**NATURAL SELECTION VERSUS EMERGENT SELF-ORGANIZATION IN EVOLUTIONARY POLITICAL ECONOMY**

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Abstract:

 Political economies evolve institutionally and technologically over time. This means that to understand evolutionary of political economy one must understand the nature of the evolutionary process in its full complexity. From the time of Darwin and Spencer natural selection has been seen as the foundation of evolution. This view has remained even as views of how evolution operates more broadly have changed. An issue that some have viewed as an aspect of evolution that natural selection may not fully explain is that of emergence of higher order structures, with this aspect having been associated with the idea of emergence. In recent decades it has been argued that self-organization dynamics may explain such emergence, with this being argued to be constrained, if not overshadowed by natural selection. Just as the balance between these aspects is debated within organic evolutionary theory, it also arises in the evolution of political economy, as between such examples of self-organizing emergence as the Mengerian analysis of the appearance of commodity money in primitive societies and the natural selection that operates in the competition between firms in markets.

“This is the doctrine of Malthus, applied to the whole animal and vegetable kingdoms. 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.” - Charles Darwin (1859, p. 4)

“Every resultant is either a sum or a difference of the co-operant forces: their sum, when their directions are the same – their difference, when their directions are contrary. Further, every resultant is clearly traceable in its components, because these are homogeneous and commensurable. It is otherwise with emergents, when, instead of adding measurable motion to measurable motion, or things of one kind to other individuals of their kind, there is a co-operation of things of unlike kinds. The emergent is unlike its components insofar as these are incommensurable, and it cannot be reduced to their sum or their difference.”

* George H. Lewes (1875, p. 412)

**Introduction**

 The evolution of human beings has increasingly operated through the political economic systems that they live within. Those living in more productive systems have survived and reproduced better than those who do not. This process resembles evolutionary natural selection as it operates more broadly within nature. Thus, the evolution of such systems has become central to the evolution of the species as a whole. This view first found expression with such figures as Herbert Spencer (1851) and Darwin (1871), although the principal mechanism by which this cultural evolution operated was through the Lamarckian (1809) mechanism of the inheritance of acquired characteristics.[[1]](#footnote-1) Among those coming to agree with this view late in his life was Friedrich Hayek (1979, 1988),[[2]](#footnote-2) although many others did so as well (Marshall, 1890; Veblen, 1898; Schumpeter, 1911; Alchian, 1950; Boulding, 1978; Nelson and Winter, 1982; Rosser, 1992; Hodgson, 1993).

 It was Spencer (1852) who first coined the term “natural selection,” although it was Malthus (1798) who inspired not only him but also both Darwin and Alfred Russel Wallace in their independent breakthroughs in discovering the “Darwinian” theory of organic evolution (Darwin and Wallace, 1858). The lack of knowledge of how inheritance operated through genetics later led to a long period in the late 19th and early 20th centuries, in which the Lamarckian theory of inheritance of acquired characteristics came to dominate under the influence of Spencer and others until the neo-Darwinian synthesis combined knowledge of Mendelian genetics[[3]](#footnote-3) with probability theory to put the standard Darwinian theory onto a more solid scientific foundation (Fisher, 1930; Wright, 1931; Haldane, 1932). Natural selection was central to this synthesis and continued to be even among those who would later disagree with details of the synthesis such as its emphasis on a continuous gradualism (Eldgredge and Gould, 1972)[[4]](#footnote-4) or its disallowance of multi-level selection (Crow, 1955; Price, 1970, 1972; Hamilton, 1972). This remained true also for some who allowed for elements of pure randomness unconnected to natural selection to operate as well, most prominently one of the main developers of the neo-Darwinian synthesis, Sewall Wright (1951).

 A particular problem with the continuous gradualism view was the matter of how it came to be that higher-order structures came to appear, such as the appearance of multi-cellular organisms evolved out of single cell ones. This is the problem of *emergence*, which Hayek also stressed, a term originally due to Lewes (1875), although he drew it from Mill’s (1843) invocation of “heteropathic laws.”[[5]](#footnote-5) However, this problem had been understood as an issue even earlier for evolutionary theory, notably by Lamarck (1809) himself, although his solution involved elements of vitalist theory that would come under criticism by Lyell (1830-32) and others (including Darwin). Following the influence of Lewes, there developed in Britain the school of “emergentists” who would come to prominence in the 1920s (Alexander, 1920; Morgan, 1923), although their views fell into disfavor with the rise of the neo-Darwinian synthesis in the 1930s.[[6]](#footnote-6) Nevertheless, this emergentist view would gain a revival with the appearance of the complexity revolution in the 1990s, most prominently in connection with ideas of dynamic self-organization (Kauffman and Johnsen, 1991; Kauffman, 1993, 1995). While advocates of this view always insisted that these self-organizing processes developed within the framework of natural selection, critics argued that they underplayed the important role of natural selection (Gould, 2002).

