections, are not in the least bit unexpected. The interesting thing to observe, nonetheless, from a Darwinian perspective, is the impetus for the creative theoretical and empirical exploration of multilevel selection in the socio-economic domain. Aldrich, as we have seen, has made a credible job of establishing the existence of multiple levels of selection in the socio-economic realm, and provided a useful platform for further theoretical research.

Moreover, as part of his broad application of Darwinian principles, we recall that Aldrich also seeks to explain emergence and intra-group dynamics in the same terms. Again these evolutionary dynamics are still not yet well understood, so that it is instructive to observe how close Aldrich is to current thinking in his exploration of these processes (Keller, 1999). Accordingly, in the following assessment of Aldrich's explanation of emergence I shall expand on the suggestion here that he is unwittingly

[136] See Aldrich (1999, pp. 2-5), where he defines the organization as 'goal-directed, boundary-maintaining, and socially constructed systems of human activity', and where he unpacks its 'three dimensions' to reveal that the 'activity systems' dimension explicitly refers to the routines component.

[137] See footnote 98 above (p. 156). Also Aldrich's quotation below (p. 208)

suggesting an interactor role for entrepreneurs, and show how his treatment of this entity also informs his conceptualization of intra-group group dynamics.

Emergence and Intra-Group Dynamics

The main theme of Aldrich's book according to most reviewers is 'emergence' (Buenger, 2000; Strang, 2002; Wade, 2002; Rao, 2002). Although Buenger, at least, concedes that, 'at a very high level, *Organizations Evolving* is about variation, selection and retention' (2000, p. 1003). Certainly, as argued in the preceding section, it would appear that the variation, retention and selection trinity is underplayed by Aldrich. However, as I have also argued in his defence, Aldrich's adoption of these principles is perhaps more intuitive and nuanced than we are led to expect. Indeed, through a generous Darwinian lens, sharply focused with the generalized Darwinian terminology, their application *can* be perceived 'across levels' and include, not only his process of emergence but also his key individual, the 'nascent entrepreneur'. I aim to demonstrate here how Aldrich's multilevel selection approach, with its focus on selection, does not diminish the processes of variety creation and retention but implicitly tends to focus their respective roles at *these* primary generative levels. This is not a claim that Aldrich himself makes, but, as suggested, it may be interpreted this way from a modern Darwinian perspective.

Before pursuing the above exposition it would be useful here to reiterate that there are two senses in which Aldrich employs the term 'emergence'. The first is explicit and relates to organizational births and foundings and is simply Aldrich's preferred term to describe what he sees as a process as opposed to an event. The second sense in which Aldrich uses emergence is more implicit and relates to the philosophical notion of 'emergent properties.'[138] It is this second sense, where Aldrich treats higher level entities as emerging from lower level entities in the organizational hierarchy, that tends to be assumed in his analysis, and it is this sense of emergence that we shall be focusing upon here.

[138] Hodgson (2004, p. 32) 'A property may be said to be emergent if its existence and nature depend upon entities at a lower level, but the property is neither reducible to, nor predictable from, properties of entities found at the lower level.'

The 'Emergentist' Focus

Emergence in this second sense of emergent properties is evidently a key theme for Aldrich. He devotes whole Chapters to the 'emergence of new organizations', the 'emergence of communities of practice' and the 'emergence of new populations of organizations' respectively. And he explains that he uses the generic framework of the evolutionary approach to 'portray how new organizations emerge as people mobilize resources in pursuit of opportunities' (p. 2).

Indeed, the structure of the book, as Aldrich acknowledges (2000), reflects his "'emergentist focus" – communities are built on populations, which are built on organizations, which emerge from the actions of entrepreneurs'. It would seem that there are essentially two intertwined agendas, one being the explanation of evolution at multiple levels and the other being the explanation of emergence ('births') at multiple levels.

Aldrich's treatment of emergence is undoubtedly informed by evolutionary theory, but it needs a little unpacking. It involves the entrepreneur, the notion of 'boundary formation' and the question of 'the conditions under which organizations emerge and coalesce as social units' (p. 14), all of which call on the Darwinian selection process. Drawing on network analysis, social psychology and cognitive psychology, to explain how the founding process unfolds, Aldrich portrays the entrepreneur as being subject to strong selection forces at the interpersonal, the population and the cultural level (again indicating the notion of multiple interactors). He describes the process below, after the entrepreneur survives the initial selection process (p. 112);

> If, in spite of all the odds, all the elements in the founding process converge, an organization begins to take shape. As the people dealing with the organization begin to treat it as an ecological entity, the new organization emerges as a social unit with a life of its own. Founders make commitments in the name of the new entity, deal with government agencies as a representative of it, and find that people act toward the organization as if it really exists.

Group Selection

Although Aldrich makes no explicit reference to the notion of group selection it is interesting to perceive the implicit application above of the logic of Price's (1970, 1972) partitioned selection, as recently expressed by Henrich (2004) in his description of selection acting on intra-group and inter-group variation and resulting in organizational

emergence.[139] Notably, in accordance with this, whilst Aldrich states that variation, retention and selection apply across all levels (to include the process of emergence), it is essentially the selection process that he calls upon for his explanatory device. Basically, for Aldrich, emergence, or the founding process, is shaped by selection forces acting upon individuals.[140] Accordingly, anticipating Henrich, at an empirical as well as a theoretical level, Aldrich explores the conditions under which group selection then dominates individual selection to ultimately produce a new entity, the founding firm.

To reiterate, Aldrich essentially describes a selection process at the level of the entrepreneur which is associated with the selection of new or newly combined routines.[141] Once an organization is derived from the selection process occurring at this lower level, partitioned selection acts such that selection becomes more relevant at the organizational level. In other words, within organization variety (various routines) will be dominated by the between-organization variety (all the organizations in the relevant industry) as selection operates upon organizations.

Organizational Boundaries and Social Replicators

A very important aspect of this explanation of organizational emergence for Aldrich, and which, significantly, is again consistent with the modern Darwinian interpretation (Henrich 2004), is the development of organizational boundaries; indeed he devotes a whole Chapter to the subject. He stresses, for example, the importance of achieving standing in a population and gaining legitimacy before the organization counts as a viable unit and is able to contribute to the population character and dynamics. He then goes on to stress the importance of boundary maintenance, which includes the stabilizing replication of successful routines. And he thus reaffirms the idea and evolutionary significance of a social replicator.[142] In the following passage it can be

[139] See Chapter 7 above

[140] Or, as otherwise expressed (Aldrich and Martinez, 2003), entrepreneurship is an 'evolutionary process of social construction'.

[141] Indeed Aldrich's treatment of the entrepreneur, within this multilevel perspective, maps very neatly onto a habit-based view of action, where in a multivariate population of habit-driven entrepreneurs it is adaptation and selection processes that account for evolutionary change. There is, of course, the classical or Austrian view of entrepreneurship, which tends to depict entrepreneurs as spontaneously generated, and the extent to which this is compatible with a habit-based view of action is still open to question. For example, would they be seen as 'random mutations' or just another set of habits? Aldrich's discussion of entrepreneurs mostly suggests the latter.

[142] (p. 3) "Boundary-maintaining … The establishment of an organization implies a distinction between members and non-members, thus setting organizations off from their environments (Weber, 1947). Boundaries may be permeable. Thus, maintaining this distinction requires boundary-maintenance activity. Many organizations establish an authoritative process to enforce membership distinctions … "

seen how he links this process of emergence with the evolutionary process of change in organizations in one long continuum, illustrating his expressed desire (p. 1) to link the important questions of the origins and the persistence of organizations (p. 113);

> A true test of the knowledge and resources assembled by founders occurs when an organization achieves standing as a population member … Organizations contribute to population dynamics only after they become fully fledged units of selection. As bounded entities, they become actors that compete and cooperate with others … [A]fter boundaries coalesce and activities begin, organizations become viable carriers of routines and competencies. They thus contribute to the reproduction of population-level knowledge and become point of knowledge diffusion. As new entities, they are potential sources of variation within populations … [A]fter it emerges as an entity, an organization becomes another arena in which new routines and competencies can be generated, nurtured, and possibly copied by others. Every new organizational entity represents another test of an organizational form's fit with its environment, as well as an opportunity to modify the form.

Significantly, through Aldrich's work on organizational origins or emergence, he has considerably advanced the development of evolutionary theory for business economics and organization studies. By extending evolutionary theory to the process of emergence he offers a more comprehensive explanatory framework which moves beyond the traditional organizations' focus on structure and stability and embraces the processes involved in emergence and change (notably indicating the role of the replictor). In Nelson and Winter's (1982) account, firms were depicted as growing and contracting but their origins or initiations were never addressed. Similarly, while Hannan and Freeman's (1989) approach is characterized by their interest in founding *rates*, this is not matched by any exploration of the processes involved in the actual founding of an organization.

Group Selection and Dynamics *Between* Levels

At this juncture it is clear that in his exploration of emergence at the organizational, population and community levels, Aldrich is looking at the dynamics *between* levels. But whilst his empirical illustrations of these processes are plentiful, as, for example, with the recruiting practices and reward systems used by founders to help establish organizations as a bounded entity, it must be said the theoretical underpinnings are still

---

Hence, in indicating that there is something *for* which the organization or the group is selected Aldrich implicitly promotes the notion of a social replicator.

at an exploratory stage. Significantly however, Aldrich's research agenda nevertheless shows dramatic potential, in that it mirrors very recent developments in evolutionary theory in both the natural and social sciences (Keller, 1999; Pepper, 2003; Henrich, 2004; Knudsen, 2002, 2004; Hodgson and Knudsen, 2004b, 2006a), and I would argue that this bodes well for theory development in both fields. Aldrich clearly prioritizes emergence and the formation of individual organizations. He is also keen to look at the dynamics between the different levels of selection and at how selection effects are distributed across levels. And, as can be seen from Keller's comments below, Aldrich, in these senses, is effectively well ahead of the game in the social domain (1999, p. 7);

> The current theoretical excitement in theoretical and empirical research in multilevel selection centres on the two problems set forth … namely (1) how natural selection among lower-level biological vehicles[143] creates higher-level vehicles, [and] (2) given that multiple levels of vehicles exist, how natural selection at one level affects selection at lower or higher levels.

Indeed significantly, as indicated earlier, the questions that Keller and Aldrich pose for themselves, as well as the character of their respective explorations, intriguingly call to mind Henrich's (2004) eloquent explanation of the formation of groups under Prices' partitioned selection forces. Note for example, Keller's further speculations below;

> What attractive evolutionary forces bind low-level vehicles (i.e., vehicles nearly at the same level as the replicators themselves), like physical stretches of DNA (replicators being the genetic information encoded in such stretches), chromosomes, and cells, into intermediate-level vehicles, like multicellular organisms? Under what conditions do these attractive forces exceed the repulsive and centrifugal forces and under what conditions do they not?

As indicated above, Aldrich evidently begins to address these problems in the social domain by drawing on an extensive literature in organization science, and by exploring the tension between competition and cooperation at each level, and it is significant that he recognizes the role of the replicator (115);

[143] Notice that Keller adopts Dawkin's term 'vehicle', which was subsequently replaced by Hull's 'interactor' concept, with Dawkin's approval. Keller's use of the term merely reflects a personal preference for this label, and it is clear in his work that he uses it alongside the replicator concept in accordance with Hull's definitions.

