Universal Darwinism in Nelson and Winter's Evolutionary Theory

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ABSTRACT

Universal Darwinism holds that the three key Darwinian principles of variation, inheritance and selection can be observed at levels beyond that of the primary level of biological evolution. Nelson and Winter's unique achievement in their seminal work, *An Evolutionary Theory of Economic Change* (1982), was to apply and pursue these core principles thereby *extending* Darwinism to economics and effectively satisfying the conditions prescribed by the zoologist, Richard Dawkins , who coined the term 'Universal Darwinism' in 1983.

In terms of the history of ideas, this is a remarkable achievement. Nelson and Winter are the first economists since Veblen (1899) to actually *apply* Darwin's principles of variation, inheritance and selection to economic phenomena. Although a few economists certainly talked of evolution and evolutionary terms did appear in the literature, for example, in Schumpeter (1976; 1934), Hayek (1982; 1988) and Boulding (1981), evolutionary theory was not fully worked out or understood in the Darwinian sense. Nelson and Winter's work represents a dramatic move forward in this regard.

Seeking to explain technological and economic change, Nelson and Winter skilfully identify parallels between 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 the species. Causal mechanisms in their economic theory ingeniously mimic those of the complex interweaving biological processes of variety formation, character inheritance and natural selection. Darwinian cause and effect relationships are clearly perceptible.

However, in spite of this remarkable achievement Nelson and Winter demonstrate a curious reluctance to claim their Darwinian heritage and instead they align themselves with 'Lamarckism'. Darwin is mentioned only *once* in the text. Furthermore, a close study of the analytical parities that they draw between the two spheres reveals puzzling ambiguities in their use of the terms. By focusing in this paper on a particular confusion around the selection process I hope to demonstrate that these ambiguities are linked, both to Nelson and Winter's reluctance to be labelled 'Darwinian' as well as to their underestimation of the nature and scope of Darwinism in modern evolutionary theory. Moreover, it will be shown here how Darwinism actually facilitates and clarifies their theory. Thus, in the light of major clarifications achieved in the philosophy of biology in recent years this paper aims to highlight the true Darwinian parentage of Nelson and Winter's theory, to focus on its achievements and emphasis its extensive untapped explanatory potential.

1. Introduction

This paper focuses on the prominent work of Richard Nelson and Sidney Winter, '*An Evolutionary Theory of Economic Change'* (1982). The aim is to investigate 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 'Universal Darwinism' in their evolutionary theory of economic change. Thus, it is a conceptual and theoretical study. It is also an interdisciplinary project which draws on a number of disciplines including biology, philosophy, business economics and organization studies.

Given the interdisciplinary nature it might be useful to begin with a few definitions of terms from the fields of biology and philosophy of biology. This will be followed by a short discussion of 'Universal Darwinism'. The next sections will then focus on Nelson and Winter's use of evolutionary ideas, highlighting the important parallels that they draw as well as the interesting ambiguities. Special attention will be paid to a particularly significant confusion regarding their use of the process of selection. The paper will conclude with a reflection on the value of Darwinism for economics.

2. Definition of terms

2. 1. The Process of Natural Selection

The philosopher of biology, David Hull (2001, p. 53) makes the important point that a brief characterization of the process of selection cannot suffice to impart a deep understanding of the process. However, with this warning he then presents a considered and concise definition (Hull's italics);

> *we define selection as repeated cycles of replication, variation, and environmental interaction so structured that environmental interaction causes replication to be differential.* The net effect is the evolution of the lineages produced by this process.

For the purposes of this paper, and taking into account Hull's warning, the above offers a suitably reliable and modern definition. This might usefully be compared to Darwin's own definition, which although not yet informed by genetics, is nevertheless a descriptive and helpful illustration of the process of natural selection (Darwin 1975, p. 68);

> 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.