 A similar debate exists within the realm of evolutionary political economy. Among those listed above, those more in tune with the de-emphasizing any sort of emergence or self-organization include Marshall, Alchian, and Nelson and Winter, with the rest more open to such ideas, even if the dynamically complex form of self-organization promulgated by Kauffman was not necessarily a part of the views of most of the earlier adherents. Nevertheless, particularly within the Austrian tradition, the idea of self-organization developed drawing upon ideas from the Scottish Enlightenment developed, with Menger’s (1892) theory of the spontaneous emergence of commodity money in primitive societies seminal in this regard. Hayek (1937, 1948, 1951) would also develop ideas of emergence and self-organization even before he came to apply these more specifically to discussions of evolutionary political economy later in his career (Lavoie, 1989; Rosser, 1999, 2010, 2011, 2012; Koppl, 2009; Wagner, 2010, 2012; Lewis, 2012).

**Natural Selection and Evolutionary Political Economy**

 As noted above, it was the vision of Malthus of humans competing over scarce resources as their populations increased that independently inspired both Darwin and Wallace to see natural selection as the central key to their theories of organic evolution, even as Malthus never concerned himself with such applications to non-human situations.[[7]](#footnote-7) Indeed, whereas natural selection in organic evolution underlies the dynamic processes that would lead a group of finches migrating to the Galapagos Islands to gradually differentiate into a set of differentiated species, each adapted to a particular ecological niche on the islands, particularly in terms of the kind of food they would eat, Malthus never posited such dynamic processes in human societies. He was notorious for being one of the great pessimists of the “dismal science” of economics. There was no hope of betterment for humanity because its sinful lust would constantly lead it to expand its population whenever conditions improved until those improvements would be undone as population pressed against the means of subsistence, leading to the infamous checks of war, famine, and pestilence. His pessimism was deeply rooted in the disasters of the French Revolution that he observed in his youth, leading him to turn against the sunny optimism of his father, a friend of the anarchist William Godwin and admirer of Condorcet. While he would become the first Professor of Political Economy in Britain, he also became a cleric of the Church of England, seeing only the balm and strictures of religion as the ultimate resolution for the doomed and sinful poor. While his friend and rival Ricardo disagreed with him on many matters, he adopted substantial portions of Malthus’s gloomy vision in his formulation of the Iron Law of Wages as underlying the tendency to secular stagnation of the economy.

 While he did not provide the link between the economist Malthus and the biologists Darwin and Wallace, the crucial figure in communicating between the social and biological from 1850 until into the early 20th century in Britain was Herbert Spencer, with few today realizing the immense influence he exercised in his own day. While today Darwin is viewed as on a pedestal far above the somewhat obscure and odd Spencer, in their own day Darwin looked up to Spencer as probably the greater and vaster intellect, if not for the profundity of his knowledge of evolution and biology, then for his ability to brilliantly provide a vast integrative synthesis that crossed the social and biological sciences. Darwin disagreed with Spencer on various matters, particularly on Spencer’s attachment to Lamarckian inheritance of acquired characteristics, but he never publicly aired this disagreement and declared to a fellow biologist in 1870 that “I suspect that hereafter he [Spencer] will be looked at as by far the greatest living philosopher in England; perhaps equal to any that have lived” (F. Darwin, 1959, 2, p. 301).

 In any case, it was Spencer who first coined both the terms “natural selection” (Spencer, 1852) and also “survival of the fittest” (Spencer, 1864). In fact he also used the term “evolution” prior to Darwin, who did not use it all in the first edition of his *Origin of Species*. It was only with subsequent editions that “survival of the fittest” and “evolution” would enter into that ultimately seminal volume, although both Darwin and Wallace came to “natural selection” on their own under the influence of Malthus. Thus, in many ways, Spencer was more the father of modern evolutionary theory as we know it than either Darwin or Wallace, despite his Lamarckian sympathies.[[8]](#footnote-8)

 Spencer would also play a crucial role in influencing the economists who would specifically draw upon and cite Darwin and evolution as important in economics, although these figures would move beyond him, partly explaining the decline of his influence and fame. Arguably the first[[9]](#footnote-9) of these was Alfred Marshall who touted biology as the “Mecca” of economics in the Preface to his *Principles of Economics* (1890), even as in his more detailed analysis Marshall drew more heavily on physics concepts rather than biological or evolutionary ones. Nevertheless he followed the pro-laissez faire ideas of Spencer, if not as vigorously, given that he also drew strongly on John Stuart Mill whose liberalism gradually moved away from the purer classical form that Spencer advocated and that apparently Darwin also agreed with (Weikart, 2009). More than any of these, Spencer cross-referenced his ideas in biology and sociology to support each other, influencing Clements (1916) in supporting a “hands off” conservationist approach to nature that should be allowed to proceed through its given dynamic succession,[[10]](#footnote-10) just as in human societies he argued that laissez-faire would allow the full working out of evolutionary processes that would move humanity to a higher level of society and morality, even if along the way to this higher state the social laissez faire evolution implies society “excreting its unhealthy, imbecile, slow, vacillating, faithless members” (Spencer, 1851, p. 324).