> Given the large-scale boundary crossings occurring each day, what holds organizations together?...If intentions, resources, and boundaries converge an entrepreneur's activities take on sufficient coherence so that the people dealing with the organization began to treat it as an ecological entity, a social unit with a life of its own. Welborne and Andrews (1996: 896) used the term structural cohesion to refer to "an employee-generated synergy that propels a company forward". Emergence as a recognized entity secures a tentative place for an organization in a population, but its persistence depends upon the continual replication of its routines and competence.

Darwinian Logic and the Social Replicator

To be sure, this is the sense in which I argue that Aldrich promotes a unifying schema which intuitively follows in the footsteps of recent theoretical advances in evolutionary theory. As evidenced in the above passage, in the way that he links the process of emergence with the process of replication (routines), Aldrich's analysis extends beyond the evolution of organizations and industry, to the *formation* of organizations *and* their inter-organizational and intra-organizational dynamics. There is a consistent Darwinian logic to the meta-theoretical structure that he proposes, with, for example, the process of emergence corresponding with the internal dynamics of organizations and their own evolution.

Indeed, Aldrich displays an uncanny sense for the critical theoretical issues involved in evolutionary theory, even if he fails to articulate them as such. His coverage of the issue of boundary establishment and maintenance clearly illustrates the point. As Henrich (2002, 2004) made clear regarding the question of what it is that maintains variety between groups and dilutes variety within groups, there must be some kind of social constraint on within-group variety that ultimately serves to sustain the group. Henrich talks about 'prosociality', Boyd and Richerson suggest (1985) 'conformist transmission', Nunney (1990) suggests 'policing mechanisms' and Wilson (2002) recently proffered 'religious beliefs'. From this logic we can derive the notion of a social replicator (Hull, 1988; Hodgson and Knudsen, 2004b). Significantly Aldrich seems to assume social constraints throughout his theory in relation to both existing and emerging organizations. His comments in the passage below are typical of this stance (p. 125);

> If dissimilarities are discovered of such a magnitude as to make members uncomfortable, the most dissimilar will be encouraged to leave. "Over time, these

> processes create psychologically homogeneous work groups" (Jackson et al., 1991: 676; See also George, 1990; and Moreland and Levine, 1982). However, the high salience of task demands in *emerging* organizations may partially offset the effects of dissimilarity. Members who are totally engrossed in their tasks may be willing to tolerate dissimilar others, thus sustaining a potential source of organizational variability.

As noted by Keller above, like multilevel selection theory, the theoretical development of inter-group dynamics in evolutionary theory is still very much at the infancy stage. For our purposes here it is nevertheless pertinent to illustrate the important development of Aldrich's thinking in this regard, to signal both the broad scope of his evolutionary analysis as well as its potential as a unified schema. Pepper (2003), below, confirms the significance of such theoretical explorations;

> Standard evolutionary theory is based on selection among individuals, but during a transition the very quality of 'individuality' shifts from one level of organization to another. The theory of multilevel selection provides a powerful tool for investigating the dynamics that cause the focus of selection to shift to a higher level, thereby producing new levels of adaptation and functional integration.

The prospect of a unifying schema brings the discussion to the last important evolutionary component in Aldrich's theory. This is the entrenched idea in organization studies, notably rejected by Hannan and Freeman but nevertheless proven useful to scholars concerned with explaining change at the organization level, that is ,the idea of adaptive change. Arguably, it is through this element of Aldrich's theory that he most clearly recognizes the causal influence of organizational routines, and thus crucially demonstrates his rejection of the adaptationist versus selectionist polarization of evolutionary theory.

Selection *and* Adaptation

Significantly, mirroring the modern conceptualization of Darwinian theory and addressing the clarion call for resolution of the 'adaptation versus selection' controversy Aldrich's evolutionary model clearly accommodates 'adaptationist' forms of change. This is assumed in his fourth evolutionary principle, in what he calls, the principle of 'struggle' and it is indicated in his multilevel selection approach. Where Hannan and Freeman essentially reject the idea that firms adapt to their environments, effectively

dismissing the suggestion that firms 'learn' or that managers make consequential choices, Aldrich embraces firm-level dynamics as an important part of the evolutionary explanatory framework. This crucial component of Aldrich's theory is implicated in the discussion above on intra-organizational dynamics and is neatly summarized by Dobbin (2001, p. 1522), below;

> [Aldrich] sees the struggle between rival strategies within organizations as determined by evolutionary forces, to be sure, but he sees organizations as inherently dynamic and as constantly looking to the environment for new routines and strategies to embrace … It is key that proponents of particular organizational routines, managers of particular organizations, and entire populations of organizations actively fight to prevail and that in doing so they adjust their strategies.

It is suggested here that Aldrich's fourth principle of 'struggle' essentially represents the within-organization process of change that has traditionally been referred to in the organizations literature as adaptive or 'Lamarckian' change. Despite the fact that Aldrich does not even mention Lamarck, or the adaptationist perspective with which the later is associated, his evolutionary account undoubtedly incorporates this important form of change. Indeed it is implicit throughout his work, and it is encapsulated in the concept of 'struggle'.

This is a subtle but significant step. Aldrich has effectively managed to surpass the long running 'Lamarckism versus Darwinism' debate, which divides over whether adaptation (organization-level dynamics) should be considered as the overriding evolutionary force in the social realm or the selection process. Because of his generalized Darwinian approach he has made it possible to encapsulate both, reinforcing the view that adaptation and selection play complementary and interrelated roles in the evolutionary process (Burgelman, 1991; Levinthal, 1991; Bruderer and Singh, 1996; Hodgson, 2001b; Knudsen, 2001; Metcalfe, 2003, 2004). Aldrich is thus the first of the case studies to bridge this important theoretical divide, effectively paving the way for the resolution of the infamous 'adaptation versus selection' debate. Interestingly, this development is again consistent with theoretical advances in evolutionary theory where, it has been shown that Lamarckism (adaptation) 'nests' in the Darwinian theoretical framework (Hodgson, 2001b; Knudsen, 2001).

Through his fourth principle of 'struggle', Aldrich clearly accounts for the adaptive behaviour of organizations as they adjust to changing political and economic environments. Struggle over scarce resources involves continuous negotiation and

contemplation of rival strategies as organizations compete with each other. Moreover, within his multileveled approach, as understood here, it can be seen how struggle can be equated with the internal selection process at the organizational level. This is an intriguing discovery, for while it may appear to duplicate certain assumptions adopted by Nelson and Winter, which caused them problems, it actually offers a notable advance on their position in terms of conceptual clarifications and tractability. Nelson and Winter sought to convey the idea of firms adapting to their environments through a similar concept of 'search'. Similarly expressed in terms of the organization's deliberate attempts to seek out better routines and change accordingly, they portrayed this in the traditional Lamarckian sense of adaptive change. However, search becomes confused in their theory with the selection process; in an account which is essentially unclear about the level at which selection operates.

Aldrich, on the other hand, does not constrain his theory by labelling it, or indeed even associating it with Lamarckism. However, he still manages to incorporate the important firm-level adaptation within his Darwinian framework, through this fourth principle of struggle. As suggested here, this effectively amounts to a selection process at the organizational level and it is consistent with his account of multiple levels of selection. Accordingly it could be said that Aldrich advances Nelson and Winter's position in that he circuitously provides a less complicated foundation for an adaptationist account nesting within a Darwinian selectionist framework. In other words, adaptive behaviour, which is expressed in Nelson and Winter's search mechanism, equates with Aldrich's principle of struggle which in turn equates with another level of selection. Moreover, perhaps more dramatically, Aldrich significantly advances the ecological perspective by enabling the reintroduction of firm level dynamics to the evolutionary story.

Conclusion: The Complete Darwinian Account?

> If population ecology theory was more or less fixed at birth, like the organizations it describes, Aldrich's evolutionary theory has mutated to add the best characteristics of rival theories, like the organizations he describes.
>
> Dobbin (2001)

Aldrich evidently embraces evolutionary theory as a Meta theory, and in his use of key insights from numerous organization theories he clearly demonstrates the belief 'that the evolutionary approach serves as an overarching framework within which the value of other approaches can be recognized and appreciated' (p.42). To be sure, a close reading

of Aldrich from a modern Darwinian perspective reveals a comprehensive evolutionary approach with considerable potential. It builds on and advances the theoretical achievements of both Hannan and Freeman and Nelson and Winter, effectively merging the ecological with the evolutionary approach and crucially establishing for organization theory that ‘Lamarckian adaptation’ and ‘Darwinian selection’ play important and complementary roles in socio-economic evolution. In addition, Aldrich uniquely posits emergence as another important source of variety, significantly thereby enriching understanding of diversity in organization theory. Together with his implicit acknowledgement of the replicator and interactor distinction, and assured inclusion of multilevel selection theory Aldrich has thus laid the foundations of a comprehensive and tractable evolutionary theory of organizational change.

Part IV

Conclusion

> Nothing I have said is intrinsically a matter of biological analogy, it is a matter of evolutionary logic. Evolutionary theory is a manner of reasoning in its own right quite independently of the use made of it by biologist. They simply got there first …
>
> J. Stanley Metcalfe (1998)

11 Conclusion

The Destiny of the Darwinian Paradigm in Socio-Economic Theories of Evolution

Introduction

In a recent paper which surveyed earlier attempts to apply the Darwinian model to socio-cultural phenomena,[144] Hodgson (2005, p. 11) observed the absence of rigorous definitions of the core Darwinian concepts, as well as the absence of a distinction between the unit being selected (interactor) and the entities that replicate differentially (replicators) as a result of selection. Through the detailed evaluation here of leading contemporary evolutionary accounts and consideration of the use of Darwinian ideas across the organization studies and evolutionary economics literatures it is now possible to reflect upon the more recent developments of Darwinism in the socio-economic domain and to make a useful corresponding assessment of the emerging Darwinian paradigm. While research shows that rigorous definitions have still yet to be established and that the critical replicator-interactor distinction is still not widely appreciated it also reveals that on several fronts scholars are nevertheless unquestionably advancing in this direction.

As demonstrated through the systematic Darwinian application and dissection of the case studies above, regardless of their notable differences or how they might be labelled, a strong Darwinian thread runs through each of these accounts. And significantly, some kind of replicating entity is assumed in every case and there is clear acknowledgement of the replicator-interactor distinction in two of the three theories. Furthermore, as has been documented, the treatment of the Darwinian model by these influential authors is representative of the main strands of evolutionary thought across their respective disciplines. And finally these developments have notably been complemented by important work on the refinement of concepts and investigation of what entities might count as replicators and interactors in the social arena. Indeed the

[144] For example, the work of Bagehot (1872), Ritchie (1889), Veblen (1898), Baldwin (1909) and Keller (1915)

combined evidence suggests that 'the possibility of a Darwinian and evolutionary social science is now in prospect' (Hodgson, 2005, p. 12).

Significantly, evidence here suggests that as well as notable improvements in the quality of Darwinian theorizing there has also been a marked increase in the amount of adoption of Darwinian ideas by social scientists, thus underpinning the argument set out in Chapters 2 and 3 about the ontological assumptions of evolutionary economists and organization scholars, and the inevitability of the Darwinian model for their respective disciplines. What this comparative analysis has clearly shown, is that even 'non-Darwinians', through their own theoretical and empirical investigations, invariably end up drawing on the explanatory logic of Darwinian theory; whether they recognize it or not. Indeed, one key development to be revealed in this investigation of the explosion of evolutionary rhetoric is the underlying explosion of 'Darwinian thinking' on the part of theorists.

