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Geoffrey M. Hodgson · Thorbjørn Knudsen

Dismantling Lamarckism: why descriptions of socio-economic evolution as Lamarckian are misleading

Abstract This paper addresses the widespread tendency to describe socio-economic evolution as Lamarckian. The difference between Lamarckian and Darwinian replication is clarified. It is shown that a phenotype-genotype distinction must first be established before we can identify Lamarckian transmission. To qualify as Lamarckian inheritance, acquired properties at the phenotypic level must be encoded in a genotype that is passed on to the next generation. Some possible social replicators (or genotypes) are identified, with a view to exploring possible distinctions between genotype and phenotype at the social level. It is concluded that the Lamarckian label does not readily transfer to socio-economic evolution, despite the fact that social genotypes (such as routines) may adapt within any given phenotype (such as an organisation). By contrast, no such problems exist with the description of socio-economic evolution as Darwinian.

Keywords Lamarckism · Darwinism · Evolution · Genotype · Phenotype · Memes · Habits · Routines

JEL Classification B52 · D20 · D83

G. M. Hodgson
The Business School, University of Hertfordshire, De Havilland Campus, Hatfield, Hertfordshire, AL10 9AB, UK

T. Knudsen
Department of Marketing & Management, University of Southern Denmark, Odense Campus, DK-5230, Odense M, Denmark
E-mail: tok@sam.sdu.dk

G. M. Hodgson (✉)
Malting House, 1 Burton End, West Wickham, Cambridgeshire, CB1 6SD, UK
E-mail: g.m.hodgson@herts.ac.uk

1 Introduction

Many prominent social scientists including Jack Hirshleifer 1982, Herbert Simon (1981), William McKelvey (1982), Richard Nelson and Sidney Winter (1982), Robert Boyd and Peter Richerson (1985), Friedrich Hayek (1988), and Arthur Robson (1995), have described socio-economic evolution as 'Lamarckian'.[1] Unfortunately, the precise meaning of the term, and whether or not it is meant to exclude Darwinism, is less frequently made clear. Critics of this Lamarckian label are few, including David Hull (1982, 1988) and John Wilkins (2001). Wilkins (2001) portrays it as an ambiguous term with three prominent and different meanings:

The *first* meaning of Lamarckism is the notion that acquired characters can or will be inherited. Jean Baptiste de Lamarck strongly promoted this idea, but it was not original to him.[2] We discuss this notion of Lamarckism extensively below.

A *second* strong theme in the writings of Lamarck, which he developed rather than originated, is the idea that evolution involves increasing complexity. Although later Lamarckians such as Herbert Spencer took up this idea, it has today grown beyond its Lamarckian associations, and is rarely associated specifically with the Lamarckian label.

A *third* use of the Lamarckian label associates it with the emphasis on will, choice, anticipation, or volitional activity in the process of evolutionary change. Many Lamarckians have invoked the concept of will or volition to explain the development of acquired characteristics (e.g. Butler 1878). However, Lamarck himself emphasised neither will nor volition, and their association with Lamarck's theory originates with his hostile critic Georges Cuvier (Lamarck [1809] 1984; Boesiger 1974; Burkhardt 1977).

In an obvious and general sense, the third meaning of Lamarckism is uncontroversial and does not exclude Darwinism. Although human mental capacities are more highly developed, most living organisms anticipate, choose, and strive for prefigured goals. These intentional factors generally play a major role in biological as well as cultural evolution, because the nature and sophistication of these cognitive mechanisms has an enormous bearing on adaptation and survival in the evolutionary process. This was a theme in Darwin's own writings, and has been developed by leading Darwinian biologists (Mayr 1960; Waddington 1969, 1976; Corning 1983). Darwinism does not deny intentionality, it simply insists that it has evolved in a causal process, and that intentions themselves are caused.

It is only in a special case, where these anticipative and purposive capacities are assumed to have somehow appeared independently of a Darwinian evolutionary process, that the third meaning becomes problematic. Yet this extraordinary version of the third meaning, with its open door to theism, is as far from Lamarck as one could imagine.

In its uncontroversial form, the third meaning acquires more bite when it is combined with the first meaning of Lamarckism above: volition thus becomes part

[1] The authors wish to thank Marion Blute, Peter Corning, Kevin Greene, David Hull, John Nightingale, Richard Nelson, the editor Uwe Cantner and two anonymous referees for comments on earlier versions. This paper is dedicated to David Hull, who inspired much of its argument.

[2] Lamarck ([1809] 1984, p. 113) himself believed in the stronger version of this thesis, that *all* acquired characters are inherited: 'All the acquisitions and losses wrought ... through the influence of the environment ... are preserved by reproduction to the new individuals'.

of the mechanism by which new characteristics are developed and acquired. But the third meaning says nothing about inheritance, which is the key element in the first meaning.

The volitional acquisition of characteristics is often contrasted to allegedly 'blind' or random mutations in some versions of Darwinism. In response, Darwin himself never wrote of random mutations, and in principle core Darwinian principles are broad enough to accommodate both contrasting accounts. Furthermore, the acquisition of characters is primarily a developmental phenomenon,[3] whereas genetic mutations necessarily involve changes in a genotype. For the comparison to be appropriate, it has at least to be upheld that acquired characters are encoded in the genotype *and* that the modifications in the genotype are passed on to offspring. In fact, Darwin (1859, 1868) himself believed in both these possibilities.

We accept the possibility, in the social if not the biological sphere, that a (social) genotype may be affected by a (social) phenotype, just as firms can affect their routines in the Winter (1971) and Nelson and Winter (1982) models. Our argument below concerns problems in the other part of the argument, concerning the *inheritance* of acquired characters. Hence the controversy surrounding the Lamarckian label centres mostly on the first meaning.

In two independently drafted papers (Hodgson 2001; Knudsen 2001), we asked if socio-economic evolution were Lamarckian or Darwinian? We upheld that both biological and social evolution are Darwinian, in the sense that Darwin's principles of variation, selection, and inheritance apply to both biological and socio-economic entities. This does not mean that the details of the evolutionary processes are similar; it means simply that broadly defined and generalized Darwinian principles apply to both domains (Hodgson 2002; Hodgson and Knudsen 2006). The idea that general Darwinian principles apply to social as well as biological evolution was suggested by Darwin (1859, 1871) himself and has been put forward by a number of subsequent authors.[4] The related insight that Darwinian principles apply to any level of biological organization, including molecules, cells, organisms, groups, species, and ecological communities was introduced by Lewontin (1970). Today, it is widely accepted (Brandon 1999).

We also pointed out that the proposition that socio-economic evolution is broadly Darwinian does not mean that a Lamarckian possibility is necessarily excluded. However, since the theoretical and experimental work of August Weismann (1893) this possibility has been generally excluded in modern biology, because there is no apparent mechanism by which the acquired characters of an Earthly organism can be transferred to its genotype.[5] But the units and mechanisms

[3] The organism's acquisition of characters in developmental or mature stages is commonly referred to as phenotypic plasticity.

[4] Notably Campbell (1965) and Dawkins (1983). See Hodgson (2004) for a historical account.