While he would later moderate these views and support charity for the poor as well as hold to a firm pacificism, it was such sentiments that led him to be derided by later observers as the father of a supposedly inhuman “social Darwinism” (Hofstadter, 1944; Leonard, 2009). This designation and the ill-repute that this concept fell into in the wake of World War II may be responsible as much as anything for the current obscurity of Spencer, although it must also be admitted that he was superseded by others in the many fields in which he wrote, thus also obscuring his important role in developing ideas in these numerous areas.

In any case, in economics Marshall certainly superseded Spencer, who was better known for his work in sociology, biology, philosophy, and psychology than in economics or political economy (Marshall being the figure more than any other who turned “political economy” into just “economics” in the English language tradition). While much of his formal static analysis drew on physics foundations, in considering the dynamics of firms and industries Marshall would invoke natural selection and evolutionary ideas. Firms were not static entities in some unchanging equilibrium, but went through a life cycle, from youth to age and death as they competed with each other. The competition between firms and even industries operated through natural selection as they rose and fell in succession. Following Spencer, although also the older political economists going from Adam Smith through J.S. Mill, he would see a free market as bringing about the proper functioning of this process of natural selection.

Veblen (1898) would criticize Marshall quite vigorously, coining the term “neoclassical” that he used pejoratively in doing so. He would stress the dynamics of the economy in criticizing static marginal analysis, while not noticing that Marshall left the door open for that as well. Veblen certainly applied the idea of natural selection to the competition between firms and industries, particularly stressing the development of the latter over time. However, in this latter analysis he also moved somewhat in the “saltationalist”[[11]](#footnote-11) direction that Schumpeter (1911) would more fully embody, recognizing the possibility of dramatic technological breakthroughs that could discontinuously alter the face of the economy as it transformed in a manner that suggested the emergent self-organizing alternative.[[12]](#footnote-12)

As Hodgson (1993) and Gould (2002) note, Darwin’s star fell in the early 20th century due to the general ignorance regarding genetics, only overcome with the development of the neo-Darwinian synthesis in the 1930s and 40s. The revival of Darwin’s standing with this emergence laid the groundwork for the influential paper of Alchian (1950). Arguably more than any other he represented the introduction of this gradualist Darwinian view of evolution based fully on natural selection into microeconomics. Again, the emphasis as with Marshall was on the competition of firms and industries, particularly the former. Alchian’s argument became the battering ram against the arguments of proto-behavioralists who kept pointing to such inconvenient facts such as that firm managers generally do not know what their marginal costs are, thus making them incapable of consciously following the recommendations for profit-maximization put forward by Marshallian neoclassical economics. Alchian’s argument laid an instrumentalist “as if” foundation that Friedman (1953) would more clearly articulate. It does not matter whether or not economic agents consciously know how to maximize or optimize. Those who come closest to actually doing so will make the most profits and thus survive and grow faster than their rivals and will thus displace them and dominate them in an industrial process of natural selection, following very much on the model of Spencer and Marshall and seeing such processes as improving the efficiency and progress of the economy over time.

For our purposes perhaps the latest stage of this focus on natural selection without some accompanying focus on emergence or self-organization comes with the influential work of Nelson and Winter (1982), even as some of their neo-Schumpeterian followers have been more open to such emergentist ideas (Potts, 2000; Dopfer, Foster, and Potts, 2004; Foster and Metcalfe, 2012). They would draw on ideas of “universal Darwinism” most fully articulated by Richard Dawkins (1976, 1983; see also Hamilton, 1964), particularly the concept of the “meme,” which they identified with “routines” in industrial processes. Memes are the fundamental objects of natural selection and thus of evolution. Whereas for Darwin this was the organism, for the neo-Darwinians and their more fervent followers such as Dawkins, this would be the gene. For biological evolution, the gene was the meme. But for Nelson and Winter, it was industrial routines, although this has been a matter of ongoing controversy ever since (Witt, 2004). In any case, if Marshall and Alchian focused on the firm as the locus of evolutionary natural selection, just as Darwin (and Wallace) focused on organisms as the locus in biology, so Nelson and Winter sought to move to the micro underpinnings beneath individual firms and even industries to the fundamental units and interstices that underlie the technological and institutional progress of an economy and society. For them, this fundamental unit was routines, which could spread from firm to firm and industry to industry, maintaining an identity and existence of their own that would follow the trilogy identified by Hodgson (1993) as fundamental to evolution: variability, inheritance, and natural selection.[[13]](#footnote-13)