Clearly Hull's definition reflects the modern 'neo-Darwinian' evolutionary theory, in other words, the synthesis of Darwinism and Mendelian genetics which took place during the 1930s and 1940s. This synthesis bolstered evolutionary theory evidently serving to reaffirm Darwin's viewpoint 'that all adaptive evolutionary change is due to the directing force of natural selection on abundantly available variation' {Mayr, 1988 #40, p. 527}.

2. 2. Genotypes and Phenotypes

Advances in genetics and molecular biology have also similarly fleshed out the theory of natural selection. Mayr alludes to this as he describes the genotype and phenotype below (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.

The *genotype* is the genetic composition of an organism whereas the *phenotype* is its observable characteristics (Ruse 1996). In other words, the phenotype is the physical manifestation of the genotype, the phenotype is 'shaped' by the genotype. So that a phenotype is what we generally understand as an 'organism'.

2. 3. Lamarckism

'Lamarckism' refers to the theory promoted by the French evolutionist, Jean-Baptiste de Lamarck in1809, which proposed the inheritance of 'acquired characteristics'. In his view changes that are acquired during the lifetime of an organism can be passed on to its offspring. In other words phenotypic changes are somehow passed on to the organism's genotype. This theory is now widely discredited and has long since been displaced by Darwinism. Curiously, Darwin himself did not discount the possibility of the inheritance of acquired characters. However, in order for Lamarckism to work it still requires a selection process, so it would be dependent on the theoretical foundations of Darwinism.

3. Universal Darwinism

'Universal Darwinism' is a term coined by the zoologist Richard Dawkins (ed.Bendall 1983, pp. 403-25) in a paper of the same name in 1983. It has been adopted and reinforced by many others, including the philosopher of biology, David Hull(1990), the

evolutionary psychologist, Henry Plotkin (1994) and the economist Geoffrey Hodgson (2002; 1993).

Universal Darwinism holds that the three key Darwinian principles of variation, inheritance and selection can be observed at levels beyond the primary level of biological evolution. Darwinism, Dawkins argues, is not exclusively genes or DNA. Indeed, variation, inheritance and selection are *general* principles that govern the evolution of all complex systems, including, Dawkins predicts, that of life in other parts of the universe – should we ever discover it. 'The Darwinian Law', he suggests, 'may be as universal as the great laws of physics' (p. 423). In terms of explaining 'adaptive complexity', Dawkins argues that Darwinism is the *only* theory up to the task (p. 420);

> Darwinism – the non-random selection of randomly varying replicating entities by reason of their 'phenotypic' effects – is the only force I know that can, in principle, guide evolution in the direction of adaptive complexity. It works on this planet,… and there is no reason to doubt its efficacy throughout the universe.

Universal Darwinism, in effect, provides an overarching conceptual framework in which other theories can be accommodated. Hodgson (1993, p. 103), who recognizes the potential of Universal Darwinism for social evolution, helpfully breaks it down to its essentials;

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

We are, of course, accustomed to this exquisite Darwinian story in the biotic sphere with the diversity of life and evolution of species comprehensively explained through replicating, heritable genes and organisms competing for survival. But Darwinism is, above all, a causal theory, a marvelously unifying theory explaining cause and effect relationships between entities and processes. This is its power. And, as Dawkins and others have argued, Darwinism has the potential to be applicable to all evolving systems displaying those key elements of variation, inheritance and selection. Cultural evolution is no exception.

It is possible, for example, in social life to conceive of the systemic variation of 'populations' of all kinds of entities, for example, institutions, firms or ideas. Clearly these will be vast and 'varied' populations. There is a process by which some of the entities within these populations survive or are enhanced whilst other entities will diminish. This is what we understand as a 'selection process' It is a process by which individual entities, such as firms or institutions, can endure through time *and* can inherit characteristics through time or replicate in some way. It is a process by which differential survival is sustained because of the continued replenishment of variety in the system - through 'imperfect copying', for example, or the 'mutation' of these entities.

The important point is that these key Darwinian entities and processes can be observed in the social sphere as well as in the biological sphere. This is what Universal Darwinism means – it is the *extension* of Darwinism to other phenomena. So long as the core theoretical elements of variation, inheritance and selection are present then we have the direct application of Universal Darwinism.