[5] There is a minority view among biologists that the inheritance of acquired characters may be possible in a restricted set of circumstances, such as the transfer of acquired immunities from mother to child (Steele 1979; Ho and Saunders 1984; Jablonka et al. 1992; Steele et al. 1998). We entirely abstain from evaluating these minority arguments in biology, and our argument here would be unaffected by either their validity or their falsehood. Our imaginary journey (see below) to Planet Lamarck is a thought experiment, asking the question: *if* Lamarckian inheritance existed, then what would be involved? It does not mean that we believe in the possibility of Lamarckian inheritance in biological organisms on Earth. And concerning life on other real planets, we have insufficient knowledge to form an opinion.

of socio-economic evolution are very different in nature and in human society. Does Lamarckian inheritance apply widely to the human but not the biological world? There is nothing in the general Darwinian principles that logically rules out this possibility; Lamarckism and Darwinism are not mutually exclusive. This is confirmed by inspection of the following definitions of these terms:

- **Darwinism** is a causal theory of evolution in complex or organic systems, involving the inheritance of genotypic instructions by individual units, a variation of genotypes, and a process of selection of the consequent phenotypes.[6]
- **Lamarckism** is a doctrine admitting the possibility of the (genotypic) inheritance of acquired (phenotypic) characters by individual organisms in evolutionary processes.
- **Weismannism** (or neo-Darwinism) is a doctrine denying the possibility of the (genotypic) inheritance of acquired (phenotypic) characters by individual organisms in evolutionary processes.

In our previous papers on this topic, after elaborating some of these arguments in detail, we concluded that the question of whether or not Lamarckian inheritance occurs in socio-economic evolution would have in part to be answered by empirical enquiry into the actual mechanisms of replication involved. If it did occur, it was argued, it would have to ensure some continuity and durability of the accumulated knowledge embodied in habits and routines, and the Lamarckian process would necessarily rely on the complementary Darwinian mechanism of selection. The overall outcome of our earlier discussions was to leave the question of the extent of Lamarckism in socio-economic evolution open. In the present article we go further, by considering the conceptual limits to Lamarckian socio-economic evolution in more depth.

The popularity of the Lamarckian description of socio-economic evolution is extraordinary. It is not the aim of the paper to explain this popularity: instead we concentrate on the problematic nature of the label. To some it may appear obvious that key human phenomena such as learning allow the development and transmission to subsequent generations of adaptations much more rapidly than among other species. For some, this difference substantiates the description of socio-economic evolution. We fully accept that cultural transmission in human societies occurs and is much more important than in other species. Human culture is unique in its nature, dimensions and significance.

However, such observations do not themselves justify the Lamarckian label. Lamarckism involves the *inheritance* of acquired characteristics. Inheritance means more than merely 'passed on'. If it were merely the latter then the spread of a virus among members of any species would be evidence of Lamarckism. No biologist regards such epidemiological contagions as Lamarckian. The concept of inheritance is and must be invested with a different meaning: it must involve transmission from some kind of genotype to another of the same kind. That is why

[6] In biology, the genotype is the complete genetic coding of an organism, consisting of instructions on how it should grow and develop. Many of these instructions depend upon environmental triggers or stimuli. The phenotype is its actual character, including its behavioural propensities and capabilities. Each individual phenotype develops according to the instructions in its genotype and the influence of environmental conditions. As noted below, there is a close parallel here with the allied concepts of replicator and interactor.

the genotype–phenotype distinction is essential to any full definition and explanation of a Lamarckian process. Those that think otherwise are challenged to provide a definition of Lamarckism that uses the concept of inheritance in a sense that excludes contagion.

The genes are not the only form of genotype, even in the biological sphere. Following many other authors, we propose that genotypes (or replicators) exist at the social as well as the biological level. Candidates include ideas, memes, habits and routines. The possibility of Lamarckism at the socio-economic level hinges on the existence of two mechanisms: one that encodes acquired phenotypic characteristics in the genotype and another that conveys the acquired characteristics from social genotype to social genotype. We examine this possibility below.

This paper is organised in four sections. The second section concerns biological evolution and the theoretical reasons why any Lamarckian transmission must be limited (if indeed it exists at all) in any biological system. Several of these theoretical reasons turn out to have a broader applicability than to biology alone. The general significance of the genotype–phenotype distinction is also established. We show this by a visit to an imaginary planet where Lamarckian transmission does exist among its biological species. This sets the stage for the discussion of socio-economic evolution in the third section. Some possible social genotypes are considered, with a view to exploring possible distinctions between genotype and phenotype at the social level. We then consider the possibility of, and limits to, Lamarckian transmission in socio-economic evolution. The fourth section concludes the essay.

2 Problems on Planet Lamarckism

To explore further the theoretical limits to Lamarckism, we consider the viability of a hypothetical inheritance system on Planet Lamarck. We shall later explain the significance of this discussion for socio-economic evolution on Planet Earth. The first humans to explore Planet Lamarck were a group of evolutionary economists and organisation theorists.[7] They observed the reproduction of several species, including a giraffe-like organism. They noted that with each generation some characteristics would be exaggerated. With the giraffes, for example, each generation would give rise to offspring with a longer neck, resulting in a discernable increase in neck length through the giraffe lineage, from generation to generation.

One evolutionary economist quoted Joseph Schumpeter and argued that this evolutionary process seemed to operate in the giraffe species as if ‘from within’. But her colleagues pointed out that the increase of neck length occurred in an environment where the giraffes depended on sustenance and were reaching for the uppermost leaves in the trees, so the impact of the environment should not be ignored. They persuaded each other that biological evolution on this planet was in fact Lamarckian, and similar in its essentials to the Lamarckian processes of socio-economic and cultural evolution that they had analysed in human society on Earth. Accordingly they named the planet ‘Lamarck’.

[7] Our lawyers have urged us to state that any resemblance to any living evolutionary economist or organisation theorist is purely coincidental.

In their report on the biological evolution of organisms on this planet the social scientists included the diagram in Fig. 1. Their account of the evolution of organisms on Planet Lamarck noted the individual developmental process of each organism from O_i to O_i' in each generation i, subject to environmental influences E_i. The offspring in the next generation inherited and started with the acquired characteristics of O_i' in the form O_{i+1} and these were in turn developed and augmented into O_{i+1}'. This process was then repeated indefinitely. The observers proposed that this was formally similar to their Lamarckian models of learning processes in human organizations and cultures on Earth, where in each discrete stage, knowledge K_i builds on and develops to K_i' while adapting and testing in environmental conditions E_i, and this knowledge is accumulated and transmitted onto the next stage.

The social scientists added a caveat in their report that they did not have training in biology and it would be necessary for a group of evolutionary biologists to explore Planet Lamarck in order to confirm their observations and results. The evolutionary biologists on Earth were very critical of the report. They asked: how could it be possible for a characteristic acquired in the development of one organism to be passed on to the next generation? The next generation is not a mere photocopy of its predecessor, so what mechanism could account for the transmission of these characteristics from generation to generation?