Certainly one of the main aims of this thesis has been to demonstrate the prevalence of 'covert Darwinism' in the organization studies and evolutionary economics literatures, but following on from this, it has also been to evaluate the important implications of this for socio-economic theories of evolution, and ultimately to demonstrate why it is important that scholars explicitly recognize and adopt the Darwinian concepts. Essentially, as has been evidenced here, whilst covert Darwinism basically suggests agreement with the modern Darwinian paradigm, significantly it also typically signals incomplete understanding of the theory. As detailed evaluation of the case-studies has shown, the Darwinian concepts have crucial importance for helping scholars understand and articulate the evolutionary processes they seek to explain. The explicit adoption, for example, of the replicator-interactor concepts offers immediate clarification about the complex evolutionary selection process, with the types of social entities that might be identified as the interacting unit of selection (firm) helpfully separated out from the entities that might function as the enduring social replicators (organizational routines). Clearly, firm foundations for rigorous definitions now exist and it is quite evident that the Darwinian system has potential for yielding further results in the socio-cultural realm, both theoretically and empirically. Thus it is plainly commonsensical that social scientists become familiar with and actively engage with the theory.

Darwinian Substance

Significantly, both implicitly and explicitly the theories of Nelson and Winter, Hannan and Freeman, and Howard Aldrich, all reinforce the Darwinian imperative, exemplify the intuitive development towards the modern Darwinian framework, and affirm a Darwinian social ontology. For example, the important foundational assumptions and basic Darwinian ingredients are all present, the Darwinian population thinking perspective and distinctive role of variety is apparent in every case as well as the distinctive Darwinian selection process. And an inheritance mechanism, if not explicitly articulated (Hannan and Freeman, 1989) is at least assumed.

Regarding the modern expression of generalized Darwinism, the notion of group selection is invoked in the collective entity of the firm (or organization) and significantly, this is then treated as the 'primary interactor' and unit of selection in the respective selection processes. Moreover, in the accounts of Nelson and Winter and Howard Aldrich, there are clear depictions of the replicator-interactor distinction. Furthermore, implicit in the group selection assumption, and variously expressed by the authors, is the idea of multilevel selection. Indeed, as demonstrated in the respective Chapters, although variously interpreted, and with different degrees of emphasis, foundational Darwinian ideas are present in each of these prominent accounts and Darwinian entities and processes are clearly implicated in the social domain. There is, in other words, a decided shift from analogy to ontology. Assuredly, there is no doubting the Darwinian substance to these theories, or the receptive soil for its modern articulation.

Covert Darwinism

This study has identified a covert Darwinism, illustrating not only the schizophrenic relationship that social scientists have with Darwinism, but also endorsing the explanatory power and unavoidability of Darwinian ideas. Undoubtedly, as discussed in Chapter 2, the way that Darwinian ideas are used by scholars tells its own story about perceptions and understanding of the theory. It has been argued here that the widespread implicit use of Darwinian ideas is largely due to the rhetoric of 'Social Darwinism' and the acute hostility to all intellectual intercourse with biology. Significantly, the fear of association with Social Darwinism has not only led to the 'covert' use of its ideas, but crucially it has prevented social scientists from actively engaging with the modern

developments of the theory, and fuelled continuing misconceptions about its nature and scope.

Essentially, the implicit use of Darwinian ideas fundamentally reinforces the generic nature of the theory and its appropriateness for the social domain, and moreover it reflects the Darwinian nature of evolutionary phenomena under study. Indeed, to underline the point, it has been shown here that in addition to a 'knowing' implicit Darwinism,[145] the literature also reveals an 'unknowing' implicit Darwinism where scholars inadvertently or intuitively grapple towards the general Darwinian model, 'discovering', for example, the logic of the population thinking perspective, or realizing in the complexities of the selection process the notion of an enduring 'gene-like' replicating entity. Essentially Darwinian entities and processes emerge and the Darwinian perspective becomes inevitable. Accordingly, as has also been demonstrated here, it is important, for the tractability of their theories, that scholars recognize this, take the next step, and explicitly adopt the clarifying concepts of generalized Darwinism.

Explicit Adoption of Darwinism

Through the systematic dissection of these case studies and illustration of their various gaps and inconsistencies, it has been shown here that the generalized Darwinian concepts have an importance for constructing tractable theories and helping scholars understand the evolutionary processes they seek to explain. The main challenge to their productive exploitation, however, continues to be the lack of engagement with Darwinian theory. As observed by many commentators and illustrated here in detail, evolutionary theory has been changing far more than people realize; its generic character now clearly articulated through the generalized concepts, and major objections to Darwinism and associated misconceptions all satisfactorily addressed. Indeed, as previously argued, it is time for the 'Berlin Wall' to come down and for social scientists to become acquainted with generalized Darwinism. Significantly, even 'Darwinian' thinkers in these fields appear to be unfamiliar with the theoretical clarifications and conceptual developments that would enhance their own theories and advance the Darwinian model.

It has been shown here through the case studies that most problems in theory relate to misconceptions of evolutionary theory. Problems are typically experienced in the

[145] Where ideas are adopted but not acknowledged as Darwinian because of its negative associations

articulation of an evolutionary selection process, in the handling of continuity or inheritance in the selection process, and in the accommodation of Lamarckian inheritance therein. By unpacking the respective theories and identifying their particular conundrums, as well as revealing the extent of their Darwinian assumptions, it was possible to demonstrate how the modern Darwinian concepts unravelled the confusions and reinvigorated the theories.

Nelson and Winter, whilst labelling their theory 'Lamarckian', were clearly shown to be applying the core *Darwinian* principles and mimicking the corresponding modern Darwinian explanations. Although the analysis revealed confusions over units and levels of selection and the evolutionary role of organizational routines, it became apparent that by up-dating this Darwinian model with the modern concepts, the problems manifested in their 'search' mechanism were redeemable, yet the theory still remained consistent with the authors' evolutionary story as well as with the general Darwinian model. It was shown how their confusions could be untangled and theory 'rescued' by explicitly adopting the replicator and interactor concepts. Specifically, this was by applying the replicator-interactor distinction within a multileveled selection framework, positing their primary set of organizational routines as the first level of their organizational hierarchy, followed by their higher level strategic routines as the 'primary interactors', followed by multiple ascending levels of interactors (i.e., from the team to the group to the firm). And significantly, this is all accommodated within the meta-theoretical framework of generalized Darwinism which also accommodates Nelson and Winter's Lamarckian form of inheritance.

Whilst Hannan and Freeman claim to be Darwinian they notably play down the evolutionary significance of micro-economic change, essentially dismissing the notion of inheritance, presenting a biased selectionist account of evolutionary change and impoverishing their theory as a result. Again an incisive Darwinian analysis of their selection process revealed how their ecological account nevertheless implicitly assumed a replicating entity and would thus lend itself, through explicit adoption of the replicator concept, to further development into a more comprehensive evolutionary theory which significantly would accommodate both adaptation and selection. Moreover, their multileveled selection story would also be much more easily articulated through the complementary explicit adoption of the interactor concept.

Even in Aldrich's explicitly Darwinian and notably more modern account, the explicit adoption of the modern replicator-interactor terms was noticeably absent and their potential not exploited in the theory where they could have been most useful, for

example, in his discussion of the unit of selection problem and in his own multilevel selection theory.

Thus significantly, in terms of the explicit adoption of the Darwinian concepts, the study also reveals that even 'Darwinian' scholars fail to fully exploit the Darwinian system. And yet it is evident here that they all need generalized Darwinism to facilitate the theoretical tractability of their respective theories. As Parts II and III of this thesis elaborated, and the dissection of these pioneering case studies made clear, the meta-theoretical framework of general Darwinism is entirely appropriate for the socio-economic domain and moreover the explicit adoption of the replicator-interactor concepts are required for the clear expression of their evolutionary processes. It was shown in the Hannan and Freeman Chapter that, at the very least, some form of replicator needs to be posited in order to articulate selection processes in complex open systems such as those in the social realm. In Nelson and Winter's Chapter it was shown that in order to properly articulate inheritance, Darwinian as well as Lamarkian, a replicator-interactor distinction must be stipulated. And in this and Aldrich's Chapter it was also demonstrated how the replicator-interactor distinction is similarly required to articulate group, and indeed multilevel selection processes.

Indeed, as has been clearly and repeatedly demonstrated here, evolutionary scholars have much to gain both from the explicit recognition of the Darwinian character of their theories as well as the explicit adoption of its modern generalized concepts. As several scholars are notably already discovering, these concepts have huge importance for making sense of socio-economic evolutionary processes, providing the conceptual tools for their articulation and usefully guiding empirical research. The replicator concept is an excellent example in the way that it has provided scholars with much greater understanding of the evolutionary role of organizational routines in industrial growth and change, illustrating their role as stable information units as well as sources of new variety in selection processes. Conceptualizing the routine in terms of a replicator makes it much easier for scholars to know what they have to define and it eliminates much of the confusion about causality. To reiterate, the Darwinian system clearly has the explanatory power to generate further results in the socio-economic domain, so that it is important that work continues in this direction. And this point fittingly draws the conclusion to a close with some final comments on current and future research.

Current and Future Research

It has been asserted here that progress has been made towards the establishment of rigorous definitions of core Darwinian concepts and recognition of the replicator-interactor distinction. Whilst covert Darwinism has disguised the extent of this progress, investigation of the use of Darwinism in the socio-economic theories of evolution has nevertheless shown that social scientists are intuitively and explicitly working in this direction. Moreover, as highlighted throughout the study, other scholars are currently working on the conceptual refinement of these definitions for the social domain.

In summary, on the important question of the identity of social replicators and interactors, Hodgson and Knudsen (2004b) are exploring the suitability of habits and organizational routines as replicators, and the suitability of the firm, individuals, families, and nations as social interactors. Such exploratory work is complex and dependent on other theoretical clarifications, for example, the idea of social replicators and interactors is dependent on group selection theory and the establishment of sociality of structures, but notably important work has also been achieved here (Henrich, 2002, 2004; Boyd and Richerson, 1985) and indeed continues to be pursued (Hodgson 2005; Henrich and Boyd, 1998, 2000).

Whilst the importance of this detailed theoretical research has been identified, it is clear from this study that other broader theoretical questions also need to addressed, most pressing of which appears to be the question of the extent to which adaptation and selection shape evolutionary change in socio-economic realm. Many scholars featured here have identified the polarization of theory into adaptationist and selectionists camps as being the most important area of concern. While it has been shown here that social evolution is both Lamarckian and Darwinian, and that there is clear potential to reconcile adaptationist with selectionist accounts within the meta-Darwinian framework, it is clear that much theoretical and empirical research needs to be undertaken to bring this to fruition.

Darwinian Destiny

The important point to underline here is that Darwinism is a substrate-neutral philosophical system with general application. It embraces a basic philosophical commitment to detailed, cumulative, causal explanations of change, and its core principles of variation, inheritance and selection are general principles that govern the

evolution of all open complex systems which share fundamental ontological similarities. Given the ontological assumptions evidenced here of many evolutionary economists and organization scholars, it is clear that the Darwinian paradigm is inevitable and, as clearly demonstrated, it is indeed without alternative.