**Emergence and Self-Organization**

While there might be emergence without self-organization and self-organization without emergence, the two seem intimately linked and frequently coinciding, as well as being deeply linked with various forms of complexity.[[14]](#footnote-14) As emergence is probably the older concept, at least the use of the term is, we should consider what this involves, and the first thing we must recognize is that like “complexity,” it is a much debated term, particularly within philosophy from where it originally, well, emerged. The first to use the term, or more precisely “emergent,” was George Lewes in one of the opening quotations of this paper. He refers to the “co-operation of things of unlike kinds” that result in an outcome that is not the simple sum or difference of these kinds, that is different from them in some qualitative way, and that cannot be “reduced” to them in some sense. He was initially inspired by examples of various chemical reactions where two chemicals come together to form another unlike the original two, with such examples being the original key to J.S. Mill’s “heteropathic laws” (Mill, 1843).

By the 1920s, such ideas had developed further into the British *emergentist* school led by Alexander (1920), Morgan (1923), and Broad (1925), with these emphasizing more specifically the idea of emergence involving the appearance of new hierarchical levels, particularly in evolution, with these exhibiting “novelty” or “surprise.” Such ideas had been around from the beginnings of evolutionary theory with Gautieri (1805) and Lamarck (1809) both linking such emergence of higher levels with vitalist forces, an argument also pursued later particularly by Broad. Corsi (2005, p. 77) notes that “Gautieri rapidly sketched a series of steps linking the inorganic to the organic, minerals to crystals, zoophytes to plants and animals, and finally to man.” For some of the 1920s emergentists this moved further on into contemplating the emergence of ever higher states of consciousness and knowledge.

This movement would fall into disrepute in evolutionary and some other discussions with the rise of the gene-focused neo-Darwinian synthesis as well as the triumph of even more reductionist quantum mechanics in physics during the 1930s and 1940s. Holistic evolutionists advocating direct “group selection” such as Goldschmidt (1940) and Wynne-Edwards (1962) were ridiculed and pushed aside (Williams, 1966; Dawkins, 1976), with their arguments never really being revived. The future of emergentist evolutionary theory would depend on more specifically “ground up” arguments based on specificied microfoundations out of which the emergence would be shown to arise.

To return to an effort to more precisely define “emergence,” an influential definition due to philosopher James van Cleve (1990) is the following:

“If P is a property of w, then P is emergent if and only if P supervenes with nomological necessity, but not with logical necessity, on the properties of w.”

Pretty obviously as with many definitions this just shifts the issue to the meaning of the terms “supervenes” and “nomological,” with much debate over these ensuing. McLaughlin (1997, Appendix) argues that *supervenience* involves the appearance of the novel or unexpected along the lines of the 1920s British emergentists. “Nomological” refers to arising from physical laws, in contrast to logical necessity. The emergence of consciousness in the mind in Hayek’s (1951) *The Sensory Order* is seen as a good example (Lewis, 2010). A related, although unresolved issue is whether or not this new higher level can downwardly cause events at the lower levels (Hayek, 1951; Kim, 1993). Such emergence involving the appearance of higher levels exhibiting these characteristics was labeled *anagenesis* by Boulding (1978), who drew on it for his own theory of emergent economic evolution.[[15]](#footnote-15)

**Mechanisms of Emergent Self-Organization**

 After the development of the neo-Darwinian synthesis and the general collapse of the emergentist movement, it took some time for evolutionists to gradually learn mechanisms that could operate within the general understanding given by that synthesis while nevertheless allowing for emergent self-organizing phenomena to operate nevertheless. Arguably the first such mechanism studied was that of what is now called *multi-level selection*. When this occurs something resembling group selection operates, but it does as a result of interactions at the level below that of the group that bring about this emergence at the higher level. Curiously, the foundations for this understanding were based on work by two of the founders of the neo-Darwinian synthesis, namely J.B.S. Haldane and more importantly, Sewall Wright (1932), whose use of *fitness landscapes* underpinned his earlier study of how random migrations that separate sub-populations with distinctive genetic patterns from larger ones with different patterns can be the basis of a form of random evolution not necessarily based on natural selection, per se. This initially controversial phenomenon is known as the *Sewall Wright Effect*.

 Although it received little attention at the time and continues not to be fully appreciated by many, it was Wright’s close friend and associate, who encouraged him to move to the University of Wisconsin-Madison in the mid-1950s, who first developed the key mathematical condition under which this multi-level selection could occur, James F. Crow (1955) at the same time. This condition involves when an “altruistic” gene might survive and reproduce even as it is making it more likely that other genes will survive and reproduce through actions or processes that are damaging to the individual, per se. This is the essence of cooperation and has its parallel in the problem of game theory first studied at about the same time known as the *prisoner’s dilemma*, in which agents may collectively do better if they cooperate, but in which the Nash equilibrium is for them not to do so. The condition developed by Crow allows for the emergence of cooperation in both a conscious human situation over time as well as its equivalent in non-human species, even when the basic incentive and reward structure favors not cooperating on the parts of individual agents or genes. This involves distinguishing changes in fitness within a group versus changes in fitness across groups, with the emphasis on fitness clearly keeping this consistent with natural selection.