In addition, the evolutionary biologists on Earth pointed out that the model portrayed in Fig. 1 cannot distinguish between genuine inheritance and virus-like contagion. This distinction again depends on attention to the mechanisms of inheritance that were treated inadequately in the report by the social scientists.

The critics also objected that this picture of 'Lamarckian' inheritance does not explain why 'acquired' improvements are favoured over acquired impairments or injuries. If an organism becomes aged or infirm, or is injured or mutilated, then no reason is given why these impairments are not immediately passed on to the offspring. Presumably, these characteristics would also be apparent at their birth. So newborn giraffes would not only have necks as long as their parents, but would also inherit any rheumatism, diminished virility and failing eyesight. The newborn giraffe would have the same neck length as its mother, and it would not fit into her womb. If valid, Lamarckism cannot entail that the next generation starts where the previous generation ends.

In their application for a research grant to finance a second exploration of Planet Lamarck, the evolutionary biologists hypothesised for these reasons that it was unlikely that all acquired characters would be inherited. There must be some mechanism that prevented this.

They also set out a framework using the biological concepts of genotype and phenotype. They noted that in particular the evolutionary economists had made little use of these key concepts, but these were necessary to sustain an adequate

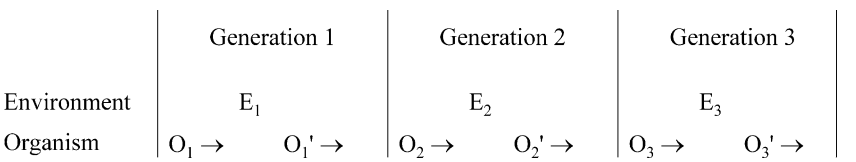

Fig. 1 A process of evolution (or contagion?)

account of Lamarckian evolution on Planet Lamarck or elsewhere, if indeed it existed. They also noted that other theorists of social or cultural evolution, including enthusiasts of 'memes', had either failed to mention the genotype–phenotype distinction in that context, or failed to reach a consensus in the identification and consistent specification of the meme-genotype or the meme-phenotype (Dawkins 1976; Blackmore 1999).[8]

Pouring more scepticism on the claims of the memeticists and other social scientists, the evolutionary biologists cited a paper by Hull (1982) that argues that memetic evolution could not be Lamarckian, but must be Darwinian. For Hull (1982, p. 278) 'social learning is not an instance of the inheritance of acquired characters'. For him, it is more like epidemiological infection or contagion. He thus rejects the notion that Lamarckian transmission is involved. For Hull (1982, p. 309), the inheritance of acquired ideas or memes is not an instance of the inheritance of acquired characters, because ideas and memes are analogous to genes, not characteristics. '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.' If we make this important distinction, and if we choose to treat memes or ideas as genotypes, then the spreading of ideas or memes is like the spreading of organisms, and does not necessarily involve the inheritance of acquired characters.

Social learning and cultural transmission can be other than the contagious spread of ideas, but only if meaningful social genotypes (or replicators) exist. We believe they do, as explained below. A key point made by Hull is that the transmission of ideas or memes is the spread of entities that are closer to genotypes not characteristics. If we deny this, or regard the genotype–phenotype distinction as unwarranted, then we have no way of distinguishing between acquired character inheritance and contagion.

In emphasising the importance of the genotype–phenotype distinction, the evolutionary biologists expanded the crude evolutionary picture in Fig. 1, into the more sophisticated presentation in Fig. 2. In both cases, the diagram omits a selection effect in order to focus on Lamarckian inheritance. The presence of selection would add an effect at the population level where entities with less fit phenotypes would exit the population and, as a consequence of their exit, the distribution of genotypes would change (because their genotype might be eliminated from the population). New entities would enter as a consequence of replication, with the more fit phenotypes leaving more replicas than the less fit. This would further alter the distribution of genotypes. In the presence of a fairly stable environmental factor and a replication process that reliably transmitted genotypes between generations, the population would slowly and systematically adapt to the environmental factor. The biologists knew all this, but following good

[8] 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.

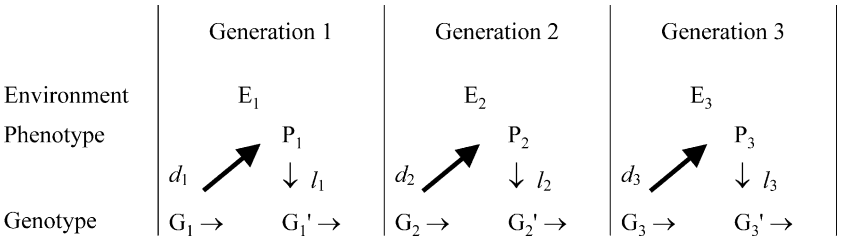

Fig. 2 An expanded evolutionary schema with Lamarckian inheritance

scientific practice, they wanted to examine the effect of Lamarckian inheritance in isolation.

Figure 2 illustrates the supposed inheritance process on Planet Lamarck, with its reported inheritance of acquired characters.[9] The symbols G_i and, G_i' refer to the genotypes of organism i in a lineage of organisms. P_i refers to the developed phenotype. In order to keep the presentation simple, we have not distinguished between stages of phenotypic development in the figure. It must be emphasised that phenotypic development is an outcome of both the genotype and the environment. In the construction of a more complete evolutionary theory, developmental process must be brought fully into the picture.

The first organism has a genotype G_1 that instructs its development d_1 (denoted by a thicker arrow) into phenotype P_1. This phenotype reflects environmental conditions E_1 as well as genotypic characteristics G_1. Somehow, through a process of Lamarckian inheritance l_1 (denoted by a down-pointing arrow), some or all of the characteristics of this phenotype are encoded in the same organism's genotype, so G_1 transforms into G_1' . Of course, such Lamarckian inheritance l is minimal or absent at the biological level on Earth. But on Planet Lamarck, we can consider the possibility that a fraction of information might be transferred with an organism from phenotype to genotype. Some or all of this information might be transferred in process l.

Next, through mating or whatever, replication occurs. So the information in genotype G_1' is passed on to the next generation in the form of genotype G_2. The same process repeats in this and subsequent generations. By the time we have reached the third generation, the genotypic outcome G_3' carries information gathered from its ancestral genotypes, including some accumulated phenotypic information encoded in genotypes, reflecting previous environmental conditions E_1, E_2 and E_3.

The evolutionary biologists noted that without the conceptual distinction between genotype and phenotype, the 'phenotype' and the 'genotype' rows in Fig. 2 would be conflated into a single row, and the characteristically Lamarckian process l would disappear from the picture. Accordingly, claims that (biological or socio-economic) evolution is Lamarckian, whether valid or not, depend on a clear distinction between genotype and phenotype in order to be adequately meaningful. Relatively few of the previous advocates of Lamarckian socio-economic evolution have paid sufficient attention to this point. This is curious because the very

[9] Similar multi-level transmission diagrams can be found in Boyd and Richerson (1985) and Durham (1991), and are now in widespread use in the literature.

existence of Lamarckian transmission turns on the phenotype–genotype distinction (Aunger 2002; Hull 1982, 1988, 2000).