This brings us to the fundamental questions that prompted this paper; the task is to evaluate the sense in which Darwinian ideas are being employed in economics, whether implicitly or explicitly. For example, is natural selection being used simply as an analogy by economists? Or, are they, perhaps unwittingly, developing theories that embrace the direct application of Darwinian principles?

In order to address these questions and to establish a Darwinian parentage in evolutionary theories we need to be very precise about the use of the terms. For example, what do we mean by replication and inheritance? What is being replicated? How is inheritance explained? And *what* is being selected? Can we establish parities with these mechanisms and entities, for example, in economics? Are the ideas really being used in the same sense as in Darwinism? If so, then we have Universal Darwinism.

4. Nelson and Winter

In this paper I hope to show that we do find Universal Darwinism in the work of Nelson and Winter. However, because of a curious reluctance on their part to be labeled Darwinian, and because of their own ambiguities in the use of the terms this has not been without its problems. Indeed the identification of a particular confusion with regard to the selection process is to be my case in point here.

The important thing to emphasize, and for social scientists to be encouraged by, is Nelson and Winter's unique achievement in the *application* of Darwinian principles to economic phenomena. In spite of the confusing rhetoric, their theory really has moved beyond 'mere' analogies, it *is* Darwinian.

Furthermore, it is also worth stressing, that this does not therefore mean that economics is being *reduced* to biology; we are not seeing economic phenomena being explained in terms of biological phenomena. On the contrary, similar entities and processes have been observed operating in both domains. Universal Darwinism is *not* reductionism at work.

5. An Evolutionary Theory of Economic Change

And so, let us now focus on Nelson and Winter and their use of biological evolutionary theory. In 1982 Nelson and Winter published their groundbreaking theory. Seeking to

explain technological and economic change they construct a dynamic theory which uniquely incorporates from biology the key evolutionary principles of variation, inheritance and selection. Nelson and Winter skilfully identify parallels between 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. Central to their theory is an economic selection process which results in the differential survival of firms within an industry.

Significantly, Nelson and Winter construct for economics a *causal* theory of evolution that mimics the complex interweaving biological processes of variety formation, character inheritance and natural selection. As we shall see, the theory meets the criteria set down by Dawkins and others for Universal Darwinism. Let us look now at how they describe their theory beginning with their principal entity (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 the above the firm is likened to the individual organism, or 'phenotype' in the biotic sphere and this is the entity upon which selection operates. They describe the firm as having certain capabilities and decision rules by which they mean 'behaviours' that are comprised of and determined by gene-like entities, identified here by Nelson and Winter as 'routines'(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.

Nelson and Winter add that within the above range they distinguish among three classes of routines. This is a significant point, in terms of their evolutionary theorising, and we shall return to it later in the paper when we discuss the selection process. They describe this hierarchy of routines 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…

All of the above firm behaviours come under the general term, 'routine'. And 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. Decision rules in Nelson and Winter's theory, essentially allude to 'choice' or 'choosing'. It is significant that different types of routines appear to play subtly different roles in Nelson and Winter's evolutionary theory. 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. As suggested we will elaborate on this important point in section seven below and will continue here with parities and consider how Nelson and Winter describe the *role* of routines in their theory (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.

For Nelson and Winter clearly 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 the above passages then, Nelson and Winter cover most of the parities that they draw from biological evolutionary theory. In terms of *entities*, the firm is the variable organism that competes with other organisms in a selection process; routines are the replicating, heritable entities that sometimes make imperfect copies of themselves and are equivalent to the genes; and the industry is clearly the species that evolves over time. There are evidently clear parallels in the use of the terms with regard to Nelson and Winter's *entities*. So what do they say about the principles or *processes*?