 Let Bw be the within-group genic regression on the fitness value of the trait as defined in Wright (1951) and Bb be the between-group genic regression to the fitness value. Let Vw be the variance among individuals within a group and Vb be the variance among means across groups. For an altruistic trait, one expects Bw to be negative while Bb to be positive. Thus as sufficient condition for the altruistic trait to increase in frequency is given by

 Bb/(-Bw) > Vw/Vb. (1)

 This equation would be rediscovered in variations later by Hamilton (1972) and by Price (1970, 1972) who published their findings in more widely read outlets than did Crow, leading to this condition being known as the “Hamilton-Price equation.” As it is, the expectation is that Vw is likely to be substantially larger than Vb, which led to skepticism that this would be a rare outcome. In order to increase the between-group fitness effect there must be ability of individuals within a group to recognize who will be a cooperator, with this easier for smaller and more isolated groups. Henrich (2004) has labeled this the “greenbeard” problem and it has been at the core of human groups learning how to cooperate to achieve common goals (Ostrom, 1990).[[16]](#footnote-16) Within organic evolution this seems most common for the social insects, who while only a small number of the species in existence, have been highly successful at surviving and reproducing and have come to represent a much larger amount of the biomass on earth than their proportion among the number of species would lead one to expect (Wilson, 2012).

 A deep argument has arisen over whether such altruism must be of a reciprocal nature (Trivers, 1971).development of punishment mechanisms to enforce cooperation that appear to be hardwired into human morality (Gintis, 2000). As it is, the subject of how to distinguish pure form from reciprocal altruism has been a matter of intense study and controversy (Fehr and Schmidt, 1999, 2010; Binmore and Shaked, 2010).

 A variation on multi-level selection has been that of *hypercyclic morphogenesis* (Rosser, 1991, Chap. 12), based on combining Turing’s (1952) idea of self-organizing morphogenesis with the hypercycle idea due to Eigen and Schuster (1979), the latter developed initially to explain the successful emergence of multi-cellular organisms out of unicellular ones, one of the deepest problems of evolution and one as clearly exhibiting emergence as much as any other. Central to this is efficient transmission of information. Darwinian natural selection operates on these self-reproducing “quasi-species” based on their ability to transmit information. Key is their ability to stabilize themselves against the accumulation of errors in reproduction, with Eigen and Schuster proposing the existence of a “threshold of information content” for a system that if exceeded will generate an “error catastrophe” and the “disintegration of information due to a steady accumulation of errors” (Eigen and Schuster, 1979, p. 25). If Vm is the number of symbols, σm is the degree of superiority of “master copy” in selective advantage and exceeds one, and qm is the quality of symbol copying, then the threshold is given by

 Vm < ln σm/(1 – qm). (2)

 This brings us finally to the models of emergent self-organization that came out of the Santa Fe Institute and its relatives starting about two decades ago, with key work by Langton (1990), Kauffman and Johnsen (1991), Holland (1992), Kauffman (1993, 1995), and Crutchfield (1994, 2003). Most of this involved studying various computer simulation models to see patterns of higher order patterns emerging out of less well ordered systems, often posed as doing so “at the edge of chaos,” although this was not a strict mathematical form of chaos. The original inspiration for this came from D’Arcy Thompson (1917), who saw order arising to fit optimal patterns. As Kauffman (1993, p. xiii) has put it, “this single force view [of Darwin’s, e.g. natural selection]…fails to stress, fails to incorporate the possibility that simple and complex systems exhibit order spontaneously.” Drawing on fitness landscapes and work of Crow and Kimura (1970), Kauffman in particular has argued that as the number of parts in a system (genes in a genotype) that are indirectly involved in the adaptation process increases from zero to one less than the number of parts directly connected, the fitness landscape will change from having a single optimum to becoming random, the *complexity catastrophe*. The so-called “edge of chaos” where spontaneous emergent self-organization can occur is most likely between these two extremes.

 This argument and its extensions by others has come under a variety of criticisms. Some come from harder line physics and computational perspectives as represented by McCauley (2005, p. 77) who argues that proper explanation involves the discovery of ergodicity and invariances, and that “we may know how a cell mutates to a new form, but we do not know how a fish evolves into a bird.” McCauley cites the work of Moore (1990) to argue that true emergence only occurs with full unpredictability and surprise in complex Turing machines or their systemic equivalents.