Whilst much theoretical and conceptual work clearly remains to be done, it is clear that the stage is nevertheless being set for a unified and generalized Darwinian theory of socio-cultural evolution. Accordingly the case has been made here for generalized Darwinism. By drawing together the Darwinian threads, implicit or explicit, in the case studies and elsewhere, it has been shown how a Darwinian meta-theory of evolution is emerging in the social sciences. While the rhetoric of social Darwinism has undoubtedly hindered progress in the development of an evolutionary theory of socio-cultural change, evidence here suggests that the tide is slowly turning and that the demonstrable convergence of thinking signals the inevitability of the Darwinian system for the socio-cultural realm and a decidedly 'New Age of Darwinism'. This is the Darwinian Destiny.

Bibliography

Alchian, A. A. 1950. Uncertainty, Evolution and Economic Theory. *Journal of Political Economy* 58 (2):June, 211-222.

Aldrich, H. E., and Marsden, P. V. 1988. Environments and Organizations. In *Handbook of Sociology*, edited by Smelser. Beverly Hill, CA: Sage.

Aldrich, Howard E. 1972. Organizational Boundaries and Inter-organizational Conflict. In *Human Relations*.

———. 1979. *Organizations and Environments*. Engelworth Cliffs, NJ: Prentice Hall.

———. *Reviews of Organizations Evolving, Aldrich's Response*. etss.net/evolution/reviews/organizations_evolving_aldrich.htm 2000 [cited 10th October.

———. 2004. Personal Communication, 18th January.

Aldrich, Howard E, and Martinez, Martha. 2003. Entrepreneurship as Social Construction: a Multilevel Evolutionary Approach. In *Handbook of Entrepreneurial Research*, edited by Z. C. Acs and D. B. Audretsch. Boston: Kluwer.

Aldrich, Howard E. 1999. *Organizations Evolving*. London: Sage Publications.

Aldrich, Howard E. and Pfeffer, Jeffrey. 1976. Environments of Organizations. *Annual Review of Sociology* 2:79-105.

Aldrich, Howard E., and Fiol, Marlene C. 1994. Fools Rush In? The Institutional Context of Industry Creation. *Academy of Management Review* 19 (4):645-670.

Allee, W. 1951. *Cooperation Among Animals*. New York: Henry Shulman.

Amburgey, T. L, and Rao, H. 1996. Organizational Ecology, Past, Present, and Future Directions. *Academy of Management Journal* 39 (5):1265-1286.

Amburgey, Terry. L, Kelly, Dawn, and Barnett, William P. 1990. Resetting the Clock: The Dynamics of Organizational Change and Failure. *Academy of Management Best Papers Proceedings*:160-164.

Anderson, Philip. 1999. Venture Capital Dynamics and the Creation of Variation Through Entrepreneurship. In *Variations in Organization Science: In Honour of Donald T Campbell*, edited by J. A. C. Baum and B. McKelvey. Thousand Oaks: California: Sage.

Arrow, Kenneth J. 1974. *The Limits of Organizations*. New York: Norton.

Astley, G. W., and Van de Ven, A. 1983. Central Perspectives and Debates in Organization Theory. *Administrative Science Quarterly* 28:245-273.

Astley, W. Graham. 1985. The Two Ecologies: Population and Community Perspectives on Organizational Evolution. *Administrative Science Quarterly* 30 (2):224-241.

Audretsch, David B, and Klepper, Steven, eds. 1999. *Innovation, Economics Development, and the Evolution of Industry*. Northampton: MA: Edgar Elgar.

Aunger, Robert. 2002. The Electric Meme: A New Theory of How We Think. New York: Free Press.

———, ed. 2001. *Darwinizing Culture: The Status of Memetics as a Science*. Oxford: Oxford University Press.

Axelrod, R. 1980a. Effective choice in the Prisoner's Dilemma. *Journal of Conflict Resolution* 24:3-25.

———. 1980b. More Effective Choice in the Prisoner's Dilemma. *Journal of Conflict Resolution* 24:379-403.

Azevedo, J. 1997. *Mapping Reality: An Evolutionary Realist Methodology for the Natural and Social Scientists*. Albany NY: SUNY Press.

Bagehot, Walter. 1872. *Physics and Politics, or Thoughts on the Application of the Principles of "Natural Selection" and "Inheritance" to Political Society*. London: Henry King.
Baldwin, J. M. 1896. A New Factor in Evolution. *American Naturalist* 30:441-51, 536-53.
———. 1909. *Darwin and the Humanities*. Baltimore: Review Publishing.
Bannister, Robert C. 1979. *Social Darwinism; Science and Myth in Anglo-American Social Thought*. Philadelphia: Temple University Press.
Barkow, J. H., L. Cosmides, and J. Tooby. 1992. The Adapted Mind. Oxford: Oxford University Press.
Bateson, William. 1908. *The Methods and Scope of Genetics*. Cambridge: Cambridge University Press.
———. 1909. *Mendel's Principles of Heredity*. London: Cambridge University Press.
Baum, J A C, and Oliver, C. 1996. The Institutional Ecology of Organizational Founding. *Academy of Management Journal* 39:1378-1427.
Baum, Joel A. C. 1990. Inertial and Adaptive Patterns in the Dynamics of Organizational Change. *Academy of Management Best Papers Proceedings*:165-169.
Baum, Joel A. C, ed. 2002. *The Blackwell Companion to Organizations*. Oxford: Blackwell.
Baum, Joel A. C , and Bill McKelvey. 1999. Variations in Organization Science: In Honour of Donald T. Campbell. Thousand Oaks, CA: Sage.
Baum, Joel A. C , and Singh, Jitendra V, eds. 1994a. *Evolutionary Dynamics of Organizations*. Vol. Oxford University Press. New York.
Baum, Joel A. C, and Tim J Rowley. 2002. Companion to Organizations: An Introduction. In *The Blackwell Companion to Organizations*, edited by J. A. C. Baum. Oxford: Blackwell.
Baum, Joel A. C, and Singh, Jitendra V. 1994c. Organizational Niches and the Dynamics of Organizational Mortality. *The American Journal of Sociology* 100 (2):346-380.
Baum, Joel A. C, and Singh, Jitendra V. 1994b. Organizational Hierarchies and Evolutionary Processes: Some reflections on a Theory of Organizational Evolution. In *Evolutionary Dynamics of Organizations*, edited by J. A. C. Baum and S. J. V. New York: Oxford University Press.
Becker, Markus C. 2004. Organizational Routines: A Review of the Literature. In *Industrial and Corporate Change*.
———. 2005. The Concept of Routines - Some Clarifications. *Cambridge Journal of Economics* 29 (2):249-262.
Bendall, D.S., ed. 1983. *Evolution from Molecules to Men*. Cambridge: Cambridge University Press.
Blackmore, S. 1999. *The Meme Machine*. Oxford: Oxford University Press.
Blute, Marion. 1976. Sociobiology: The New Synthesis. *Contemporary Sociology* 5 (6):727-731.
———. 1979. Sociocultural Evolutionism: An Untried Theory. *Behavioral Sciences* 24:46-59.
Bourke, A. F. G, and Franks, N. R. 1995. *Social Evolution in Ants*. Princeton, NJ: Princeton University Press.
Boyd, Robert and Richerson, Peter, J,. 1985. *Culture and the Evolutionary Process*. Chicago: University of Chicago Press.
———. 1990. Group Selection Among Alternative Evolutionarily Stable Srategies. *Journal of Theoretical Biology* 145:331-341.

———. 2005. *Not by Genes Alone: How Culture Transformed Human Evolution*. Chicago: University of Chicago Press.
Brandon, R. N., and Burian, R. M, eds. 1984. *Genes, Organisms, Populations: Controversies over the Units of Selection*. Cambridge, Mass.: MIT Press.
Brandon, Robert N. 1990. *Adaptation and Environment*. Priceton, New Jersey: Princeton University Press.
Brandon, Robert N. 1982. The Levels of Selection. Paper read at Philosophy of Science Assoication, at East Lansing.
———. 1986. Review article: The Nature of Selection: Evolutionary Theory in Philosophical Focus by Elliott Sober. *The Philosophical Review* 95 (4):614-617.
———. 1996. *Concepts and Models in Evolutionary Biology*. Edited by M. Ruse, *Cambridge Studies in Philosophy and Biology*. Cambridge, England: Cambridge University Press.
———. 1999. The Units of Selection Revisited: The Modules of Selection. *Biology and Philosophy* 14 (2):167-180.
Brown, Janet. 1995. *Charles Darwin: Voyaging*. vol 1. London: Pimlico.
Bruderer, Erhard, and Jitendra V Singh. 1996. Organizational Evolution, Learning and Selection: A Genetic-Algorithm-Based Model. *Academy of Management Journal* 39 (5):1322-1349.
Burgelman, Robert A. 1991. Intraorganizational Ecology of Strategy Making and Organizational Adaptation: Theory and Field Research. In *Organization Science*.
———. 1994. Fading Memories: Strategic Business Exit in Dynamic Environments. In *Administrative Science Quarterly*.
Burgelman, Robert A., and Brian S. Mittman. 1994. An Intraorganizational Ecological Perspective on Managerial Risk Behavior, Performance, and Survival: Individual, Organizational, and Environmental Effects. In *Evolutionary Dynamics of Organizations*, edited by J. A. C. Baum and J. V. Singh. New York: Oxford University Press.
Burns, Tom, Stalker, G. M. 1961. *The Management of Innovation*. London: Tavistock.
Burt, Ronald S. 1992. Organizational Ecology Book Review. *The American Journal of Sociology* 97 (4):1175-1177.
Campbell, D. T. 1958. Common Fate, Similarity and Other Indices of the Status of Aggregates of Persons and Social Entities. *Behavioral Science* 31 (1):14-25.
Campbell, D. T. 1965. Variation and Selective Retention in Sociocultural Evolution. In *Social Change in Developing Areas: A Reinterpretation of Evolutionary Theory*, edited by Barringer et al. Cambridge: Schenkman Press.
———. 1969. Variation and Selective Retention in Socio-Cultural Evolution. *General Systems* 16:69-85.
———. 1974. Evolutionary Epistemology. In *The Philosophy of Karl Popper (Vol. 14, I & II). The Library of Living Philosophers*, edited by P. A. Schilpp. La Salle, III: Open Court, pp. 413-63.
———. 1977. Comment on Robert J. Richard's 'The Natural Selection Model of Conceptual Evolution. *Philosophy of Science* 44:502-507.
———. 1982. The 'Blind-Variation-and-Selective-Retention' Theme. In *The Cognitive-Developmental Psychology of James Mark Baldwin: Current Theory and Research in Genetic Epistemology*, edited by J. M. Broughton and D. J. Freeman-Moir. Norwood, NJ: Ablex Publishing.
Carroll, G, and Hannan, M. 2000. *The Demography of Corporations and Industries*. Princeton: Princeton Univeristy Press.
Carroll, Glenn, and Hannan, Michael T. 1999. *The Demography of Corporations and Industry*. Princeton N.J.: Princeton University Press.
Carroll, Glenn R. 1984. Organizational Ecology. *Annual Review of Sociology* 10:71-93.

