

The importance of ecological economics: An interview with Herman Daly

Herman Daly and Jamie Morgan [University of Maryland, USA; Leeds Beckett University, UK]

Copyright: Herman Daly and Jamie Morgan 2019

You may post comments on this paper at

<https://rwer.wordpress.com/comments-on-rwer-issue-no-90/>

Professor Herman Daly is, in his field, amongst the best known and influential economists of the twentieth century and early twenty-first century. After the fashion of Keynes's comments regarding what makes a great carrier of the title, he is *more than* rather than merely an economist (Keynes, 1924, pp. 321-322). Since the late 1960s he has been a consistent and high-profile critic of the lack of attention paid in mainstream economics to the environmental consequences of economic activity and the real limits to economic growth (see for an early example of the contrast: Solow, 1974; Daly, 1974 and then collected Daly, 1999, 2007). Beginning with a set of selected works by contributing thinkers (Daly, 1973; updated 1980, and Daly and Townsend, 1993), Herman is closely associated with the idea of a "steady-state" economy systemic alternative (Daly, 1977 [1991], 1996, 2014). After working at Louisiana State University for twenty years he moved on to become a Senior Economist in the Environment Department for the World Bank, before working at and finally becoming Emeritus from the School of Public Policy, University of Maryland. Herman has made significant contributions in research, teaching and to social and economic policy and activism (see, for example, Daly and Cobb, 1989 [1994]; Daly and Farley, 2003 [2011]). He has been the recipient of numerous awards, visiting professorships and honorary positions, and is co-founder of the journal *Ecological Economics* (for example, Daly, 1992).

Herman's *Essays Against Growthism* (2015) is published by the World Economics Association. For information on and access to Herman's work and related activity visit:¹

<https://publicpolicy.umd.edu/faculty/herman-daly>

He is interviewed by Jamie Morgan for RWER

Jamie: Given that RWER has a large lay and general readership who may not be familiar with disciplinary terminology, it might be worthwhile to start with some commentary that creates proper context for informed discussion. The press is full of reports on "the environment" and there is a sub-discipline of economics categorized as "environmental economics". You, however, are one of the early contributors to "ecological economics". It might be helpful to briefly distinguish between the two, and explain in general why you think ecological economics is superior.

Herman: Yes, thanks for the opportunity to discuss ecological economics with you. As for overall context, ecological economics focuses on three issues with special emphasis on the third: the allocation of resources among commodity uses, the distribution of income among people, and the physical scale of the economy relative to the containing biosphere. A good allocation of resources is efficient; a good distribution of income or wealth is just; a good scale is at least ecologically sustainable. Allocation and distribution are familiar concepts from standard neoclassical economics – for every given distribution of income, there is a different

¹ See also: Centre for the Advancement of the Steady State Economy:

<https://steadystate.org/category/herman-daly/>

The Great Transition Initiative: <https://www.greattransition.org/publication/economics-for-a-full-world>

Pareto optimal allocation of resources with its corresponding optimal set of prices. Standard neoclassical economics focuses primarily on the allocation issue, paying secondary attention to distribution. It does so first because a given distribution is logically necessary for defining efficient allocation, and second because distributive fairness is, of course, important in its own right.

Crucially, the third issue, the scale or physical size of the economy relative to the containing ecosystem, is *not recognized* in standard neoclassical economics and has, therefore, become the differentiating focus of ecological economics.

Jamie: Yes, for anyone not familiar with economics and for many of those coming to it for the first time as students this third issue is striking – like discovering that cosmologists were not interested in gravity. The very idea that our primary source of understanding and explanation of an economy can take this form is (and increasingly so) weird. This is not least because economics in general has a self-image as a science and more than any other area of inquiry into the form and consequence of societies focuses on quantities, measurement, metrics, hypothesis testing and data. This, of course, is framed by key concepts, orientations and methods that influence the emphasis *on* quantification and the form *of* that quantification – not least neoclassical economics (whose concerns have and continue to have great influence on mainstream economics more generally). It is astonishing to think that a social science of quantities is not fundamentally focused on and defined in terms of its own (an economy's) uses and consequences in a material sense – though, of course, there is a great deal more to say about in what sense it is *not* focused and defined in terms of uses and consequences – since it can ostensibly seem that it is. I expect we will come back to this. Could you say a bit more about what is key to ecological economics?