Some Lamarckians have denied that developments such as the growth of a giraffe's neck must result from genotypic instructions. It is here that the third and 'volitional' interpretation of Lamarckism is sometimes invoked. But even if the giraffe could use its own will power to stretch its neck, we would then have to explain why the giraffe has a disposition to act purposefully in this manner.[10] The cause and evolutionary origin of this volitional propensity would itself have to be explained. No answer to this question is available except for a Darwinian one, in which such a wilful propensity somehow gives the giraffe a fitness advantage and it is thus favoured by natural selection. But this argument also requires that the volitional propensity is itself genetically encoded. Consequently, the propensity to stretch the neck again derives from the biological genotype.

Lamarck ([1809] 1984, p. 113) himself argued that 'a more frequent and continuous use of any organ gradually strengthens, develops and enlarges that organ ... while the permanent disuse of an organ imperceptibly weakens and deteriorates it'. This famous Lamarckian principle of 'use and disuse' does not help matters either. Again we must search for a causal explanation, why the use of an organ leads to enlargement or strengthening, and disuse to diminution. For these processes to occur in a systematic way, there must be a mechanism in the body that reacts to use or disuse, and causes such strengthening or weakening. This mechanism must be inherited, and thus must be an outcome of the genotype. Hence Lamarck's principle of 'use and disuse' cannot escape the requirement that the outcomes derive from instructions in the genotype played out in specific environmental conditions.

In systems without Lamarckian inheritance, the environment impacts on a distribution of genotypes solely through a process of selection on the expressed phenotypic properties (traits) present in the whole population. Some phenotypes are less adapted than others to a given environment. Given a systematic relationship between genotypes and phenotypes, the gene pool can thus change from generation to generation as a result of selection (Price 1995). On Planet Lamarck, selection can occur, but by contrast it is no longer necessary to account for the evolution of the genotype. Accordingly and historically, Lamarckians such as Herbert Spencer gave relatively less emphasis to selection in their evolutionary theory.

In their grant application, the evolutionary biologists elaborated the following theoretical argument. The *inheritance* of acquired characters has to be distinguished from something akin to epidemiological infection or contagion, where one phenotype influences a second phenotype without corresponding changes in the second genotype. A newborn giraffe's propensity to grow a longish neck must be encoded in the genotype of the newborn giraffe. Especially with Lamarckian transmission, this genotypic inheritance mechanism is necessary to avoid newborn giraffes having necks as long as their parents. Instead these offspring inherit a

[10] Additionally, we would also have to explain the presence of the level of phenotypic plasticity defining the giraffe's behavioural options (how much can it choose to stretch its neck?). In principle, nothing in the Lamarckian argument precludes that the giraffe would be able to change the level of phenotypic plasticity through volition. However, accepting this argument clearly exposes the untenable logic of Lamarckism.

genotypic propensity to grow long necks. This genotypic propensity is passed from generation to generation.

However, there is nothing specifically Lamarckian about the inheritance of a propensity to grow a long neck. Earthly giraffes inherit such a propensity, without Lamarckian meddling with their DNA. For Lamarckian inheritance to occur, the longer necks of the parents must further *enhance* the propensity to grow a long neck that is encoded in their genotype, and this *enhanced genotypic propensity* must then be passed on to the genotype of their offspring. Hence Lamarckian replication must involve the following two essential stages:

(L1) although its genotype already contains instructions to develop a particular characteristic, (such as a long neck) this realised phenotypic outcome somehow causes *an amplification of these genotypic instructions*, to enhance this characteristic even further; and
(L2) through reproduction, the instructions that favour this *additional* development are also passed on to the next generation.

Compare these points with the definition of Lamarckism by Hull (2000, pp. 55–6), who wrote

> inheritance is Lamarckian if the environment changes the phenotype of an organism in such a way that this organism is better adapted to the environmental factor that produced this change. This phenotypic change must then be transmitted somehow to the genetic material so that it can be passed on to the offspring of the organism through reproduction. These offspring then are born with this acquired characteristic more highly developed or with a strong tendency to produce this characteristic more highly developed. Lamarckian inheritance is the literal inheritance of acquired characteristics. The transmission must be genetic, and the relevant effect must be phenotypic.

Hull's formulation is close to ours.[11] A key element in both L2 and Hull's statement requires further emphasis. The Lamarckian 'inheritance of acquired characteristics' must mean more than the mere inheritance of the capacity to grow a long neck. The genotypic instructions that lead to the realisation of this outcome must somehow lead to the amplification of those instructions. Accordingly, Lamarckian organisms must have genotypes that provide positive feedback on the genotypic instructions that promote this growth.

Having clarified the meaning of Lamarckian inheritance, the evolutionary biologists produced some reasons for being sceptical of its existence. The first argument identified some dangers in excessive feedback from phenotype to genotype. Given that particular environmental cues trigger only a subset of a large range of phenotypic possibilities, an organism represents only one of the adaptive outcomes that are possible given its genotype. The genotype carries the accumulated wisdom of past generations, in many environments. To preserve this

[11] Note, however, that by insisting that 'Lamarckian transmission must be genetic' rather than more broadly genotypic, Hull seems to immediately rule out the possibility that (literal?) Lamarckian transmission may exist using social and other genotypes, which are not genes. Rather than excluding the possibility of Lamarckian social evolution by an act of definition at the outset, we prefer to replace the restrictive term 'genetic' by the much broader terms 'genotypic' or 'genotype' and explore the Lamarckian possibility in that context, as we do in the next section.

valuable heritage, this genotypic 'baseline' must not adjust too rapidly in response to current phenotypic outcomes.[12] Accordingly, Lamarckian inheritance would somehow have to preserve much of the genetic material that is not actually expressed in the current phenotype. Hence Lamarckian inheritance cannot be so strong that it distorts or overwhelms this legacy.

The problem of altering genetic instructions to correspond to phenotypic change gets even worse if we examine the required mechanism of back-translation. Back-translation of an acquired trait requires an accurate identification and modification of the genes that correspond to this and only this trait, such as a long neck. For example, error in back-translation of an acquired long neck might instead promote a smaller neck or larger feet.

All this presumes that the environment acts like an expert computer software redesigner, as if understanding the complex interconnections between each piece of coding and knowing which instructions to preserve and which to modify. Additionally, it must be anticipated how the environment interferes with genetic instructions as the new organism develops from embryo to maturity. Such a degree of detailed, complicated and fortuitous reprogramming is very unlikely to happen in the haphazard and undersigned turmoil of nature. Readily solving the problem of back-translating phenotypic traits to genetic information requires a one-to-one mapping of phenotype onto genotype. No such mapping is known in biology or elsewhere.[13]

Another problem concerns the very meaning of an acquired character. The evolutionary biologists pointed out that logically there were two entirely different types of acquired characters, depending on whether it (a) resulted, or (b) did not result, from instructions in the genotype. In the first case, there is nothing specifically Lamarckian about a character resulting from its genotypic coding. As argued above, Lamarckism must refer to the additional process by which the genotype somehow encodes the characteristic in its enhanced form, so that the next generation does not have to start developing from the same starting point.