 From the standpoint of more traditional evolutionary thinking among evolutionary biologists, objections come from those who argue that this approach amounts to getting “order for free” (Gould, 2002, pp. 1200-1214). While expressing admiration for work done by Kauffman and his associates, Gould argues that emergent self-organization fails to fully explain detailed evolutionary developments, which must rely more on natural selection at all stages in a more fully Darwinian mode, even as Gould accepts some non-Darwinian elements in evolution such as the random Sewall Wright Effect. Thus Gould argues that emergent self-organizing models are too general and unable to explain the evolution of “such a phyletically localized, complex, and historically particular structure as the tetrapod limb” (Gould, 2002, p. 1213). In effect, Gould throws the complexity of actual evolutionary processes back at those who put it forward as a complement to natural selection with variability and inheritance.

In their own defense, those arguing for the independent importance of emergent self-organization insist that all these processes necessarily operate within the broader rubric and constraint of natural selection, even if particular processes may not immediately reflect the direct working of natural selection. If what emerges from such self-organization is not able to sustain itself, is not able to survive and reproduce, then it will not persist. For emergent self-organization to play an important role in evolutionary processes, what emerges must be able to be naturally selected at the levels at which it is organized, even if it might appear to be that there is at a more detailed level of analysis.

**Evolutionary Emergence in Political Economy**

 As Lewis (2012) argues, following on Caldwell (2004), it was in his 1937 paper that Hayek began to develop his ideas of spontaneous order and emergence in economics, although he had apparently worked on such ideas earlier in his earlier writings on psychology not published up to that point, but that would later appear in *The Sensory Order* (Hayek, 1951). It has been widely argued that this turn arose partly from some of his frustrations with ongoing arguments about capital theory. Indeed, while most identify emergence with spontaneous order, Harper and Endres (2012) argue that they should be distinguished, with true spontaneous order more complex than emergence, which can have a consciously planned aspect to it. True spontaneous order looks like what McCauley says that Moore argues for, full unpredictability in principle associated with the complete lack of any planning (Buchanan and Vanberg, 1991).

 As it is, while Menger’s arguments about the spontaneous emergence of money constitute the archetypal example, he did not fully lay out what was involved in such emergence or how it related to broader concepts. It was Hayek within the Austrian tradition who did this most thoroughly, and whose ideas themselves on this only gradually emerged over time. Indeed, it appears that although the work was published later, it was his psychological work that underpins his ideas on the subject. In this he was studying ultimately the emergence of consciousness from the nervous system, and he drew on the work of earlier Gestalt psychologists in this (McDougall, 1923), although he would later also be influenced strongly by general systems theory (von Bertalanffy, 1962). Thus he saw the nervous system operating to develop “organized fields” of “complex sensory phenomena” in accumulating layers, or looking from the top down:

“The fact that the whole system of sensory qualities must in this sense be regarded as one organized field need not prevent us, however, from occasionally speaking of different fields as sub-systems within which the elements are differentiated by a more dense and complex system of relations.” (Hayek, 1951, p. 77)

In the final chapter of that book he famously pushed this argument to an extreme point while noting arguments of Gödel (Koppl and Rosser, 2002) regarding the limits to self-awareness:

“…even though we may understand its *modus operandi* in general terms, or, in other words, possess an explanation of the principle on which it operates, we shall never, by means of the same brain, be able to arrive at a detailed explanation of its working in particular circumstances, or be able to predict what the results of its operations will be. To achieve this would require a brain of a higher order of complexity, though it might be built on the same general principles. Such a brain might be able to explain what happens in our brain, but it would in turn still be unable fully to explain its own operations, and so on.” (Hayek, 1951, pp. 188-189)[[17]](#footnote-17)

It is not immediately obvious that these arguments apply to his discussion of spontaneous order in socio-economic systems. That discussion referred to older arguments from the Scottish Englightenment, and took the following form:

“What the economists understood for the first time was that the market as it had grown up was an effective way of making man take part in a process more complex and extended than he could comprehend and that it was through the market that he was made to contribute ‘to ends which were no part of his purpose.’” (Hayek, 1948, pp. 14-15)

Eventually he would combine these strands of argument into a broader perspective on emergence and complexity. He would directly link this formulation to the older arguments made by the members of the British emergentist school, tracing back the origins of their arguments through Lewes to Mill as described above in this paper and also argued by Lewis (2012). Thus:

“The ‘emergence’ of ‘new’ patterns as a result of the increase in the number of elements between which simple relations exist, means that this larger structure will possess certain general or abstract features which will recur independently of the particular values of he individual data, so long as the general structure (as described, e.g., by an equation) is preserved. Such ‘wholes’, defined in terms of certain general properties of their structure, will constitute distinctive objects of explanation for a theory, even though such a theory may be merely a particular way of fitting together statements about the relations between individual elements… What we single out as wholes will be determined by the consideration whether we can isolate recurrent patterns of coherent structures of a distinct kind which we do in fact encounter in the world in which we live.” (Hayek, 1967, p. 26)

While it is not explicitly clear in this quote, from this time on Hayek increasingly linked such emergence to evolutionary processes that operate at the level of Lamarckian multi-level selection within human societies. Particular spontaneous socio-economic orders are naturally selected and persist if they are successful in competition with other such orders. He argued for the superiority of such spontaneously emerged orders, with British natural law being a favorite example of his along with competitive markets.