———. 1987. Publish and Perish: The Organizational Ecology of Newspaper Industries. Greenwich, Conn.: JAI Press.
———, ed. 1988. *Ecological Models of Organizations*. Cambridge, Mass.: Ballinger.
Carroll, Glenn R., and Jacques Delacroix. 1982. Organizational Mortality in the Newspaper Industries of Argentina and Ireland: An Ecological Approach. In *Administrative Science Quarterly*.
Carroll, Glenn R., and Hannan, Michael T. 1989. Density Dependence in the Evolution of Populations of Newspaper Organizations. *American Sociological Review* 54 (4):524-541.
Child, John. 1972. Organizational Structure, Environment and Performance: The Role of Strategic Choice. *Sociol.,* 6:1-22.
Clark, Norman, and Juma, Calestous. 1988. Evolutionary Theories in Economic Thought. In *Technical Change and Economic Theory*, edited by G. Dosi, J. Freeman, R. Nelson, G. Silverberg and L. L. G. Soete. London: Pinter.
Cohen, Michael D, and Sproull, Lee S, eds. 1996. *Organizational Learning*. London: Sage.
Coriat, Benjamin, and Dosi, Giovanni. 2002. The Institutional Embeddedness of Economic Change: An Appraisal of the 'Evolutionary' and 'Regulationist' Research Programmes. In *A Modern Reader in Institutional and Evolutionary Economics*, edited by G. M. Hodgson. Cheltenham: Edward Elgar.
Cyert, Richard M., and March, James G. 1963. *A Behavioural Theory of the Firm*. Englewood Cliffs, N.J.: Prentice-Hall.
Cziko, G. 1995. Without Miricles: Universal Selection Theory and the Second Darwinian Revolution. Cambridge MA: MIT Press.
Darwin, Charles. 1859. *On The Origin of Species by Means of Natural Selection or the Preservation of Favoured Races in the Struggle for Life.* 1st ed. Vol. 2. London: Murray.
———. 1871. *The Descent of Man*. London: Murray.
———. 1874. *The Descent of Man, and Selection in Relation to Sex*. New York: A L Burt.
———. 1975. *The Origin Of Species By Means of Natural selection Or the Preservation of Favoured Races In the Struggle For Life*. Edited by J. W. Burrow: Penguin. Original edition, 1859.
———. [1844] 1996. Letter to Leonard Horner. In *Charles Darwin's Letters: A Selection*, edited by F. Burkhardt. Cambridge: Cambridge University Press.
———, ed. [1887] 1958. *The Autobiography of Charles Darwin*. Edited by N. Barlow, *The Autobiography of Charles Darwin*. London: Collins.
Darwin, Charles with an Introduction by Ernst Mayr. 1859. *On the Origin of The Species: A Facsimile of the First Edition*. Cambridge, Massachusetts: Harvard University Press (1975).
Dawkins, Richard. 1976. *The Selfish Gene*. Oxford: Oxford University Press.
———. 1982. *The Extended Phenotype*. Oxford: Oxford University Press.
———. 1983. Universal Darwinism. In *Evolution from Molecules to Men*, edited by D. S. Bendall. Cambridge: Cambridge University Press.
———. 1986. *The Blind Watchmaker*. Harlow: Longman.
De Vries, H. 1889. *Intracellulär Pangenesis*. Jena: Gustav Fisher.
Degler, Carl N. 1991. *In Search of Human Nature: The Decline and Revival of Darwinism in American Social Thought*. New York: Oxford University Press.
Delacroix, Jacques, and Carroll, Glenn R. 1983. Organizational Foundings: An Ecological Study of the Newspaper Industries of Argentina and Ireland. In *Administrative Science Quarterly*.

Delacroix, Jacques, and Swaminathan, Anand. 1991. Cosmetic, Speculative and Adaptive Organiational Change in the California Wine Organizational Industry: A Longitudinal Study. *Administrative Science Quarterly, Ecology and Strategy* 36 (4):631-661.
Dennett, Daniel C. 1994. E Pluribus Unum? Commetary on Wilson and Sober: Group Selection. *Behavioral and Brain Sciences* 17 (4):617-618.
———. 1995. *Darwin's Dangerous Idea: Evolution and The Meanings of Life*. London: Allen Lane The Penguin Express.
———. 2000. Foreword. In *Darwinizing Culture: The Status of Memetics as a Science*, edited by R. Aunger. Oxford: Oxford University Press.
Desmond, Adrian, and Moore, James. 1991. *Darwin*. London: Michael Joseph.
Dewey, John. 1910. *The Influence of Darwin on Philosophy and Other Essays in Contemporary Philosophy*. New York: Holt.
———. 1957. *Reconstruction in Philosophy*. New York: Harper and Row.
———. 1997. *The Influence of Darwin on Philosophy and Other Essays in Contemporary Philosophy*. New York: Holt. Original edition, 1910.
Dietz, Thomas, Tom R Burns, and Frederick H Buttel. 1990. Evolutionary Theory in the Social Sciences. *Sociological Forum* 5:155-171.
Dobbin, Frank. 2001. Organizations Evolving: Review. *Social Forces* 79 (4):1521-1523.
Dobzhansky, Theodosius. 1955. *Evolution, Genetics and Man*. London: Wiley.
———. 1970. *Genetics of the Evolutionary Process*. New York: Columbia University Press.
Dosi, Giovanni. 2000. *Innovation, Organization and Economic Dynamics: Selected Essays*. Cheltenham: Edward Elgar.
Dosi, Giovanni and Malerba, Franco. 2002. Interpreting industrial dynamics twenty years after Nelson and Winter's *Evolutionary Theory of Economic Change*: a preface. *Industrial and Corporate Change* 11 (4):619-622.
Dosi, Giovanni, and Freeman, John, eds. 1988. *Technical Change and Economic Theory*. London: Pinter.
Dosi, Giovanni, Nelson, Richard R, and Winter, Sidney G, eds. 2000. *The Nature and Dynamics of Organizational Capabilities*. New York: Oxford Universitiy Press.
Dow, Sheila. 2002. Methodological Pluralism and Pluralism of Method. In *A Modern Reader in Institutional and Evolutionary Economics: Key Concepts*, edited by G. M. Hodgson. Cheltenham: Edward Elgar.
Downie, Jack. 1958. *The Competitive Process*. London: Gerald Duckworth & Co.
Dugatkin, L. A., and Reeve, H.K. 1994. Behavioral Ecology and Levels of Selection: Dissolving the Group Selection Controversy. *Advances in the study of Behavior* 23:101-133.
Durham, William H. 1991. *Coevolution: Genes, Culture, and Human Diversity*. Stanford: Stanford University Press.
Edelman, Gerald M. 1987. Neural Darwinism: The Theory of Neuronal Group Selection. New York: Basic Books.
Eldredge, N, and Salthe, S. N. 1984. Hierarchy and Evolution. *Oxford Reviews in Evolutionary Biology* 1:182-206.
Eldredge, N., and Grene, M. 1992. *Interactions: The Biological Context of Social Systems*. New York: Columbia University Press.
Eldredge, Niles. 1985. *Unfinished Synthesis: Biological Hierarchies and Modern Evolutionary Thought*. Oxford: Oxford University Press.
———. 1986. Information, Economics, and Evolution. *Annual Review of Ecology and Systematics* 17:351-369.

Ellis, Lee. 1996. A Discipline in Peril: Sociology's Future Hinges on Curing its Biophobia. *American Sociologist* 27:21-41.
Field, Alexander J. 2002. *Altruistically Inclined: The Behavioral Sciences, Evolutionary Theory, and the Origins of Reciprocity*. Edited by T. Kuran, *Economics, Cognition, and Society*. Michigan: University of Michigan Press.
———. 2004. Why Multilevel Selection Matters. *unpublished, Presented at Jena Conference on Evolutionary Concepts in Biology and Economics 2nd-4th December 2004*.
Fisher, R. A. 1958. *The Genetical Theory of Natural Selection*. 2nd ed. New York: Dover.
Foster, John. 1997. The Analytical Foundations of Evolutionary Economics: From Biological Analogy to Economic Self-Organization. *Structural Change and Economic Dynamics* 8:427-51.
Freese, Jeremy. 2001. Review of 'The Evolution of Human Sociality: A Darwinian Conflict Perspective' by Stephen K Sanderson. *Contemporary Sociology* 31 (3):358-359.
Friedman, M. 1953. The Methodology of Positive Economics. In *Essays in Positive Economics*, edited by M. Friedman. Chicago: University of Chicago Press.
Galunic, Charles D, and Weeks, John R. 2002. Intraorganizational Ecology. In *The Blackwell Companion to Organizations*, edited by J. A. C. Baum. Oxford: Blackwell.
Gasman, Daniel. 1971. *The Scientific Origins of National Socialism: Social Darwinism in Ernst Haeckel and the German Monist League*. London: Macdonald.
———. 1998. *Haeckel's Monism and the Birth of Facist Ideology*. Lang: New York.
George, Jennifer M. 1990. Personality, Affect, and Behaviour in Groups. *Journal of Applied Psychology* 75 (5):(October) 107-116.
Ghiselin, Michael T. 1969. *The Triumph of the Darwinian Method*. Berkeley and Los Angeles: University of California Press.
Gould, Stephen Jay. 1981. *The Mismeasure of Man*. New York: W W Norton.
———. 1987. An Urchin in the Storm. London: Penguin.
Gould, Stephen Jay, and Elisabeth A. Llyod. 1999. Individuality and Adaptation across Levels of Selection: How Shall we name and generalize the unit of Darwinism? *PNAS* 96 (21):11904-11909.
Haeckel, Ernst. 1874. *Anthropogenie oder Entwicklungsgeschichte des Menschen*. Leipzig: Engelmann.
Haines, Valerie A. 1992. One Long Argument: Charles Darwin and the Genesis of Modern Evolutionary Thought. *Contemporary Sociology* 21 (6):820-822.
Haldane, J. B. S. 1932. *The Causes of Evolution*. London: Longmans, Green.
Hamilton, William D. 1975. Innate Social Aptitudes of Man: An Approach from Evolutionary Genetics. In *Biosocial Anthropology*, edited by R. Fox. London: Malaby Press.
Hannan, Michael T. 1983. *Structural Inertia and Organizational Change, Tech. Rep. No 5, Organ. Stud. Sect., Inst. Math. Stud. Soc. Sci.,*. Stanford: California: Stanford University.
———. 2005. Ecologies of Organizations: Diversity and Identity. *Journal of Economic Perspectives* 19 (1):51-70.
Hannan, Michael T. and Freeman, John. 1977. The Population Ecology of Organizations. *The American Journal of Sociology* 82 (5):929-964.
———. 1984. Structural Inertia and Organizational Change. *American Sociological Review* 49:149-164.
———. 1989. *Organizational Ecology*. Cambridge:MA: Harvard University Press.