In the second case, the 'acquired character' does not result from instructions in the genotype. Neither can it result from (unintentional or intentional) behaviour in the organism, because behavioural dispositions may themselves be genetically inherited. The remaining possibility is an accidental impact of the environment. Unfortunately, however, in any realistic case most accidental impacts result in injuries. Hence the most straightforward case of an acquired characteristic is an injury. But for species to evolve, such injuries must be limited. Hence the effects of both types of 'acquired character' must be highly limited for evolution and adaptation to be sustained through time. To provide a complete explanation, we need to account for the existence of sufficiently tight limits that disallow inheritance of useless and injurious characters. The only possible explanation for the evolution of the limits that are required to filter the many useless and injurious characteristics is natural selection. Accordingly, Lamarckism depends on the Darwinian principle of selection in order to explain why any disastrous propensity to inherit acquired impairments does not prevail. As Richard Dawkins (1986, p.

[12] See Maynard Smith and Szathmáry (1999), Knudsen (2001, 2002a). DNA has a remarkable mechanism for limiting mutations. Consisting of two strands, one strand can be checked against the other by an enzyme, and if necessary repaired by other enzymes.

[13] Recent work in biology implies that the mapping of phenotype onto genotype is many-to-one or even many-to-many (Stadler et al. 2001).

300) argues, 'the Lamarckian theory can explain adaptive improvement in evolution only by, as it were, riding on the back of the Darwinian theory.' Lamarckism, if valid in any particular domain, depends on Darwinian mechanisms of selection for evolutionary guidance.

Lamarckian inheritance requires natural selection for guidance, hence it must not over-reach the effects of natural selection. We know that natural selection works very slowly and erratically, so that the generational effects of any Lamarckian inheritance, with its strong injurious bias, must be small by comparison.

Consider if there were competition on Planet Lamarck between Lamarckian and non-Lamarckian species. For Lamarckian inheritance to be prevalent it must bestow an advantage. But much acquired character inheritance is disadvantageous or injurious. The most obvious advantage for Lamarckian inheritance is that it may allow the enhancement of fortuitous adaptations to a given environment. However, this advantage would be reduced in complex or changing environments, because Lamarckism might lead to the species being too quickly locked in to an inferior peak in the fitness surface. Accordingly there are good theoretical reasons, as on Earth, why biological evolution is largely or entirely non-Lamarckian.

Hence Lamarckism faces severe *theoretical* limits that may be derived independently of the empirical investigation into the inheritance process. The evolutionary biologists made all these theoretical points in their research grant application, and then made the case that empirical enquiry into the inheritance mechanisms on Planet Lamarck was essential to ascertain whether such an unlikely outcome of Lamarckian inheritance did in fact exist. They left for Planet Lamarck some time ago, and we have yet to receive their research report.

In the meantime, it was noticed by some social scientists that many of the key points in the application for research funding for the journey to Planet Lamarck were quite general, and applied to all cases of evolution with a population of replicating entities. Accordingly, the key theoretical observations of the evolutionary biologists, as outlined in this section, applied also to socio-economic or cultural evolution on Earth, which several other authors had claimed to be essentially Lamarckian. It is the purpose of the next section to report the implications of this wide-ranging observation.

3 Back to socio-economic evolution on Planet Earth

One of the messages of the fable in the previous section is that the distinction between genotype and phenotype is vital to understand the mechanisms of an evolutionary process involving inheritance and replication. Any specification of a fully fledged evolutionary process, involving a population of developing and replicating entities, must clearly identify the relevant genotypes and phenotypes. This is quite a general point, and applies to socio-economic and cultural evolution in human society, as well as to biological systems. In particular, any claim that

socio-economic or cultural evolution is Lamarckian depends on the genotype–phenotype distinction for its explication.[14]

Remarkably, however, despite frequent claims of Lamarckism in these literatures, works in evolutionary economics, organisation theory, evolutionary anthropology and memetics seldom make use of the genotype–phenotype distinction, or explore the nature of genotypes or phenotypes in their domain.[15] There is much loose discussion of the transmission of ideas, beliefs, knowledge or memes, but relatively little dissection of the precise processes involved.

We now apply the key insights of the preceding section to evolutionary processes in economies and societies. First we ask by what criteria a (biological or social) entity qualifies as a genotype. There is relatively little discussion of this question in the literature. Dawkins (1976) argued that a replicable genotype must have the characteristics of longevity, fecundity and replicative fidelity. Our DNA replicates with a high degree of precision and with a low probability of mutation. By contrast, in the social domain, no candidate social genotype gets close to DNA by Dawkins's criteria. We have to search for other distinguishing criteria.

These criteria must be able to identify social genotypes, which by definition are not inherited biologically, which act as stores of social dispositions, rules and knowledge, and which can guide the development of human patterns of behaviour and social structures, depending on the overall context. Social genotypes are neither genes nor DNA; they are replicated by other means. A social genotype is a complex of dispositions to behave in particular ways in particular situations. These behaviours may include thoughts as well as actions.

Additional criteria become available when we consider the role of a genotype as a replicator. The division between replicator and interactor closely parallels the distinction between genotype and phenotype. As Robert Brandon (1996, p. 125) put it, the distinction between replicators and interactors 'is best seen as a generalization of the traditional genotype–phenotype distinction'. Accordingly, using the two distinctions in conjunction, further highly general criteria become available. In his application of Darwinian principles to the evolution of scientific knowledge, Hull (1988, p. 408) usefully defines a replicator as 'an entity that passes on its structure largely intact in successive replications' and 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.'

Furthermore, detailed and general definitions of replication have been developed by Peter Godfrey-Smith (2000), Dan Sperber (2000), and Robert Aunger (2002). There are slight differences between their formulations, but all agree on the centrality of the following necessary criteria for replication. (1) *Causation:* the source must be causally involved in the production of the copy. (2) *Similarity*: the copy must be like its source in relevant respects. And (3) *Information transfer*: the process that generates the copy must obtain the information that makes the copy similar to its source from that same source.

Our next task is to locate some possible social genotypes. A number of candidates can be put forward, including (a) ideas, (b) memes, (c) habits of thought

[14] However, Price's (1995) general formulation of the concept of selection does not make use of the genotype–phenotype distinction (Knudsen 2004). The distinction becomes important when the mechanisms of replication and transmission are considered. The significance of the genotype–phenotype distinction was established in Darwinian biology in the twentieth century.

[15] Winter (1971), McKelvey (1982), Hull (2000) and Aunger (2002) are among the exceptions.

or behaviour, or (d) organizational routines. These are not necessarily mutually exclusive, and other possible social genotypes may exist. Several memeticists have proposed that the 'meme' is a general concept that covers all other possibilities. More detailed analyses of the characteristics and mechanisms regarding (c) and (d) are presented elsewhere, in which organizational routines depend on individual habits as a substrate.[16]

3.1 Ideas or memes as social genotypes?

First we consider ideas and memes as possible genotypes. We noted above that there has been some apparent difficulty in enforcing a distinction between genotype and phenotype in the case of ideas and memes. With regard to ideas, can these be (genotypic) instructions that drive behaviour, or (phenotypic) rationalisations of preceding actions or attitudes, or both? Similarly, are ideas or memes replicators or interactors, or both? Without answers to these questions, there is no possibility of adjudicating on the question of whether memetic evolution is Lamarckian or not. Describing such evolution as Lamarckian would at best be ungrounded and premature.