 In his final writings (Hayek, 1988) he sharply contrasted such evolutionarily emerged spontaneous orders with centrally directed or planned orders imposed according to supposedly rational plans from above. He saw the source of the *fatal conceit* of such efforts as being in France, with its long tradition from Descartes in philosophy (if not earlier) through Colbertiste *dirigisme* in ancient régime economic policy, to the more fully idealized utopias of Saint-Simon and others. This had earlier manifested itself in how France came to be a nation, the nation where the term “nationalism” was invented. Essentially the province around Paris, the Ile de France, simply conquered the rest and imposed its language and rules on the rest over a long period of time. After the French Revolution, Napoleon Bonaparte imposed his own order upon this nation from the center, reordering its provinces into departments, establishing his own centrally imposed law code upon the nation, as well as a new currency and bureaucracy and so on. He even attempted to spread this to the rest of Europe by force of arms in imitation of his royal predecessors within France, only to fail in this effort, as would Hitler so fail in the 20th century. Nevertheless, for all of Hayek’s denunciation of French political and economic traditions, it remains a nation and one that is reasonably free in terms of personal liberties and not entirely unsuccessful economically, although that reflects that it has always held back from full-blown central planning and control and moved to being democratically ruled a long time ago.

 While the French model looks more like what we have seen in history, in more recent times we have seen nations and groupings of nations into higher structures emerge from lower levels in a more self-organized and cooperative manner, if consciously so in contrast with pure spontaneous order. So, the United State came into being as a result of a freely organized entity out of the former colonies, even if it was maintained during the Civil War by force. Switzerland also emerged out of its cantons agreeing to form a higher unity, although this unity was also challenged at times largely on grounds of religious differences and conflicts, only becoming set in its modern form in 1848.[[18]](#footnote-18) More recently still we have seen the effort to reinvent the Roman Empire or the Napoleonic or Hitlerian visions in a democratic and freely cooperating way in the form of the European Union and its sub-part, the Eurozone. That these entities are facing serious challenges and may not survive shows that not all such entities persist and survive, although this may yet be the case for the EU and the Eurozone, a topic beyond this paper.

 Although he does not see himself in much agreement with Hayek, Mirowski (2007) has put forth a view that this observer thinks shares much of this evolutionary spontaneous self-organization perspective. He controversially argues that markets are algorithms, not just like algorithms, and that market systems spontaneously emerge out of each other and compete with each other in an evolutionary process of natural selection. This is clearly linking together these two processes, much as Hayek does: spontaneous and emergent self-organization with natural selection. Even as these orders may emerge, they may also fail to survive or reproduce. Thus, futures markets emerged from spot markets; options markets from futures markets; derivatives markets from options markets, and then more recently various forms of higher-order derivatives markets such as credit default swaps and collateralized debt obligations. The latter in particular have almost completely disappeared in the wake of the financial crisis of 2008, although one cannot say for certain that they will not yet re-emerge at some later time in some form or other. Mirowski’s argument has come under criticisms both in terms of the real nature of markets (Kirman, 2007) as well as on logical and computational grounds (Zambelli, 2007). However, it would seem that the core of his argument still may hold even if one modifies his arguments to account for those criticisms, with what is left still resembling in many ways the view that Hayek eventually developed after a long period of intellectual evolutionary emergence.

**Conclusions**

 This paper makes no claim on ultimately resolving the debate between the natural selection and self-organization views of evolution in the broader sense. Nor does it do so even within the context of the cultural evolution of humans within the political economic context. Nevertheless, it seems that both processes are at work at many junctures, if not always and everywhere. Political economic systems do evolve through competing with each other in a process resembling biological natural selection, although with much more marked Lamarckian elements than in the biological realm. And in both realms it would appear that we observe moments of phase transition or discontinuity where a higher order structure emerges out of lower order ones without there necessarily being some higher order planner or director who brings about this emergence. The most dramatic examples in economics have involved those old ones of the spontaneous emergence of commodity monies as described by Menger as well as the spontaneous order of markets and natural law described by Hayek. While these examples exist, they do not necessarily rule out other processes or disprove the arguments of more conventional economists who eschew such evolutionary arguments in favor of more static equilibrium models.