Herman: Regarding quantification ecological economists distinguish growth from development. Growth is increase in size by assimilation or accretion of matter – it is quantitative. Development is qualitative improvement in design, priorities, or purpose. Growth is easier to measure than development, but development is more important for the future. Sustainable development, so-called, is qualitative improvement without quantitative growth in scale beyond ecosystem capacities for waste absorption and resource regeneration. By accepting ecological limits, we force the path of progress away from quantitative growth and on to qualitative development. Some argue that because economics deals with growth in value (GDP), it does not really encounter physical limits. While it is true that value cannot be expressed in simple physical units, it is also true that value of production is measured in units of “dollar's worth”, not dollars, and a dollar's worth of anything is a physical quantity, namely that quantity that can be purchased for one dollar. Aggregating many diverse “dollar's worth” quantities into GDP does not erase the physical dimensions. The eagerness to defend “growthism” gives rise to many lame arguments.

The key to understanding ecological economics is its pre-analytic vision of the economy as an open subsystem of a larger ecosystem that is finite, non-growing, and materially closed (though open with respect to solar energy). This immediately suggests three analytical questions that *do not arise* in standard neoclassical economics:

1. How large is the economic subsystem relative to the containing ecosystem?
2. How large can it be?
3. How large should it be?

These lead to the further question:

4. Is there an optimal scale beyond which physical growth in the economic subsystem begins to reduce total welfare by diminishing the sources of ecological services faster than it increases the sources of production services?

Jamie: The very obvious answer to this fourth question based on any sane consideration of the first three, an answer that would be intuitive to anyone giving it proper consideration, assuming they had not first been socialized in ways that distorted the capacity to answer question four, is surely yes.

Herman: And ecological economics' answer is "yes". But for standard neoclassical economics the question cannot arise since the concepts of scale and "throughput" are absent.

Jamie: Which makes this issue of primary points of departure vital because...

Herman:because if the economy grew into the void, it would encroach on nothing, and its growth would have no opportunity cost. But since the economy in fact grows into and encroaches upon the finite and non-growing ecosystem, there is an opportunity cost to growth in scale, as well as a benefit. The costs arise from the fact that the physical economy, like an animal, is a "dissipative structure" sustained by a metabolic flow from and back to the environment. This flow, which we have called "throughput" (adopting the term from engineers) begins with the depletion of low-entropy useful resources from the environment. It is conformed to or followed by the processes of production and consumption, which, despite the connotations of the words, are only physical transformations of existing matter. The flow ends with the return of an equal quantity of high-entropy polluting wastes. Depletion and pollution are costs.

Not only does the growing economy encroach spatially and quantitatively on the ecosystem, it also qualitatively degrades the environmental sources and sinks of the metabolic throughput by which it is maintained. I can't stress enough just how important it is to understand that this forces a continual co-evolutionary adaptation between the economy and the ecosystem. If that adaptation is made in such a way that the throughput remains within the natural capacity of the ecosystem to absorb wastes and regenerate resources for a very long time, then the scale of the economy is considered "sustainable."

The main concerns of standard neoclassical economics contrast with this because it lacks the third issue. Optimal allocative prices *do not* guarantee a sustainable scale any more than they guarantee a just distribution of income. Attaining a sustainable scale, a just distribution, and an efficient allocation are three *distinct* problems. They are certainly not isolated, but solving one does not solve the others. Ecological economics leads to an important insight here, achieving three different goals generally requires three different policy instruments. This is illustrated by the cap-auction-trade system, a favored policy of ecological economists. Three policy actions are required in proper sequence. First, a quantitative limit is set, reflecting judgments of sustainable scale. That is, a previously unlimited or free good is recognized as scarce and the scale of its use is quantitatively limited. Second, the newly scarce good or right is now a valuable asset – who owns it? Deciding who owns it is a question of distributive justice. Third, once scale and distribution decisions have been collectively decided, we can then have individualistic market trading and efficient allocation, at least for most rival and excludable resources.