Some meme enthusiasts wish to retain a broad definition of the meme, and end up treating the meme as a genotype in one context, and a phenotype in another. This creates havoc with discussions of whether or not memetic transmission is Lamarckian. Blackmore (1999, pp. 61–2) proposes that whether memetic evolution is Lamarckian or not depends on whether it is meme-as-behaviour or meme-as-instructions that is being copied. She argues that copying-the-product brings the possibility of Lamarckian inheritance of acquired modifications to the outcome, whereas copying-the-instructions does not; any alterations in behaviour or outcome will not be passed on, because it is the instructions, not the outcomes, that are being replicated.

However, even if we regard the meme-as-behaviour, and consider the copying of outcomes, it is still misguided to jump to the conclusion that a Lamarckian possibility exists. In particular, the identity of the genotype behind the (phenotypic) meme-as-behaviour is unclear. If this genotype is literally the genes, then the analysis switches back to biological mode, where we know that Lamarckian transmission is largely or entirely ruled out by the Weismann barrier. Alternatively, for those that treat the meme as behaviour, there must be some *social* genotype that corresponds to that behavioural phenotype. But this remains unidentified. Consequently, within the meme-as-behaviour version of memetics, no case for regarding memetic transmission as Lamarckian has been adequately established.

Some prominent proponents of the meme treat it as a genotype and a replicator, rather than a phenotypic phenomenon, such as behaviour (Aunger 2002; Hull 1982, 2000). Hull convincingly argues that memetic transmission, where memes are treated as ideas and genotypes, cannot legitimately be described (literally or metaphorically) as Lamarckian. Hull (1982, p. 311; 2000, p. 87) starts from the view that 'memes are analogous to genes, not characteristics'. Consequently, memes may be modified or acquired, but this is neither the modification nor the acquisition of a characteristic. Memetic transmission is the inheritance of acquired

[16] See Hodgson (2003), Hodgson and Knudsen (2004), Knudsen (2002a,b, 2004).

memes, and memes are genotypes not phenotypic characteristics. Accordingly, social learning and other forms of memetic transmission cannot be instances of the inheritance of acquired characters. For Hull, the replication and spread of memes is more like epidemiological infection or contagion. In conclusion, if we treat the meme as a genotype and a replicator, then any description of memetic transmission as Lamarckian is mistaken.

3.2 Habits or routines as social genotypes?

Let us now explore the possibility of habits and routines as social genotypes. In a series of essays (cited in the preceding footnote) we have explored the possibility of regarding habits and routines as replicators (or genotypes). This strategy avoids some of the vagueness and difficulties associated with the 'meme', but creates further problems for the use of the 'Lamarckian' label in the socio-economic context, as we shall explain below. We treat habits and routines as dispositions, rather than expressed behaviour as such. If we acquire a habit we do not necessarily use it all the time. It is a *propensity* to behave in a particular way in a particular class of situations.

Similarly, we have argued that it is also preferable to treat routines as propensities (Hodgson 2003; Knudsen 2002a). As Levitt and March (1988, p. 320) put it: 'The generic term "routines" includes the forms, rules, procedures, conventions, strategies, and technologies around which organizations are constructed and through which they operate.' Michael Cohen et al. (1996, p. 683) concur in treating a routine as a disposition: 'A routine is an executable *capability* for repeated performance in some *context* that [has] been *learned* by an organization in response to *selective pressures.*'

In evolutionary, developmental and functional terms, instinct comes before habit, and habit comes before belief and reason. Instincts provide inherited behavioural cues that guide us initially in our newborn state. Then our actions, resulting from instinct or cultural interaction, lead to the formation of habitual dispositions. In turn, these habits or dispositions form the basis of our conceptualisations and beliefs. Thus, habits are the basis of both reflective and nonreflective behaviour (Kilpinen 1999, 2000; Hodgson 2004).

The evolution of instincts, which by definition are inherited genetically, is a matter for biology. We know that Lamarckian transmission is essentially ruled out in biology, and human instincts evolve very slowly. By contrast, habits are largely a cultural phenomenon and can evolve much more rapidly. They are dispositions that are acquired through repeated mental or physical behaviours, in specific social contexts. Habits can sometimes spread through a culture, resulting in a remarkable uniformity of dispositions and eventually beliefs, even in a large society.

3.3 Can habit replication be described as Lamarckian?

Our theoretical strategy is to treat habits as genotypes, in the sense that they preserve and transmit social roles, attitudes, knowledge and skills, and act as the relatively durable substrate of all beliefs and deliberative reason. To establish this point fully would be to divert us from the main theme of this essay, but our reasons

are laid out more extensively elsewhere, as well as in the pragmatist literature as a whole.[17]

An important corollary is worth raising at this stage. From the biological point of view, habits are part of the biological phenotype; they are expressions of genetic instructions in interaction with the environment. However, from the social viewpoint, habits become genotypes. This is partly because they satisfy the conditions of longevity, fidelity and fecundity, relative to the shorter time-scales and wider margins at the social level. An aspect of the phenotype at one level becomes a potential genotype at a higher level, but under different standards of longevity and fidelity. Although the relevant criteria to establish such classifications are not yet sufficiently refined, the general idea of phenotypic features acting as genotypes at a higher level is necessary for a multiple level selection theory. Accordingly, habits are both phenotypes (with regard to genetic replicators) and genotypes (with regard to socio-economic evolution).

Addressing the replication of habits, first consider habits relating to observable behaviour. Unlike the replication of DNA or computer viruses, habits of behaviour do not directly make copies of themselves. Instead they replicate indirectly, by means of their behavioural expressions. They can impel behaviour that is consciously or unconsciously followed by others, as a result of incentive or imitation. It is possible, but not always necessary, that codifiable rules or instructions are also involved. Eventually, the copied behaviour becomes rooted in the habits of the follower, thus transmitting from individual to individual an imperfect copy of each habit by an indirect route. Referring to the definition of replication by Godfrey-Smith, Sperber and Robert Aunger noted above, in what sense is a replicated habit of behaviour *similar* to the one from which it derived? The similarity results from the shared propensity to perform similar behaviours under similar conditions.

Often we repeatedly follow the behaviour of others, because of an instinctive or acquired disposition to conform. Behaviour can also be moulded by incentives or constraints, giving reasons to acquire specific customs, follow particular traffic conventions and use specific linguistic terms. In following others, we too build up habits associated with these behaviours. The behaviours are imitated and also the habits giving rise to them are replicated.

Habit replication often relies on imitation. Imitation need not be fully conscious, and it will also involve some 'tacit learning' (Polanyi 1967; Reber 1993; Knudsen 2002a). Perhaps imitation can occur even without strong incentives, on the grounds that the propensity to imitate is instinctive, and this instinct has itself evolved for efficacious reasons among social creatures (Campbell 1975; Boyd and Richerson 1985; Simon 1990; Tomasello 2000). However, an imitation instinct might require an existing set of common behaviours in the group, otherwise an emerging propensity to imitate might not have a selection advantage. Furthermore, if imitation is more than mimicry, then the rules and understandings associated with it also have to be transmitted.