Although they are not explicit about it, *variation* is clearly assumed as part of their story, with, in the above quotation, for example, differential survival being 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. They are much more *ex*plicit, on the other hand, with their *inheritance* mechanism when they talk, for example, about routines being inherited and routines influencing the behaviour of organisms. Routines are described as being persistent, copied, imitated and passed on to tomorrow's firms, there is plainly an inheritance mechanism in the theory. They are also *ex*plicit about s*election*, for example, in their description of the selection of organisms with 'better routines'. The selection process is expanded upon below, where they go on to describe the selection environment, once again supporting the supposition that it is the firm that is being selected;

> the 'selection environment' of an organization is 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.

We appear then to have sound parities both with the entities *and* with the processes. But what about *causality* and the overall *structure* of the theory? Do we have parities here? Certainly from the clutch of quotations above, we can clearly perceive the standard biological 'derived' sense of selection applying to the genes; 'they are selectable in the sense that organisms with certain routines may do better than others'. Nelson and Winter are plainly describing the economic equivalent of genes being selected *as a consequence* of the organism being selected. Hull clarifies this important point about the selection process below (2001, p. 61);

> 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.

Finally and relatedly, we also appear to have parity in the overall *structure* of the theory. Nelson and Winter's theoretical framework evidently mirrors the classic hierarchical organisation of gene-based biological evolution which has genes at the bottom of the hierarchy followed by the organism and then the species.

Thus, we have Universal Darwinism in Nelson and Winter's theory. Or do we? Do the mechanisms and processes really function in the same Darwinian way? Moreover, is this what Nelson and Winter claim about their theory? As indicated in the above overview, Nelson and Winter do have the core Darwinian principles of variation, inheritance and selection. They have the entities, the processes and the overarching theory, but what about consistency, for example, in their use and application of the aforementioned mechanisms? Do these causal mechanisms find direct equivalence in biological evolutionary theory?

This is where it becomes more complex. Although Nelson and Winter manage to identify the economic equivalent of a genotype, phenotype and species, when we look more closely at their selection process and at how they interpret inheritance and variety creation we find ambiguities and it becomes much harder to discern the degree of equivalence. Three interrelated problems become apparent. Firstly, there is a distorted portrayal of the 'organizational hierarchy', secondly confusion surrounding the 'level of selection' and thirdly there is a misapprehension about 'Lamarckian inheritance'. Two propositions emerge from this configuration of problems. The first is to examine the extent that Nelson and Winter's theory is actually a 'dual level selection theory', and the second is to suggest that as a consequence they mistakenly identify it with Lamarck.

These propositions we will explore by turning first to the process of selection. This appears to be the root of the problem for Nelson and Winter and generates the three-fold problem referred to above. We will then consider whether or not the theory is Lamarckian. We need to be clear about the unit of selection, the selection environment and the level of selection assumed in Nelson and Winter's theory and consider whether these correspond with the organizational hierarchy and causal mechanisms of biological evolution. 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.

6. Biological Influences

Nelson and Winter (p. 9) openly acknowledge the 'borrowing of basic ideas from biology'. Indeed they declare the rights of economists 'in perpetuity' to use to do so, given that Darwin's theory of natural selection was itself inspired by the economist, Thomas Malthus (1798) and his *Essay on Population* . However, and this point is worth bearing in mind, they stress that this is a 'flexible' use of biological ideas, and that they will adopt and amend them 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.

Significantly, this is the *one and only occasion* that Nelson and Winter mention Darwin, in the context of *his* inspiration from Malthus. If they align themselves with any name from biology it is with that of Lamarck, he is mentioned on many occasions. Lamarck, as noted earlier, is the widely criticised French evolutionist who proposed the inheritance of acquired characteristics – the view that characteristics acquired during the lifetime of an organism may be passed on, from the phenotype to the genotype, to the offspring of that organism.

I would suggest that a misunderstanding about the nature and scope of Darwinism, and its relationship to Lamarckism, is one reason why Nelson and Winter label themselves Lamarckian. They appear to be under the general misapprehension that Darwinism and Lamarckism are mutually exclusive but this is NOT the case. Even Darwin did not deny the possibility of the inheritance of acquired characteristics. Furthermore, in order for Lamarckian inheritance to work it requires the theoretical structure of Darwinism.