Jamie: But limits are of vital concern...

Herman: Right, as growth pushes us from an empty world to a full world, the limiting factor in production increasingly becomes remaining natural capital, not manmade capital. For example, the fish catch today is no longer limited by manmade capital of fishing boats but by the complementary natural capital of fish populations in the sea. As we move into a “full world” (in relation to our activity and consequences), economic logic remains the same – to economize on and invest in the limiting factor. But the identity of the limiting factor changes from manmade to remaining natural capital, and our economizing efforts and policies must change accordingly. Therefore, it becomes more important to study the nature of environmental goods and services in both their stock-flow and fund-service dimensions – and to determine if they are rival or non-rival, and excludable or non-excludable – in order to know if they are market goods or public goods.

Jamie: So, from your point of view as one of the first ecological economists, ecological economics is not just a different point of departure than standard neoclassical economics it also absorbs what is potentially insightful from it?

Herman: Yes, ecological economics draws mainly from *classical* economics (e.g. the stationary state of J.S. Mill), but draws on some neoclassical concepts as well. Indeed, our initial aim was to reform neoclassical economics, not to trash it. But we discovered that neoclassical economists, as represented by their most prestigious journals, totally resisted any reform that was the least bit unfriendly to their ideology of growthism. That led to a more confrontational relation, and to the establishment of our own journal and society. How close a relation should exist between standard neoclassical economics and ecological economics remains a divisive issue. Ecological economics accepts the standard analysis of allocative efficiency, given prior social determination of the scale and distribution questions, and given that the resources in question are rival and excludable. Under these conditions it considers market allocation preferable to central planning. Scale and distribution limits already make large demands on our capacity for central command and control, and render the market more fit for the limited job of allocation. Some critics consider that to somehow be a complete “surrender” to neoclassical economics, although it seems to me a very big reform of neoclassical economics, so big that the neoclassicals have not been willing to make it. Although the main difference has been the focus on scale, that difference has entailed more attention to often neglected dimensions of distribution – namely, intergenerational distribution of the resource base, and distribution of places in the sun among humans and all other species (biodiversity). Also, as more vital resources cease being free goods as a result of growth in scale, and are allocated by the market, the fairness of the distribution underlying market allocation becomes ever more critical. Once growth in scale has become uneconomic, and there is evidence that in some countries it has, it can no longer be appealed to as the macroeconomic solution to poverty. Poverty reduction requires increased sharing. And the big motivation for growthism in the first place has been to avoid the need to share.

Jamie: Clearly, ecological economics because it takes limits seriously must also take the constitution of ethics seriously. However, since our initial purpose is to give a clear sense of what makes ecological economics different than environmental economics is there anything else that it might be important to clarify?