Because habits of thought are unobservable, they cannot replicate straightforwardly via imitation. To show how habits of thought are replicated, we need to

[17] See Hodgson (2004), Joas (1996) and Kilpinen (2002), as well as classics such as Dewey (1922) and Veblen (1914), and modern psychological approaches such as Ouellette and Wood (1998) and Wood et al. (2002).

consider how thoughts are limited by constraints that somehow bear upon mental activity. The replication of habits of thought is guided by similar external constraints and similar inborn constraints of brain design. However, such replication also requires the communication of similar mental models, so that two or more individuals may interpret given sense data in a similar way. Hence this replication process cannot be completed without the existence of a common language. The ability to refer to common mental models through language enables communication and thereby replication of mental models.

Of course, we must have some other prior instincts or habits that enable us to recognise incentives or imitate others. Habit replication thus itself depends on prior instincts or habits. Some kind of (social or biological) genotype has to exist for the behaviour to be imitated. It may operate via the copying of (phenotypic) behaviours, but always relies on prior genotypic instructions of some kind. Habit replication via a phenotype implies neither the absence nor unimportance of a genotype, at any stage of the process.

Can habit replication be Lamarckian? Hodgson (2001, 2003) suggested this elsewhere, even if this possibility is highly limited. Because the replication of some habits works through the phenotypic and behavioural level, any additional behavioural characteristic that did not relate to the original habit might also be transmitted to the receiver. With some habits, acquired characters can be inherited because their replication works through characteristics, not through the direct replication of the generative structures.

We now wish to refine this assessment of habit replication as potentially Lamarckian. We show below that it all depends on how we translate the Lamarckian steps L1 and L2 above from biological to social terms. The transmission of habitual genotypes is always indirect. Lamarckism would have to be rendered consistent with indirect transmission, yet the work of Lamarck himself, and much of relevant subsequent literature, relates to the biological world, where genotypic transmission is always direct rather than indirect. It is an important question (revisited below) whether indirect transmission should in principle be admitted within the Lamarckian schema.

Serious problems also arise with step L2. A Lamarckian process that is defined in these terms would require that the relevant aspect of the phenotype (an acquired thought or behaviour) of the first person was also back-translated into its genotype (habit). This may occur when repeated (phenotypic) thoughts or behaviours give rise to new or amended (genotypic) habits. But the phenotypic behaviour could be occasional or accidental and not encoded in a habit, yet still be imitated by the second person. Strictly, according to the formulation in L2, the first case would be Lamarckian but the second would not.

At first sight, this may seem to resolve the issue: a Lamarckian possibility exists with regard to the replication of habits, as long as the acquired behaviour gives rise

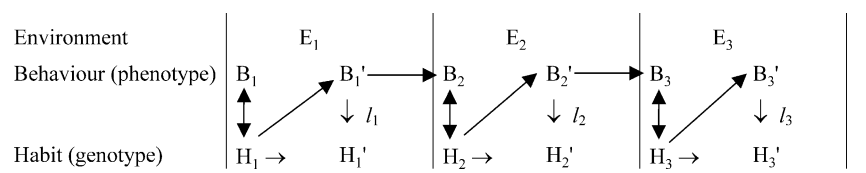

Fig. 3 The replication of habits of behaviour

to an enhanced habit in the first person before the behaviour is imitated by a second person. In Fig. 3, behaviour B_1 becomes ingrained in habit H_1. Practice and interactions with the environment lead to modified behaviour $B_1^{'}$ and modified habits $H_1^{'}$. The second agent copies this modified behaviour, and the process is repeated. A 'Lamarckian' process of habit transmission is shown in Fig. 3 by the downwards-pointing arrows *l* indicating the affect of the behavioural phenotype on the habitual genotype.

Comparing Figs. 2 and 3, there is an important difference in the role played by the 'Lamarckian' step *l*. As shown in Fig. 3, this step affects neither the genotype nor the phenotype of the person that imitates the behaviour. The modification of habit to $H_i^{'}$, which occurs just prior to the imitation, plays no role in the replication process or its result. The significance of this observation is that the definitionally essential Lamarckian step *l* plays no causal role in the replication process. The step leads into a causal cul-de-sac. What is crucial to the description of Lamarckian replication plays no vital role in the 'Lamarckian' replication of habits in the social domain! This outcome results from the fact that with the replication of habits, genotype-to-genotype transmission is indirect.

3.4 Can routine replication be described as Lamarckian?

Let us now consider the possibility of treating routines as organizational level genotypes. When routines are copied from organisation to organisation then this in part may involve the adoption by the imitator of similar and explicit rules and procedures. Even if routine replication consisted entirely of the 'blueprint' copying of codifiable procedures, then a Lamarckian description would still be inappropriate, for reasons similar to Hull's objection to the idea that meme replication is Lamarckian, as discussed above. Blueprint transmission of routines is the inheritance of genotypes. There is no inheritance of the additionally acquired phenotypic characteristics of the performed routines.

On the basis of extensive research on the nature of routines we know, however, that much of the know-how inherent in routines is tacit and often uncodifiable (Polanyi 1967; Nelson and Winter 1982; Hannan and Freeman 1989; Cohen and Bacdayan 1994; Cohen et al. 1996). The formation of routines operates via the creation of interlocked habits of individuals in a team. Hence habit replication is a part of routine replication. Often the routine must be observed and practised, because the transfer of blueprint information is not enough to consolidate the routine. As a result, the same problems that emerged with a 'Lamarckian' description of habit replication occur with the replication of routines.

There is an extensive debate within organisation science as to how changes in routines in firms occur, and whether the evolution of organisations and routines is a 'Lamarckian' process. Near one extreme is the view that rules and routines are difficult to alter within any specific organisation, and that changes occur principally through the selection and elimination of some organisations, rather than adaptations of routines within the organisations themselves (Hannan and Freeman 1989). A huge case study literature, too massive to begin citing here, testifies to the conservative nature of organisations, and the durability of their habits and routines, even when more productive or efficient alternatives exist. However, our purpose

here is not to adjudicate over the empirical claims but to consider the applicability of the 'Lamarckian' label to significant adaptation and change in the routines in any given organisation. The unfortunate fact is that the dispute within organisation science over the extent to which routines can adapt is typically described as a contest between 'Darwinian' and 'Lamarckian' conceptions of organisational change (Usher and Evans 1996).

In part, what is problematic is the broad use of the 'Lamarckian' label simply to describe the adaptation of routines within any given organisation. Such descriptions have nothing to do with the *inheritance* of characteristics (acquired or otherwise) from one organisation to another. The use of the Lamarckian label to categorise a process that does not explicitly involve inheritance is in defiance of most historical uses of the term.

In sum, we have explored several options for possible replicators in socio-economic evolution. Every one carries problems for the application of the 'Lamarckian' label in this domain. If the genotype–phenotype distinction cannot be applied, then the Lamarckian description is not meaningful. If it can be applied, then further problems arise. In the case of memes-as-genotypes the further problem is that memes may be modified or acquired, but this is neither the modification nor the acquisition of a characteristic. In the case of habits and routines, a crucial and defining Lamarckian step plays no causal role in the replication process.