———. 1989b. Setting the Record Straight on Organizational Ecology: Rebuttal to Young. *American Journal of Sociology*.
Hannan, Michael T., Carrol, Glenn R., Dundon, Elizabeth A., and Torres, John C. 1995. Organizational Evolution in a Multinational Context: Entries of Automobile Manufacturers in Belgium, Britain, France, Germany, and Italy. In *American Sociological Review*.
Haverman, Heather A. 2000. The Future of Organizational Ecology: Forging Ties Among Paradigms. *Contemporary Sociology* 29 (3):476-486.
Hawley, Amos. 1944. Ecology and Human Ecology. *Social Forces* 22:398-405.
———. 1950. *Human Ecology: A Theory of Community Structure*. New York: Ronald.
———. 1968. Human Ecology. In *International Encylopedia of the Social Sciences*, edited by D. L. Sills. New York: Macmillan.
Hayek, F. A. 1967. Notes on the Evolution of Systems of Rules of Conduct. In *Studies in Philosophy, Politics and Economics*. London: Routledge and Kegan Paul.
———. 1982. *Law, Legislation and Liberty*. Vol. 3 Volume combined edn,. London: Routledge and Kegan Paul.
———. 1988. *The Fatal Conceit: The Errors of Socialism, Vol 1 of Collected Works of F. A. Hayek*. London: Routledge.
Henrich, Joe, and Boyd, Robert. 1998. The Evolution of Conformist Transmission and the Emergence of Between-Group Differences. *Evolution and Human Behavior* 19:215-241.
Henrich, Joseph. 2004. Cultural Group Selection, Coevolutionary Processes and Large-Scale Cooperation. *Journal of Economic Behavior & Organization* 53:3-35.
Henrich, Joseph, and Boyd, Robert. 2000. Why People Punish Defectors: Weak Conformist Transmission can Stabilize Costly Enforcement of Norms in Cooperative Dilemmas.
Heylighen, Francis, and Campbell, D. T. 1995. Selection of Organization at the Social Level: Obstacles and Facilitators of Metasystem Transitions. *World Futures: The Journal of General Evolution: Special Issue on 'The Quantum of Evolution: Toward a Theory of Metasystem Transitions'*.
Himmelfarb, Gertrude. 1959. *Darwin and the Darwinian Revolution*. London: Chatto and Windus.
Hodgson, Geoffrey M. 1993. *Economics and Evolution: Bringing Life Back into Economics*. Cambridge, UK and Ann Arbor, MI: Polity Press and University of Michigan Press.
———. 2001a. *How Economics Forgot History: The Problem of Historical Specificity in Social Science*. New York: Routledge.
———. 2001b. Is Social Evolution Lamarckian or Darwinian? In *Darwinism and Evolutionary Economics*, edited by J. Laurent and J. Nightingale. Cheltenham: Edward Elgar.
———. 2001c. Darwin, Veblen and the Problem of Causality in Economics. *History and Philosophy of the Life Sciences* 23:383-422.
———. 2002a. *A Modern Reader in Institutional and Evolutionary Economics*. Cheltenham: Edward Elgar.
———. 2002b. Darwinism in Economics: From Analogy to Ontology. *Journal of Evolutionary Economics* 12 (3):259-282.
———. 2002c. 'How Do Institutions Evolve?' Fourth International Workshop on Institutional Economics, at Great Offley, Hertfordshire, UK. 3-5 July 2002.
———. 2003. The Mystery of the Routine: The Darwinian Destiny of An Evolutionary Theory of Economic Change. *Revue Économique* 54 (2):355-84.
———. 2004a. *The Evolution of Institutional Economics: Agency Structure and Darwinism in American Institutionalism*. London: Routledge.

———. 2004b. Social Darwinism in Anglophone Academic Journals: A Contribution to the History of the Term. *Journal of Historical Sociology* 17 (4):428-63.
———. 2005. Generalizing Darwinism to Social Evolution: Some Early Attempts. *Journal of Economic Issues* 39 (4):899-914.
———. 2006. The Concept of a Routine. In *The Handbook of Organizational Routines*, edited by M. Becker: (forthcoming).
Hodgson, Geoffrey, M, and Knudsen, Thørborn. 2004a. The Firm as an Interactor: Firms as Vehicles for Habits and Routines. *Journal of Evolutionary Economics* 14 (3):281-307.
Hodgson, Geoffrey M, and Knudsen, Thorbjørn. 2004b unpublished. The Replication of Habits. *Presented at the Sixth International Workshop of the Centre for Research in Institutional Economics, Great Offley 2004*.
Hodgson, Geoffrey, M, and Knudsen, Thorbjørn. 2004c unpublished. The Nature and Units of Selection. Presented at the 'Evolutionary Concepts in Economics and Biology' workshop at the Max Planck Institute, Jena, Germany, 2-4 December 2004.
Hodgson, Geoffrey M, and Knudsen, Thorbjørn. 2006a. Why We Need a Generalized Darwinism: And Why Generalized Darwinism is Not Enough. *Journal of Economic Behavior & Organization (forthcoming)*.
———. 2006b. The Limits of Lamarckism Revisited: On the Importance of the Distinction Between Genotype and Phenotype, and Other Matters Relating to Socio-Economic Evolution. *(forthcoming)*.
Hofstadter, Richard. 1944. *Social Darwinism in American Thought, 1860-1915*. 1st ed. Philadelphia: University of Pennsylvania Press.
Hull, David, L. 1980. Individuality and Selection. *Annual Review of Ecology and Systematics* 11:311-332.
———. 1981. The Units of Evolution: A Metaphysical Essay. In *The Philosophy of Evolution*, edited by U. J. Jensen and R. Harré. Brighton: Harvester Press.
———. 1982. The Naked Meme. In *Learning, Development and Culture: Essays in Evolutionary Epistemology*, edited by H. C. Plotkin. New York: Wiley.
———. 1984. The Units of Evolution: A Metaphysical Essay. In *Genes, Organisms, Populations: Controversies over the Units of Selection.*, edited by R. Brandon and R. M. Burian. London: Cambridge, Mass., MIT Press. Original edition, 1980. In U. J. Jensen and R. Harré *Studies in the Concept of Evolution*. London: Harvester Press.
———. 1988. *Science as a Process: An Evolutionary Account of the Social and Conceptual Development of Science*. Chicago: University of Chicago Press.
———. 1990. Ernst Mayr on the Philosophy of Biology: A Review Essay. *Journal of Historical Methods* 23 (1):42-45.
———. 2000. Taking Memetics Seriously: Memetics Will be What we Make It. In *Darwinizing Culture: The Status of Memetics as a Science*, edited by R. Aunger. Oxford: Oxford University Press.
———. 2001. *Science and Selection: Essays on Biolgical Evolution and the Philosophy of Science*: Cambridge University Press.
———. 2004. Personal Communication, 6th June.
Hull, David, L, Rodney E Langman, and Sigrid S Glenn. 2001. A General Account of Selection: Biology, Immunology, and Behavior. In *Science and Selection: Essays on Biological Evolution and the Philosophy of Science*, edited by D. Hull. Cambridge: Cambridge University Press.
Hutchinson, G Evelyn. 1957. Concluding Remarks. *Cold Spring Harbour Symposium on Quantitative Biology* 22:415-427.

———. 1978. *An Introduction to Population Ecology*. New Haven, Conn.: Yale University Press.
Jablonka, Eva, and Ziman, John. 2000. Evolutionary Models for Technological Change. In *Technological Innovation as an Evolutionary Process*, edited by J. M. Ziman. Cambridge: Cambridge University Press.
Jackson, Susan E, Brett, Joan F, Sessa, Valerie I, Cooper, Dawn M, Julin, Johan A, and Peyronnin, Karl. 1991. Some Differences Make a Difference: Individual Dissimilarity and Group Heterongeniety as Correlates of Recruitment, Promotions, and Turnover. *Journal of Applied Psychology* 76 (5):(October) 675-689.
James, William. 1880. Great Men, Great Thoughts and the Environment. *Atlantic Monthly* 46:441-59.
Johannsen, W. 1909. *Elemente der Exakten Erblichkeitslehre*. Jena: Gustave Fischer.
Kanter, R, M. 1984. *The Change Masters*. New York: Touchstone.
Kauffman, Stuart. 1995. *At Home in the Universe: The Search for Laws of Self-Organization and Complexity*. Oxford and New York: Oxford University Press.
Keisler, Charles A., and Keisler, Sara B. 1969. *Conformity*. Reading, MA: Addison-Wesley.
Keller, Laurent, ed. 1999. *Levels of Selection in Evolution*. Princeton: Princeton Paperbacks.
Knudsen, Thorbjørn. 2001. Nesting Lamarckism within Darwinian Explanations: Necessity in Economics and Possibility in Biology? In *Darwinism and Evolutionary Economics*, edited by J. Laurent and J. Nightingale. Cheltenham: Edward Elgar.
———. 2002. Economic Selection Theory. *Journal of Evolutionary Economics* 12:442-470.
———. 2002. The Evolution of Cooperation in Structured Populations. *Constitutional Political Economy* 13:129-148.
———. 2004. General Selection Theory and Economic Evolution: The Price Equation and the Genotype / Phenotype Distinction. *Journal of Economic Methodology* 11 (2):147-173.
———. 2004. Personal Communication, 31st May.
———. 2005. Personal Communication, 11th December.
Kogut, B, and Zander, U. 1992. Knowledge of the Firm, Combative Capabilities, and the Replication of Technology. *Organization Science* 3:383-397.
Krebs, J. R , and Davies, N. R. 1997. Behavioural Ecology: An Evolutionary Approach. Oxford: Blackwell.
Lamarck, Jean-Baptist. 1809. *Philosophie zoologique*. Translated by H. Elliot. Paris: Dentu.
Landa, Janet T. 2004. The Bioeconomics of Homogeneous Middleman Groups as 'Adaptive Units'. *Unpublished, Presented at Jena Conference on Evolutionary Concepts in Biology and Economics 2nd-4th December 2004*.
Langton, John. 1979. Darwinism and the Behavioral Theory of Sociocultural Evolution:An Analysis. *The American Journal of Sociology* 85 (2):288-309.
———. 1984. The Ecological theory of Bureaucracy: The Case of Josiah Wedgwood and the British Pottery Industry. In *Administrative Science Quarterly*.
Laurent, John. 2001. Darwin, Economics and Contemporary Economists. In *Darwinism and Evolutionary Economics*, edited by J. a. N. Laurent, John. Cheltenham: Edward Elgar.
Laurent, John, and Nightingale, John, eds. 2001. *Darwinism and Evolutionary Economics*. Cheltenham: Edward Elgar.