I would also suggest that this confusion over Lamarckism, along with other confusions about the selection process, is the reason why, on closer inspection Nelson and Winter's important parities begin to break down.

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 when we look more closely, 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. For example, in the quotation below 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 again underline their understanding of the operation of the selection process, suggesting as they do the organism's genotype and phenotype duality and equating the routines (operating characteristics) with the genotype and the firm with the phenotype. 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. It is implied that routines are being selected *by the firm* in a process they describe as 'search'. Searching for new and better routines is likened to the process of 'mutation' in the biotic sphere, the process of change at the genetic level. But search, as we will see below, is also portrayed as a selection process.

7. Dual Level Selection?

To what extent is Nelson and Winter's theory a dual level theory? I would argue that Nelson and Winter unwittingly end up developing a *dual-level* selection theory, that is, selection operating at the levels of the firm *and* of the routine. Dual level selection can be discerned, it is implicit and, indeed, it makes sense of their theory, as we shall come to see. We will begin by looking at how they explain their 'search process', this is Nelson and Winter's economic equivalent of genetic mutation.

Having first noted the full range of characteristics generally described as routines, Nelson and Winter then pointed out that there is a hierarchy of decision rules (page 6 above), they then go on to say (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'. Genetic mutation in biological theory *is* partly determined by its genetic environment, and genes do interact with each other. But genetic mutation 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.

The direction of causality clearly seems to be confused here. The 'routine-guided, routine-changing processes' suggests gene-based causality, with the genotype (partly) determining the phenotype. But the 'firm's search policy' suggests that change is effected by a selection process activated by the firm, in other words, with the phenotype determining the genotype. They talk above (pp. 6,7) about a class of routine, 'higher level routines', which make the 'search- type', strategic decisions about change in the firm. Nelson and Winter specified distinctions between 'choosing' type routines at being at a higher level than other routines. In other words some routines are seeking out other, 'better' routines. There appears to be a blurring of boundaries between the phenotype and genotype because of the way that the 'firm' and the 'routine' have been conceptualized in Nelson and Winter's search process. Could it be that Nelson and Winter are introducing another level in the organizational hierarchy? If they are, then this is 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 so it adopts or 'selects' better routines, these become incorporated into its portfolio of organizational

routines which are then passed onto the next generation. 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 to the genetic material and are then passed on to the next generation.

The point is, that whilst mutation in biological theory *is* partly determined by the organism's genetic makeup, mutation or 'change' is not portrayed as being simultaneously 'selected' by the organism. This would appear to reverse or certainly confuse the causal direction of the theory. Thus we have confusion about exactly what entity is being selected which generates further confusion about explanations of change in the firm. The overall structure of evolutionary theory dictates that selection happens at the level of the organism - genes are 'selected' as a consequence of the organism being selected, the organism itself does not do the selecting.

The confusion, I would suggest, is brought about by the apparent double-meaning of their term, 'search'. Search, as we have seen, implies both 'change' (mutation) and 'selection' (choosing). Nelson and Winter conflate the two meanings in their term 'search', and then describe this 'process of search' as happening simultaneously with a second level of selection, i.e., selection of the firm. In other words there is an implied second level of selection coupled with the 'traditional' selection process.

So, does this mean that Nelson and Winter's theory is a dual level selection theory? Or is it instead Lamarckian?

8. Lamarckism?

In a later passage, the Lamarckian conclusion is perceptible and it suggests why Nelson and Winter call themselves Lamarckian, because essentially, in biological terms, what they are describing here is the inheritance of acquired characteristics. Let us look at the relevant passage and bear in mind the above analysis that 'search' refers to selection of the routines, a firm activity, and that the word 'selection' here 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, Lamarckian inheritance.

I would argue that *because* they found the theory concluding that the organism is effectively changing the genes, they didn't recognize this as Darwinian and so labeled it Lamarckian. Because they perceived that theirs is *not* 'Darwinian inheritance' it had to be Lamarckian inheritance. However they nevertheless realized that they needed the Darwinian framework. This, I would suggest is the root of the problem and why they find themselves developing a dual-level selection theory.