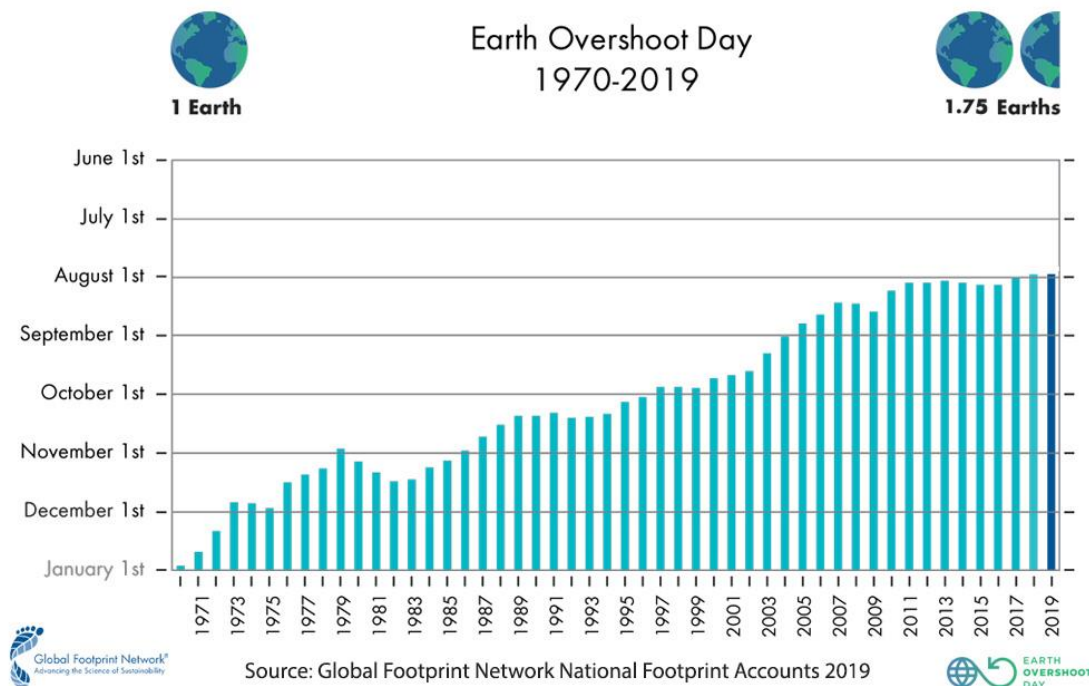
Herman: There are a lot of technical issues. Debates between standard and ecological economics include whether natural and manmade capital are primarily substitutes or

complements, the degree of coupling between physical throughput and GDP, and the degree of coupling between GDP and welfare. Ecological economics sees manmade and natural capital as fundamentally complementary, with natural capital providing limits; whereas standard economics sees them as substitutes and consequently with neither factor limiting. Standard neoclassical economics sees a tight coupling between GDP and welfare and a loose coupling between GDP and throughput. Ecological economics sees a tight coupling between GDP and throughput, with a loose coupling between GDP and welfare beyond basic sufficiency. Standard neoclassical economics puts growth in first place, ecological economics aims for a steady state to avoid uneconomic growth.

More generally, students are sure to ask: What is the relationship between ecological economics and courses in “resource economics” or “environmental economics” that are often taught in economics departments? The difference is that the latter two are both subfields of standard neoclassical economics; they do not consider scale an issue, have no concept of throughput, and are focused on efficiency of allocation. Resource economics deals with the efficiency of allocation of labor and capital devoted to extractive industries. It develops many useful concepts, such as scarcity rent and user cost. Likewise, environmental economics also focuses on efficiency of allocation and how it is disrupted by pollution externalities. Concepts of internalizing externalities by Pigouvian taxes or well-defined and enforceable property rights (Coase Theorem) are studied as solutions.² Nevertheless, the aim of both resource and environmental economics is allocative efficiency via right prices, *not sustainable scale*. For this reason, in the standard textbooks, resource and environmental economics chapters have to be tacked on at the end of the book because they do not fit the isolated system paradigm, which perforce omits both resource inputs and pollution outputs.

Jamie: And to return to something we previously noted, the very idea of a focus on the environment as a specialist sub-discipline of economics, as though only some need be concerned by the issue of resource use and consequences when thinking about an economy is odd. Surely one of the most important insights of ecological economics is that its concerns ought to be fundamental to economics not compartmentalized as “sometimes” an area of concern when problems arise. Would it be fair to say that one of the main differences is that ecological economics positions its concerns as Chapter One, rather than the environmental economics chapter tacked on in general textbooks? Concomitantly, its focus is economies in which environmental problems would, in principle, be avoided rather than retrospectively recognized for resolution (as though subsequent damage limitation was a rational solution in the aggregate and as a trajectory for the way we live collectively on a finite planet)? That, of course, opens up many issues in terms of what a “problem” is and, in any case, we are not in an original position – we are where we are. According to the Global Footprint Network, “Earth overshoot day” (the day in the year on which humanity’s demand for ecological resources and services exceeds the annual regenerative capacity of the Earth – an indicative and interesting if contestable approach to natural systems) this year (2019) was July 29th. This is two months faster than twenty years ago and requires 1.75 equivalent Earths:

² Note from Jamie: Pigouvian tax refers to taxes on negative externalities (the social marginal costs of a good or service exceeds the private marginal cost and is not currently included in the pricing, the tax is intended to close the difference reducing output and consumption of that good, subject to elasticity). Pigou followed Marshall at Cambridge, but was then one of the chief focuses of criticism by Keynes leading to the *General Theory*.



<https://www.overshootday.org/newsroom/press-release-july-2019-english/>

Again, this seems a stark reminder of just how important ecological economics is and the difference its difference makes.

Herman: Yes, ecological economics would not be surprised by “unexpected” externalities of depletion and pollution, since it connects resource and environmental economics by recognizing from the beginning the real-world connection between depletion and pollution via the concept of throughput. Joshua Farley and I have written a textbook which aims to do what you suggest (Daly and Farley, 2003 [2011]). To reiterate, the connection between the input and output ends of the throughput, its scale and entropic nature, are *unrecognized* by standard neoclassical economics, as is the fact that the effective limit on throughput may stem from either end, and may change over time (e.g. peak oil depletion versus “peak” greenhouse gas emissions). The metabolic throughput brings the first and second laws of thermodynamics into the center of economic theory, greatly increasing our recognition of scarcity, and limiting the devotion to “growthism”. This is an important concept. Currently, scarcity is at the root of economics, but the *physical* root of scarcity is omitted. The laws of thermodynamics are the main physical root of scarcity. The constraint that the laws of thermodynamics and scarcity place on growthism is hard to deny, so consequently the challenge tends to be ignored or countered by techno-fantasies. A very good response to the challenge, however, is the Global Ecological Footprint analysis (see Wackernagel and Rees, 1996) that you alluded to.³ In my opinion, it is far more deserving of the so-called Nobel Prize in economics than many of the contributions for which the Prize has been given.⁴

³ See: <http://environment-ecology.com/ecology-writings/598-ecological-footprint.html>

⁴ Note from Jamie: The Swedish Bank Prize, established 1968, was *not* envisaged by Nobel in his will that initiated the prize system, but it is administered by the Nobel Foundation. William Nordhaus received the prize in 2018. However, as Nordhaus (1991) and other interventions indicate his contribution includes specific arguments reducing the sense of urgency and need for action regarding

Jamie: And yet in ignoring this an informed ignorance threatens our future. Ed Conway, the well-respected economics editor of Sky News wrote the following in a recent op-ed in *The Times* newspaper:

Instead of seeking economic growth, they say governments should be attempting to constrain it. It is hard to know where to begin with this madness... [Regarding GDP and growth] the more we moan about its deficiencies, the more likely we are to forget that there are few phenomena in the world as magical as economic growth. Growth makes us healthier, it lengthens our lives, it (mostly) makes us happier, it diminishes poverty and narrows the gaps between countries, it expands opportunities and frequently liberates those who are oppressed. Even bearing in mind its faults, it remains one of the world's great miracles... So by all means let's measure economic growth better. Let's ensure our growth is even cleaner. Let's share it out more equally. But for heaven's sake let's not actively try to stop it (Conway, 2019).