The conclusion we draw is that Lamarckian concepts do not readily and meaningfully transfer from biological to social evolution. But, by contrast, we have found no similar barrier to the application of generalized Darwinian principles to the social domain. Darwinian concepts can be generalised more readily, to cover all evolving systems with replicating populations of some kind.

4 Concluding remarks

The Lamarckian possibility has a curious attraction in the social sciences. Despite there being scant evidence and inadequate conceptualisation of the actual mechanisms of replication in the social world, many argue that socio-economic processes are Lamarckian. But why would anyone favour the Lamarckian explanation over the Darwinian, given the difficulties and incompleteness of the Lamarckian explanation?

We have noted that enthusiasts of the Lamarckian label often emphasise the substantial transmission of knowledge and skill from one generation to another in socio-economic evolution, and that nothing like this occurs among other species. Our response is that this process does not involve the *inheritance* of acquired characters, in an adequate sense that excludes virus-like contagion.

Consider the difference between the spread of fashions in clothing, and the contagious spread of laughter around a room. In the latter case, as Dan Sperber (2000) argues, there is copying of laughing behaviour but without the copying of the *capacity* to laugh. There is no *inheritance* of this capacity: the ability to laugh already exists and it is triggered by the stimulus. Without such inheritance this process cannot be Lamarckian.

By contrast, the spread of a fashion can often lead to a change of individual preferences, habits or dispositions. If so, then the disposition to wear or admire particular styles of clothing is inherited. The Lamarckian description passes the

inheritance test, but it is only possible by making a distinction between behaviour and dispositions, close to the distinction between phenotype and genotype. Furthermore, as shown above, Lamarckian descriptions are unwarranted unless the acquired behaviour gives rise to an enhanced disposition in the first person before the behaviour is imitated by a second person. However, this enhanced disposition plays no role in the replication process or its result! The Lamarckian description may be strictly valid in this limited case only, but it is misleading because it illuminates no vital step in the inheritance process.

Explaining social evolution requires a valid inheritance model, one that identifies the underlying cause of the material that is transmitted among agents. Otherwise, there is no way of knowing whether observed changes are outcomes of selection processes, drift, or something else. Once we look at these processes, we can see that the inheritance of acquired characters is at most highly limited even in the socio-economic sphere.

Of course, the mechanisms of evolution in the social and the biological spheres are very different. But the irony, as we have shown here, is that the essential Lamarckian principles are more closely and exclusively related to the biological sphere than they are to the social, notwithstanding the fact that Lamarckian replication is rare or nonexistent with biological species on Planet Earth. The very concept of Lamarckism depends on relatively direct genotype-to-genotype replication, and a clear genotype–phenotype distinction. Prominent accounts of the replicators in socio-economic evolution lack one or both of these elements. Consequently, any use of the Lamarckian label to differentiate social from biological evolution would be misplaced and misconceived.

By contrast, the core Darwinian principles of variation, replication and selection seem to have a more general applicability, and evidently would apply to social as well as biological evolution. Those that insist that social evolution is Lamarckian often ignore the more accommodating nature of general Darwinian principles.

Against this, some organisation theorists propose that volition, deliberation, purpose, planning and learning cannot be explained by the simple primitives of the general Darwinian principles. For example, Baum and Ingram (1998) argue that organizations capable of adapting during their life-time are more Lamarckian than Darwinian. Similarly, Rigby and Essletzbichler (1997) and others, view change in firms resulting from profit-induced search, learning and imitation as Lamarckian. In particular, it has been argued that Lamarckian evolution promotes quick learning (Bruderer and Singh 1996; Nelson and Winter 1982).

These arguments are representative of a common and persistent usage of the ‘Lamarckian’ label in the literature on economic and organizational evolution. According to van de Ven and Poole (1995), those adopting Darwinian evolution of social organizations argue that traits are inherited through intergenerational processes whereas those following Lamarck argue that traits are acquired within a generation through learning and imitation. It is surprising to see that many works actually agree with this distinction and promote Lamarckian evolution over Darwinian (Hedlund 1994; Helfat 1994; Metcalfe 1994; Rosenberg 1992) even without much consideration of the nature of either form of evolution.

These arguments are problematic for a number of reasons. First, as shown by our definitions above, Lamarckism and Darwinism are not in principle mutually exclusive. Second, in order to speak of Lamarckian evolution, traits that are

acquired within a generation must also be inherited through intergenerational processes. The fast and loose conceptualisation of Darwinism and Lamarckism that is widespread in much of the literature on organisations is unfortunate because it uses a simplistic and insufficient distinction. Acquiring traits through learning and adaptation is a necessary condition of Lamarckism, but it is not sufficient. In order to qualify as Lamarckism, the acquired traits must also be encoded in a genotype that is passed on to the next generation. Third, in a Darwinian explanation by natural selection, the traits of an entity develop according to the instructions in its genotype and the influence of environmental conditions. The process of development opens the possibility that the individual entity adapts to the environmental conditions within the possibilities given by its instruction set. It is therefore important to understand how the genotype maps onto the phenotype. Moreover, the instructions for a character may be quite open-ended, allowing multiple conditional responses or a gradual fixation through learning. Rather than merely distinguishing between entities on the basis of the range of their behavioural options, we must carefully examine the underlying mechanisms of the transmission of such options.

Fourth, as regards the issue of Lamarckism promoting quick learning, it is unclear what is meant. Lamarckism surely promotes a quicker encoding of the properties of the environment, at least if we assume that acquired traits are somehow correctly back-translated into the genotype. However, this quicker encoding may have little effect on the pace of learning relative to the rate of replication. For example, viruses and bacteria reproduce themselves much more rapidly than most, if not all, ideas in the social realm (Hull 2000). In order to understand quick learning at the population level, we need to take a closer look also on replication strategies. And in order to understand individual level learning, we must examine how the genotype of an entity maps onto its phenotype.

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.

More generally, we believe that it is necessary and useful to make a distinction between social (i.e. non-genetic) genotypes and social phenotypes. Some primitive evolving systems do not have anything corresponding to a genotype, which carries generative information through time and somehow passes it from structure to structure. Nevertheless, more complex evolving systems are likely to develop genotypes and mechanisms of genotypic transmission. Otherwise, the phenotypes could soak up and transmit any environmental disturbance and cumulate irrelevant and erroneous traits. Genotypes provide a degree of baseline stability, so that vaguely efficacious selection of phenotypes can occur. Such stability, exhibited in substantial information storage and a high degree of cultural and institutional conservatism, is also characteristic of socio-economic evolution. Without social genotypes, the cumulation of every panic, craze, fad and fashion would completely disrupt the transmission and selection of tried and tested social knowledge.

We have shown that with the specification of plausible social replicators or genotypes, the Lamarckian description carries severe problems in the social

domain. Whether we regard ideas, memes, habits or routines as genotype and replicators, then the replication of each of these cannot properly and usefully be described as Lamarckian. No such a priori problems of transferability apply to the core Darwinian principles.

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