Lawrence, Paul R, and Lorsch, Jay W. 1967. *Organization and Environment: Managing Differentiation and Integration*. Boston, MA: Graduate School of Business Administration.
Le Conte, Joseph. 1892. *The Race Problem in the South*. New York: Appleton.
Leigh, E. 1971. *Adaptation and Diversity*. San Francisco, CA: Freeman, Cooper & Co.
———. 1977. How Does Selection Reconcile Individual Advantage with the Good of the Group. Paper read at Proceedings of the National Academy of Sciences of the United States of America.
———. 1983. When Does the Good of the Group Overide the Advantage of the Individual? Paper read at Proceedings of the National Academy of Sciences of the United States of America.
———. 1991. Genes, Bees and Ecosystems: The Evolution of a Common Interest Among Individuals. *Tree* 6:257-262.
Levinthal, D. A. 1997. Three Faces of Organizational Inertia: Wisdom, Inertia and Discovery. In *Technological Innovation: Oversights and Foresights*, edited by Z. Shapira. Cambridge: Cambridge University Press.
Levinthal, D. A. 1991. Organizational Adaptation and Environmental Selection - Interrelated Processes of Change. *Organization Science* 2 (1):140-145.
———. 1992. Surviving Schumpeterian Environments: An Evolutionary Perspective. *Industrial and Corporate Change* 1 (3):427-443.
Levitt, B., and March, J. G. 1988. Organizational Learning. In *Annual Review of Sociology*, edited by W. R. Scott. Palo Alto, CA: Annual Reviews.
Lewontin, R. C. 1970. The Units of Selection. *Annual Review of Ecology and Systematics* 1:1-18.
———. 1974. *The Genetic Bias of Evolutionary Change*. New York: Columbia University Press.
Lewontin, Richard, Rose, Steven, and Kamin, Leon J. 1984. *Not in Our Genes: Biology, Ideology and Human Nature*. New York: Random House.
Linnaeus, C. 1758. *Sytema naturae*. 10th ed. Stockholm.
Llyod, E. 1992. *Keywords in Evolutionary Biology*. Edited by E. Llyod. Cambridge, MA: Harvard University Press.
Lopreato, Joseph, and Crippen, Timothy. 1999. *Crisis in Sociology: The Need for Darwin*. Brunswick, NJ: Transaction Publishers.
Lyell, Charles. 1830. *Principles of Geology: Being an Attempt to Explain the Former Changes of the Earth's Surface, by Reference to Causes Now in Operation.* 3 Vols. 1830-33. London: Murray.
Malthus, Thomas. R. 1798. *An Essay on the Principle of Population, as it Affects the Future Improvement of Society, with Remarks on the Speculations of Mr. Godwin, M. Condorcet, and other Writers*. London: Johnson.
March, James, G. 1982. Footnotes on Organizational Change. *Administrative Science Quarterly* 26 (563-597).
March, James G. 1991. Exploration and Exploitation in Organizational Learning. *Organization Science* 2 (1):71-87.
———. 1996. Continuity and Change in Theories of Organizational Action. *Administrative Science Quarterly* 41:278-87.
March, James. G, and Simon, Herbert A. 1958. *Organizations*. New York: Wiley.
March, James. G. 1965. *Handbook of Organizations*. Chicago: Rand McNally.
Marshall, Alfred. 1890. *Principles of Economics: An Introductory Volume. 1st edn.* London: Macmillan.
———. 1920. *The Principles of Economics (8th edn)*. London: Macmillan.
Marx, Karl. 1867. *Das Kapital: Kritik der politischen Ökonomie*. Vol. 1. Hamburg: Meissner.

Maynard Smith, J. 1970. Time in the Evolutionary Process. *Studium Generale* 23:266-72.
———. 1975. *The Theory of Evolution*. 3rd ed. Harmondsworth: Penguin.
———. 1989. *Evolutionary Genetics*. Oxford: Oxford University Presss.
Maynard Smith, J, and E Szathmáry. 1999. *The Origins of Life: From the Birth of Life to the Origin of Language*. Oxford: Oxford University Press.
Mayr, Ernst. 1959. Darwin and the Evolutionary Theory in Biology. In *Evolution and Anthropology : A Centennial Appraisal*. Washington D.C.: The Anthropological Society of Washington.
———. 1976. *Evolution and the Diversity of Life: Selected Essays*. Cambridge: Mass: Belknap.
———. 1978. Evolution. *Sci. Am* 239:46-55.
———. 1982. *The Growth of Biological Thought: Diversity, Evolution, and Inheritance*. Cambridge, Massachusetts: Harvard University Press.
———. 1988. *Toward A New Philosophy of Biology: Observations of an Evolutionist*. 1st ed: Cambridge. MA:Harvard University Press.
———. 1991. *One Long Argument: Charles Darwin and hte Genesis of Modern Evolutionary Thought*. Cambridge: Harvard University Press.
———. 1997. The Objects of Selection. *Proceedings of the National Academy of Sciences of the United States of America* 94 (6):2091-2094.
McGovern, William M. 1941. *From Luther to Hitler: The History of Facist-Nazi Political Philosophy*. Boston: Houghton Mifflin.
McKelvey, Bill. 1982. *Organizational Systematics: Taxonomy, Evolution, Classification*. California: University of California Press.
McKelvey, Bill, and Joel A. C Baum. 1999. Donald T Campbell's Evolving Influence on Organization Science. In *Variations in Organization Science: In Honor of Donald T Campbell*, edited by J. A. C. Baum and B. McKelvey. Thousand Oaks, California: Sage.
Meikle, Scott. 1985. *Essentialism in the Thought of Karl Marx*. London: Gerald Duckworth and Co.
———. 1995. *Aristotle's Economic Thought*.
Metcalfe, J Stanley. 1998. *Evolutionary Economics and Creative Destruction*. London: Routledge.
Metcalfe, J. Stanley. 1987. Evolution and Economic Change. Paper read at Technology and Economic Progress: Proceedings of Section F (Economics) of the British Association for the Advancement of Science, at Belfast.
———. 1994. Competition, Fisher's Principle and Increasing Returns in the Selection Process. *Journal of Evolutionary Economics* 4:327-346.
———. 2003. Industrial Growth and the Theory of Retardation: Precursors to an Evolutionary Adaptive Theory of Economic Change. *Revue Économique* 54 (2):Mars.
———. 2004. *Book Review: Technological Innovation as an Evolutionary Process (2001) edited by John Ziman*. Evolutionary Theories in the Social Sciences Website 2004 [cited 15th December 2004]. Available from www.etss.net/index.php/weblog/booksandreviewsfull/105/.
Michod, Richard E. 2000. *Darwinian Dynamics: Evolutionary Transitions in Fitness and Individuality*.
Miles, Robert H, and Cameron, Kim. 1982. *Coffin, Nails and Coporate Strategies*. Englewoods Cliffs, NJ: Prentice-Hall.
Miner, Anne S. 1991. Organizational Evolution and The Social Ecology of Jobs. *American Sociological Review* 56 (6):772-785.

———. 1994. Seeking Adaptive Advantage: Evolutionary Theory and Managerial Action. In *Evolutionary Dynamics of Organizations*, edited by J. A. C. Baum and J. V. Singh. New York: Oxford University Press.
Monod, J. 1971. *Chance and Necessity*. New York: A. A. Knopf.
Murmann, Johann P. 2004. *Murmann's Web Page http://murmann.kellogg.northwestern.edu/researches/PDW_AOM_2*. A Professional Development Workshop sponsored by the BPS Division of the Academy of Mangement 2004 [cited 141204 2004].
Murmann, Johann P, and Rivkin, Jan W. 2004. *Adaptation Versus Selection in Industry Change: Toward a Contingency View* [Murmann's Website]. A Professional Development Workshop sponsored by the BPS Division of the Academy of Management 2004 [cited 14 December 2004]. Available from http://murmann.kellogg.northwestern.edu/researchers/PDW_AOM_2004.htm.
Murmann, Johann P. 2003. Knowledge and Competitve Advantage: The Coevolution of Firms, Technology, and National Institutions. In *Cambridge Studies in the Emergence of Global Enterprise*, edited by G. Jones. Cambridge: Cambridge University Press.
Murmann, Johann P. , Aldrich, Howard E, Levinthal, Daniel, and Winter, Sidney, G. 2003. Evolutionary Thought in Management and Organization Theory at the Beginning of the New Millennium. A symposium on the State of the Art and Opportunities for Future Research. *Journal of Management Inquiry* 12 (1):22-40.
Murmann, Johann P., and Homburg, Ernst. 2001. Comparing Evolutionary Dynamics Across Different National Settings: The Case of the Synthetic Dye Industry. *Journal of Evolutionary Economics* 11:177-205.
Neilsen, F. 1994. Sociobiology and Sociology. *Annual Review of Sociology* 20:267-303.
Nelson, R R , and Winter, S G. 1982. An Evolutionary Theory of Economic Change: Cambridge, MA: Harvard University Press.
Nelson, R R and Winter, S G. 1974. Neoclassical Vs. Evolutionary Theories of Economic Growth: Critique and Prospectus. *The Economic Journal* 84 (336):886-905.
———. 1982. *An Evolutionary Theory of Economic Change*: Cambridge, MA: Harvard University Press.
Nelson, Richard, R. 1991. Why do Firms Differ, And How Does it Matter? *Strategic Management Journal* 12 (12):61-74.
———. 1995. Recent Evolutionary Theorising About Economic Change. *Journal of Economic Literature* XXXIIII (March 1995):48-90.
Nightingale, John. 1997. Anticipating Nelson and Winter: Jack Downie's theory of evoluionary economic change. *Journal of Evolutionary Economics* 7:147-167.
Nunney, Leonard. 1998. Are We Selfish, Are We Nice, or Are We Nice because We Are Selfish? *Science, New Series* 281 (5383):1619-1621.
———. 1999. Lineage Selection: Natural Selection for Long Term Benefit. In *Levels of Selection in Evolution*, edited by L. Keller. Princeton: Princeton Paperbacks.
Parsons, Talcott. 1932. Economics and Sociology: Marshall in Relation to the Thought of his Time. *Quarterly Journal of Economics* 46 (2):316-47.
———. 1934. Some Reflections on 'The Nature and Significance of Economics. *Quarterly Journal of Economics* 48 (3):511-45.
———. 1937. *The Structure of Social Action*. 2 vols. New York: McGraw-Hill.
Pearsall, Judy, ed. 2001. *The New Oxford Dictionary*. Oxford: Oxford University Press.
Penrose, Edith, T. 1952. Biological Analogies in the Theory of the Firm. *American Economic Review* 42:804-819.
———. 1959. *The Theory of the Growth of the Firm*. Oxford: Blackwell.

Pepper, John. 2003. *What Drives Transition in Individuality?* John Pepper's Website: 'Research Interests'. 2003 [cited 9th April 2003]. Available from http://www.santafe.edu/~jpepper/interests.htm.
Perry, Ralph Burton. 1918. *The Present Conflict of Ideals: A Study of the Philosophical Background of the World War*. New York: Longmans Green.
Pfeffer, J. 1993. Barriers to the Advance of Organizational Science: Paradigm Development as a Dependable Variable. *Academy of Management Review* 18 (4):599-620.
Pfeffer, J, and Salancik, G. R. [1978] 1990. The Design Management of Externally Controlled Organization. In *Organization Theory*, edited by D. S. Pugh. London: Penguin.
Pinker, S. 1994. The Language Instinct: The New Science of Language and Mind. London: Penguin.
Plotkin, Henry C. 1994. *Darwin Machines and the Nature of Knowledge: Concerning Adaptations, Instinct and the Evolution of Intelligence*: Harmondsworth: Penguin.
———. 1997. *Evolution in Mind: An introduction to Evolutionary Psychology*. London: Allen Lane.
Popper, Karl R. 1972. *Objective Knowledge: An Evolutionary Approach*. Oxford: Oxford University Press.
Potts, Jason. 2000. *The New Evolutionary Microeconomics: Complexity, Competence and Adaptive Behaviour*. Edited by G. M. Hodgson, *New Horizons in Institutional and Evolutionary Economics*. Cheltenham, UK: Edward Elgar.
Price, G. 1970. Selection and Covariance. *Nature* 227:520-521.
———. 1972. Extensions of Covariance Selection Mathematics. *Annals of Human Genetics* 35:485-490.
———. 1995. The Nature of Selection. *Journal of Theoretical Biology* 175:389-396.
Pugh, D. S. 1990. Organization Theory: Selected Readings. London: Penguin. Original edition, 1971.
Quine, W. V. 1969. *Ontological Relativity and Other Essays*. New York: Columbia University Press.
———. 1980. *From a Logical Point of View*.
Reeve, H. Kern, and Keller, Laurent. 1999. Levels of Selection: Burying the Units-of-Selection Debate and Unearthing the Crucial New Issues. In *Levels of Selection in Evolution*, edited by L. Keller. Princeton: Princeton Paperbacks.
Richerson, Peter J. 2005. Personal Communication, 8th October.
Richerson, Peter J., and Boyd, Robert. 2001. Built for Speed, Not for Comfort: Darwinian Theory and Human Culture. *History and Philosophy of the Life Sciences* 23:423-63.
———. 2005. *Not By Genes Alone: How Culture Transformed Human Evolution*.
Rindos, David. 1985. Darwinian Selection, Symbolic Variation, and the Evolution of Culture. *Current Anthropology* 26 (1):65-88.
Ritchie, D. G. 1890. *Darwinism and Politics*. London: Swan Sonnenschein.
———. 1896. Social Evolution. *International Journal of Ethics* 6 (2):165-81.
Romanes, George John. 1893. *Darwin and After Darwin: An Exposition of the Darwinian Theory and a Discussion of Post-Darwinian Questions*. 2nd ed. Vol. 1. London: Longmans, Green.
Rose, Hilary and Rose, Steven. 2000. *Alas Poor Darwin: Arguments against Evolutionary Psychology*. London: Jonathan Cape.
Ross, Kenneth G and Keller, Laurent. 1988. Genetic Control of Social Organization in an Ant. *Proceedings of the National Academy of Sciences of the United States of America* 95 (24):14232-14237.