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1. This process has often been labeled “social Darwinism,” a term used pejoratively to describe Spencer’s views in particular (Hofstadter, 1944), although this involved considerable misrepresentation on various grounds (Leonard, 2009; Weikart, 2009). [↑](#footnote-ref-1)
2. See Caldwell (2004), Marciano (2009), Marmefelt (2009) for further discussion. [↑](#footnote-ref-2)
3. While Mendel (1866) appeared not long after *Origin of the Species*, it remained unknown to Darwin and those interested in evolution until William Bateson translated it into English in 1901 and invented the term “genetics” in 1906, with Wilhelm Johannsen (1909) coining “gene,” “genotype,” and “phenotype,” thus laying the groundwork for the later neo-Darwinian synthesis (Rheinberger, 2012). [↑](#footnote-ref-3)
4. The early Mendelians such as Bateson and Johannsen called themselves “saltationalists” and criticized the continuity arguments of Darwin and early probability followers such as Galton, emphasizing the discrete nature of genotypes and phenotypes, although the neo-Darwinian synthesis would integrate these views showing that even though genotypes (and phenotypes) might be discrete, distributions of characteristics could still be described by continuous normal distributions over populations that were expected to change only gradually over time. [↑](#footnote-ref-4)
5. See Rosser (2012) for further discussion. [↑](#footnote-ref-5)
6. A coincident factor in this was the simultaneous triumph of quantum mechanics over the deterministic position of Einstein. Einstein also became more focused on larger scale phenomena, particularly gravitation and its role in a possible unified field theory, whereas quantum mechanics focused on subatomic particles as well as stochasticity, rather like the gene-level focus of the neo-Darwinians. While this may seem irrelevant, the emergentists had attempted to address many disciplines in their vision of evolution proceeding from subatomic particles to groups of humans, if not further, this process itself crossing the disciplines as one moved from physics through chemistry to biology and ultimately to social science and philosophy with humans. [↑](#footnote-ref-6)
7. While Malthus was the primary influence from economics onto Darwin and Wallace, for Darwin more particularly he was also influenced by the earlier work of the Scottish enlightenment on matters involving neither biology nor economics. Thus, he admired both Adam Smith’s discussion of the evolution of languages in the third edition of his *Theory of Moral Sentiments* (1767) as well as the discussion of the evolution of laws and customs by Hume (1779). [↑](#footnote-ref-7)
8. On the other hand it must be noted that even to this day in France, Lamarck is given the superior position above all of these as the true father of evolution, and there is no question that Darwin drew copiously on his work. [↑](#footnote-ref-8)
9. Perhaps the first economist to notice Darwin’s work was Karl Marx in 1860 who wrote to Engels that “although it is developed in the crude English style, this is the book which contains the basis in natural history for our view” (Marx and Engels, 1942, p. 126). However, they tended to prefer his analysis of biological evolution while viewing humans as operating differently due to their ability to control production, with their unhappiness with Darwin on this front at least partly due to his admiration for Malthus, whom they despised. Nevertheless, one can argue that their historical materialism was an example of emergent evolution with its stages of modes of production appearing as phase transitions out of Hegelian dialectics, with the neo-Darwinian Haldane influenced by them. [↑](#footnote-ref-9)
10. Clements’s ideas of a unique successional path for each environment has become as extinct as the idea of the ubuiquity of single equilibria in economics (Holling, 1992). [↑](#footnote-ref-10)
11. This term implying discontinuity comes from the Latin for “jump,” as used in the phrase *natura non facit saltum*, “nature does not make jumps,” first coined by Leibniz and quoted in the Prefaces to both Darwin’s *Origin of Species* and Marshall’s *Principles of Economics*, indicating their fundamental belief in gradualism (Rosser, 1992; 2011, Chap. 6). [↑](#footnote-ref-11)
12. For Schumpeter (1934, p. 64), such saltationalist evolutionary emergence in technology is given by “…that kind of change arising from within the system which so displaces the equilibrium point that the new one cannot be reached from the old one by infinitesimal steps. Add successively many mail coaches as you please, you will never get to a railway thereby.” [↑](#footnote-ref-12)
13. See also Hodgson and Knudsen (2006) for further discussion of the usefulness but limits of universal Darwinism. [↑](#footnote-ref-13)
14. A prominent form of complexity that has little to do with either of these is computational complexity, of which there are a variety of definitions. For a debate over the greater relevance for economics of dynamic versus computational complexity see Rosser (2009); Velupillai (2009). [↑](#footnote-ref-14)
15. Rosser, Folke, Günther, Isomäki, Perrings, and Puu (1994) would posit the moment of such an emergence as being the *anagenetic moment*, drawing on a model of entrainment of lower level oscillators generating a higher order structure due to Nicolis (1986). As with Hayek, Nicolis was studying emergence in brains and mental phenomena. [↑](#footnote-ref-15)
16. An early advocate of this argument for human evolution was the anarchist Peter Kropotkin (1902). [↑](#footnote-ref-16)
17. Despite the apparent absoluteness of this, a few pages later Hayek partly allows for the individual to understand his or her own “mental events” by means of introspection, using the term *verstehende* for this process, an idea much emphasized by Koppl (2006, 2009). [↑](#footnote-ref-17)
18. However, as in France, the name of the nation is derived from the name of one of its cantons, Swyz. [↑](#footnote-ref-18)