9. Universal Darwinism in Nelson and Winter's Theory

So, finally, if Nelson and Winter's theory is a dual level selection theory, what does this mean? Can it still be Darwinian? The answer to this is 'yes'. Modern Darwinian theory now acknowledges that selection can happen at more than one level. The theoretical refinement of biological evolutionary theory in recent years has served to clarify the roles and activities of genes and organisms as well as to clarify the complex and interweaving mechanisms of variation, inheritance and selection.

There was considerable debate and confusion within biology with regard to, what became known as the 'unit of selection problem'(Lewontin 1970; Hull 1984; Brandon 1996, 1999, 1982). It is therefore quite understandable that such ambiguities as I have been discussing in relation to Nelson and Winter should arise. One of the outcomes of the recent developments in the philosophy of biology is 'multilevel selection theory'. This acknowledges, amongst other things, that in the biotic sphere selection occurs at more than one level. The philosopher, Ernst Mayr (1978) is widely credited for the insightful recognition of natural selection as a two-step process, making possible a much clearer understanding of its operating mechanisms. In a more recent text he describes this duality in the following way (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.

The continuous restoration of variability to which Mayr refers, 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'. This is, according to Mayr, Darwinian selection 'as it is fully understood by the evolutionists' (1997,p. 2091). And for our purposes here,

this is what we understand as the classic formulation of *single-level* selection theory. I suggest that in the above quotation about search and selection (p. 12) Nelson and Winter are unknowingly attempting to articulate the two step process elucidated here by Mayr. There seems to be an intuitive understanding of this curiously confusing process of natural selection.

Another related development has been the further refinement of terms so that it is much clearer about what happens at each level of the evolutionary hierarchy. Hull (2001; 1980b; 1984; 1980a), who has made a significant contribution to this development sets out an alternative and more general hierarchy which builds on Mayr's elucidation of the selection process and provides a conceptual platform which promises clarification of evolutionary theory beyond the sphere of biology;

> 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.

Hull identified these different entities as the 'replicator' and 'interactor' and these have become 'generalized' terms amongst theorists for the 'genotype' and 'phenotype' (Brandon 1990, p. 78). Hull sets out the definitions of these terms below, along with the selection process itself and that of *lineage*, which represents the notion of the species (1990, p. 409);

> *replicator* – an entity that passes on its structure largely intact in successive replications.
>
> *interactor* – an entity that directly interacts as a cohesive whole with its environment in such a way that this interaction *causes* replication to be differential.

It is stressed that 'replicators and interactors are the entities that function *in* selection processes'. Whereas Hull suggests a more general term for species, those entities 'that result from successive replication' but *do not* actually function in selection;

> *lineage* – an entity that persists indefinitely through time either in the same or an altered state as a result of replication.

Hull goes on to show, through his succinct definition of selection, how these technical terms clarify the process of selection;

> *selection* – a process in which the differential extinction and proliferation of interactors *cause* the differential perpetuation of the relevant replicators.

The development of Darwinism through the refinement of theory and clarification of definitions facilitates understanding beyond the biotic sphere. As indicated here, Universal Darwinism has the potential to both accommodate and clarify Nelson and Winter's theory. For example, it is easy to conceive of their firms as interactors and the routines as replicators. And, moreover, this modern framework facilitates the exploration

of Nelson and Winter's theory as a dual level theory, with their higher level routines being considered as a possible additional level of interactors. Nelson and Winter clearly want to include the activity of 'choice' in their range of routines and this, as we have seen, causes problems for the theory. Their ' flexibility' with evolutionary ideas from biology enables them to bring in Lamarck but arguably the theory has greater potential in explicitly and wholly adopting the more general 'Universal Darwinism', where it is now theoretically possible to accommodate selection at multiple levels. Thus, to suggest, as I have done here, that Nelson and Winter's theory is Darwinian is to acknowledge that it is Darwinism at its most general level.