Ruse, M, ed. 1996. *Concepts and Methods in Evolutionary Biology, Cambridge studies in Philosophy and Biology*. Cambridge: Cambridge University Press.
Ruse, Martin, E. and Holmes, E., ed. 1996. *The Oxford Dictionary of Biology*. Third Edition ed, *Oxford Paperback Reference*. Oxford: Oxford University Press. Original edition, 1985.
Salthe, S. N. 1985. *Evolving Hierarchical Systems*. New York: Columbia University Press.
Sandell, Rickard. 2001. Organizational Growth and Ecological Constraints: The Growth of Social Movements in Sweden, 1881 to 1940. *American Sociological Review* 66 (5):672-693.
Sanderson, Stephen K, and Ellis, Lee. 1992. Theoretical and Political Perspectives of American Sociologists in the 1990s. *American Sociologists* 23:26-42.
Saviotti, P, and Metcalfe, J. S. 1991. *Evolutionary Theories of Economic and Technical Change*. Reading, MA: Academic Publishers.
Schumpeter, J. A. 1934. *The Theory of Economic Development*. Translated by R. Opie. German ed. Cambridge, MA: Harvard University Press.
———. 1976. *Capitalism, Socialism and Democracy*. 5th ed. London: George, Allen and Unwin. Original edition, 1942.
Scott, W. R. 1987. *Organizations: Rational, Natural, and Open Systems*. Englewood Cliffs, NJ: Prentice-Hall.
———. 1998. *Organizations: Rational, Natural and Open Systems*. 4th ed. New Jersey: Prentice Hall.
Shute, Daniel. 1896. Racial Anatomical Peculiarities. *American Anthropologist* 9 (April):123-7.
Simon, Herbert A. 1957. *Administrative Behaviour*. 2nd ed. New York: Macmillan.
———. 1991. Bounded Rationality and Organizational Learning. *Organization Science* 2 (1).
Simpson, George, Gaylord. 1944. *Tempo and Mode in Evolution*. Edited by L. C. Dunn, *Columbia Biological Series*. New York: Columbia University Press.
Singh, J. V., House, R. J., and Tucker, D. J. 1986. Organizational Change and Organizational Mortality. *Administrative Science Quarterly* 31:587-611.
Singh, Jitendra V and Lumsden, Charles J. 1990. Theory and Research in Organizational Ecology. *Annual Review of Sociology* 16:161-95.
Sober, Elliott. 1980. Evolution, Population Thinking, and Essentialism. *Philosophy of Science* 47:350-383.
———. 1984. *The Nature of Selection: Evolutionary Theory in Philosophical Focus*. Cambridge, Mass.: MIT Press.
———. 1985. Abstract of Invited Papers: Reductionism and the Theory of Evolution. A.P.A. Western Division Meetings. *No&ucurc;s* 19 (1):67-68.
Sober, Elliott, and Wilson, David Sloan. 1998. *Unto Others: The Evolution and Psychology of Unselfish Behavior*. Cambridge, MA: Harvard University Press.
Stinchcombe, Arthur L. 1965. Social Structure and Organizations. In *Handbook of Organizations*, edited by J. G. March. Chicago: Rand McNally.
Teece, D. J, Pisano, G, and Sheun, A. 1997. Dynamic Capabilities and Strategic Management. *Strategic Management Journal* 18 (7):507-533.
Teece, David J, Pisano, Gary, and Sheun, Amy. 1990 unpublished Working Paper. Firm Capabilities, Resources, and the Concept of Strategy. *University of California at Berkeley, Centre for Research in Management*:90-9.
Toulmin, Stephen. 1972. Human Understanding. London: Oxford University Press.
Tushman, M, and O'Reilly, C. 1997. *Winning Through Innovation: a Practical Guide to Managing Organizational Change*. Cambridge, MA: Harvard Business School Press.

Udry, J. Richard. 1995. Sociology and Biology: What Biology do Sociologists Need to Know? *Social Forces* 73:1267-78.
———. 2000. Biological Limits of Gender Construction. *American Sociological Review* 65 (3):443-457.
Van de Ven, Andrew H., and Grazeman, David N. 1991. Evolution in a Nested Hierarchy: A Geneology of Twin Cities Health Care Organizations, 1853 - 1995. In *Variations in Organization Science: In Honor of Donald T. Campbell*, edited by B. McKelvey. Thousand Oaks, California: Sage.
van den Berghe, Pierre L. 1974. Bringing Beasts Back In: Towards a Biosocial Theory of Aggression. *American Sociological Review* 39 (December):777-788.
———. 1975. *Man in Society: A Biosocial View*. New York: Elsevier.
———. 1990. Why Most Sociologists Don't (and Won't) Think Evolutionarily. *Sociological Forum* 5 (2):173-185.
Veblen, T. B. 1898. Why Is Economics Not An Evolutionary Science?
———. 1899. *The Theory of the Leisure Class: An Economic Study of Institutions*. New York: Macmillan.
———. 1907. The Socialist Economics of Karl Marx and His Followers II: The Later Marxism. *Quarterly Journal of Economics* 21 (1):February, 299-322.
Vrba, E. S., Eldredge, N. 1984. Individuals, hierarchies and processes: Towards a more complete evolutionary theory. *Paleobiology* 10:146--71.
Vromen, Jack. 1995. *Economic Evolution: An Enquiry Into The Foundations Of New Institutional Economics*. New York: Routledge.
———. 2001. The Human Agent in Evolutionary Economics. In *Darwinism and Evolutionary Economics*, edited by J. Laurent and J. Nightingale. Cheltenham: Edward Elgar.
———. 2004. Conjectural Revisionary Economic Ontology : Outline of an Ambitious Research Agenda for Evolutionary Economics. *Journal of Economic Methodology* 11 (2).
Wade, M, J. 1978. A Critical Review of Models of Group Selection. *Quarterly Review of Biology* (53):101-114.
Warglien, Massimo. 1993. Hierarchical Selection an Organizational Adaptation in a Population of Projects. Paper read at Paper prepared for the ASSI conference on Hierarchies, Markets, Power in the Economy: Theories and Lessons from History, Dipartimento di Economia e Direzione Aziendale, Universita Di Venezia, Italia.
Weick, K. E. 1979. *The Social Psychology of Organizing*. Reading, MA: Addison-Wesley.
Weismann, August. 1889. Essay Upon Heredity and Kindred Biological Problems, edited by A. E. Shipley. Oxford: Clarendon Press.
———. 1893. *The Germ Plasm: A Theory of Heredity. English trans.* London: Scott.
Welborne, Theresa M, and Andrews, Alice O. 1996. Predicting the Performance of Initial Public Offerings: Should Human Resource Management be in the Equation? *Academy of Management* 39 (4):(August) 891-919.
Wheeler, Michael, Ziman, John, and Boden, Margaret, eds. 2002. *The Evolution of Cultural Entities. Proceedings of the British Academy 112*. Oxford: Oxford University Press.
Williams, G. C. 1966. *Adaptation and Natural Selection: A Critique of Some Current Evolutionary Thought.* Princeton: Princeton University Press.
———. 1992. *Natural Selection: Domains, Levels, and Challenges*. Oxford: Oxford University Press.
Wilson, D. S. 1975. A Theory of Group Selection. Paper read at Proceedings of the National Academy of Sciences.

———. 1997. Human Groups as Units of Selection. *Science, New Series* 276 (5320):1816-1817.
———. 1999. A Critique of R.D. Alexander's Views on Group Selection. *Biology and Philosophy* 14 (3):431-449.
———. 2002. *Darwin's Cathedral: Evolution, Religion, and The Nature of Society*. Chicago: University of Chicago Press.
Wilson, D. S. & Sober, E. 1994. Re-Introducing Group Selection to the Human Behavioral Sciences. *Behavioral and Brain Sciences* 17 (4):585-654.
Wilson, Edward, O. 1975. *Sociobiology: The New Synthesis*: Cambridge. MA:Harvard University Press.
Winter, S. G. 1990. Survival, Selection, and Inheritance in Evolutionary Theories of Organization. In *Organizational Evolution*, edited by J. V. Singh. Newbury Park, CA: Sage.
Winter, Sidney G. 2003. Evolutionary Thought in Management and Organization Theory at the Beginning of the New Millennium. *Journal of Management Inquiry* 12 (1):22-40.
Winter, Sidney, G. 1964. Economic 'Natural Selection' and the Theory of the Firm. *Yale Economic Essays* 4 (1):225-272.
Witt, Ulrich. 1997. Self Organization and Economics - What is New? *Structural Change and Economic Dynamics* 8:489-507.
———. 2003. *The Evolving Economy: Essays on the Evolutionary Approach to Economics*. Cheltenham: Edward Elgar.
———. 2004. 'Evolutionary Concepts in Economics and Biology' Workshop, at Max Planck Institute Jena, Germany. 2-4 December 2004.
———. 2004. On the Proper Interpretation of 'Evolution' in Economics and its Implications for Production Theory. *Journal of Economic Methodology* 11 (2):125-146.
Woods, Erville B. 1920. Heredity and Opportunity. *American Journal of Sociology* 26 (1):1-21.
Wynne-Edwards, V. C. 1962. *Animal Dispersion in Relation to Social Behavior*. New York: Hafner.
Young, Ruth. 1988. Is Population Ecology a Useful Paradigm for the study of Organizations? *American Journal of Sociology*.
Zald, Mayer N. 1994. A New Paradigm for Organizational Studies? In *Contemporary Sociology*.
Ziman, John, ed. 2000. *Technological Innovation as an Evolutionary Process*. Cambridge: Cambridge University Press.
Ziman, John M. 2002. Selectionist Reasoning as a Tool of Thought. In *The Evolution of Cultural Entities*, edited by M. Wheeler, J. Ziman and M. Boden. Oxford: Oxford University Press.