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10. Conclusion

It has been my intention here to highlight of the value of 'Universal Darwinism' for economics. This paper, whilst it has undoubtedly raised many questions, it has also offered an indication of the significance of Universal Darwinism for economics through the work of Nelson and Winter. Their intuitive understanding of this universal theory manages, in spite of the ambiguities, to illustrate its promise. Without doubt this remarkable theory has extensive and powerful explanatory potential with the capacity to explain complexity, diversity and change. But, as Nelson and Winter have also highlighted, Darwinism has the seductive appeal of a beguilingly simple theory when it is in fact it is deceptively complex. Thus, Darwinian evolutionary theory must be used with caution.

Bibliography

Bendall, D.S., ed. 1983. *Evolution from Molecules to Men*: Cambridge University Press.

Boulding, K. E. 1981. *Evolutionary Economics*. Beverley Hills, CA: Sage Publications.

Brandon, Robert. 1982. The Levels of Selection. Paper read at Philosophy of Science Association, 1982, at East Lansing.

———. 1999. The Units of Selection Revisited: The Modules of Selection. *Biology and Philosophy* 14 (2):167-180.

Brandon, Robert, N. 1990. *Adaptation and Environment*. Princeton, New Jersey: Princeton University Press.

———. 1996. *Concepts and Methods in Evolutionary Biology*. Edited by M. Ruse, *Cambridge Studies in Philosophy and Biology*. Cambridge, England: Cambridge University Press. Original edition, 1996.

Darwin, Charles. 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.

Hayek, F. A. 1982. *Law, Legislation and Liberty, 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.
Hodgson, G. M. 1993. Is Social Evolution Lamarckian or Darwinian? In *Darwinism and Evolutionary Economics*, edited by J. a. N. Laurent, John: Cheltenham: Edward Elgar.
———. 2002. Darwinism in Economics: From Analogy to Ontology. *Journal of Evolutionary Economics* 12 (3):259-282.
Hull, David, L. 1980a. The Units of Evolution. In *Studies in the Concept of Evolution*, edited by U. J. a. H. Jensen, R. London: The Harvester Press.
———. 1980b. Individuality and Selection. *Annual Review of Ecology and Systematics* 11:311-332.
———. 1984. The Units of Evolution: A Metaphysical Essay. In *Genes, Organisms, Populations: Controversies over the Units of Selection.*, edited by R. a. B. Brandon, Richard M. London: Cambridge, Mass., MIT Press. Original edition, 1980. In Studies in the Concept of Evolution, ed. U. J. Jensen, R. Harré. London: The Harvester Press.
———. 1990. *Science as a Process: An Evolutionary Account of the Social and Conceptual Development of Science*. Chicago: The University of Chicago Press. Original edition, 1988.
———. 2001. *Science and Selection: Essays on Biolgical Evolution and the Philosophy of Science*: Cambridge University Press.
Lewontin, R. C. 1970. The Units of Selection. *Annual Review of Ecology and Systematics* 1:1-18.
Mayr, Ernst. 1978. Evolution. *Sci. Am* 239:46-55.
———. 1988. *Toward A New Philosophy of Biology: Observations of an Evolutionist*. 1st ed: Cambridge. MA: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.
Nelson, R R and Winter, S G. 1982. *An Evolutionary Theory of Economic Change*: Cambridge, MA: Harvard University Press.
Plotkin, Henry C. 1994. *Darwin Machines and the Nature of Knowledge: concerning Adaptations, Instinct and the Evolution of Intelligence*. Harmondsworth: Penguin.
Ruse, M., 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.
Schumpeter, J. A. 1934. *The Theory of Economic Development, trans. R. Opie from the German edn of 1912*. Cambridge, MA: Harvard University Press.
———. 1976. *Capitalism, Socialism and Democracy*. 5th ed. London: George, Allen and Unwin. Original edition, 1942.
Veblen, T. B. 1899. *The Theory of the Leisure Class: An Economic Study of Institutions*. New York: Macmillan.