This was published just over a day after the IPCC Special Report on *Climate Change and Land* (IPCC, 2019), a report intended to contribute to the IPCC's work in analyzing the scope to achieve the UNFCCC COP 21 Paris agreement targets (see, including an essay by Herman, Fullbrook and Morgan, 2019; Morgan, 2016). The new report garnered significant publicity (not least because it emphasizes the unsustainable nature of current trajectories and the need for major shifts in land use and food consumption patterns).⁵ Conway's op-ed makes no mention of real limits, or current and future consequences of economic activity (beyond we could be "even cleaner"). His specific target here is degrowth rather than a steady-state economy, but the basic lack of understanding of the very idea of limits and the many connotations his statements involve are glaring. They are rooted in an economics education and framework that see economies as places that create and solve their own problems in a general process of dynamic progress of perpetual expansion. A situation where one need only nudge or steer markets whilst growth delivers more of what we want (even if we don't know what that is yet). Much of what he says touches on concerns you have addressed under various arguments and based on contesting evidence. But before we turn specifically to some of those could you just bring together this first part of our discussion by clarifying just what is typical in textbook representations of an economy and how something like a production function, which to some may *seem* to be about physical things is not adequate as a way to articulate the real nature of an economy?

Herman: Yes. First, regarding Conway – no one is against being truly richer. The question is, does growth in real GDP any longer make us richer as it did in the "empty world", or is it now in the "full world" making us poorer? That is, once we count the expanding, but heretofore uncounted, costs of growth, such as climate change, biodiversity decline, depletion, toxic substance and radiation release, water and land use conflicts, etc.

environmental harm in general and climate change specifically. For a trenchant critique see Hickel (2018)

⁵ Agricultural land use is a major cause of emissions and climate change: noting the significant increase in the global population; that human use directly affects about 70% of the ice-free land surface; agriculture accounts for 70% of freshwater use; since 1961 per capita supply of meat and vegetable oils has doubled, 2 billion people are overweight (compared to 821 million undernourished) and 25-30% of total food produced is wasted; dryland (desertification) area has increased by average 1% per year since 1961.

If we are thinking about how frameworks affect our thinking, consider the neoclassical-Keynesian synthesis presented in nearly all introductory textbooks. It starts with the basic circular flow diagram. Firms supply products to households (national product) and households supply factors to firms (national income). Money circulates in the opposite direction. The diagram nicely combines supply and demand and prices in the products market with supply and demand and prices in the factors market, with the flow of money, and with the determination of aggregate national income and national product. Later chapters add leakages and injections from the circular flow: savings return as investment through finance; taxes return as government spending through public finance; imports are balanced by exports through international finance.

This can be a very useful and unifying vision, but it has a major defect – nothing *enters* from the outside, nothing *exits* to the outside. It is an isolated system that just keeps going without running down or wearing out. There is no outflow of waste to the environment, nor any replenishing inflow of resources from the environment. An isolated system has no environment. The economy is depicted as a perpetual motion machine in disregard of the Second Law of Thermodynamics. The economy has no digestive tract tying it to the external world – only an internal circulatory system. The metabolic throughput of matter/energy is abstracted from, probably because it was not considered scarce in the “empty world”. But devotion to exponential growth quickly brought us to the “full world” in which the scale of throughput has generated uncounted externalities and “illth” to an extent that overwhelms the counted wealth also generated by the economy.

Ignoring the metabolic throughput in the basic pre-analytic vision has the further consequences that in our national income accounts resources in the ground and natural waste absorption capacities are valued at zero. Also, resources are omitted from the neoclassical production function that contains *only* labor and capital. And if resource flows are sometimes plugged into the usual Cobb-Douglas function, to be incongruously multiplied times labor and capital funds, the result is a contradiction to the First Law of Thermodynamics – the cook can bake a ten pound cake with only a few ounces of ingredients simply by increasing labor and capital – by stirring harder and baking in a bigger oven. To be clear then, standard economics ignores the contribution of the metabolic throughput of resources both in its microeconomic production function and in its macroeconomic national accounting – two massive errors that at least are consistent with each other.

Jamie: Ok, let’s start to pick up issues that bear on specific concepts and then move to matters that affect policy and contemporary issues. You mention the term “illth”. Could you say a little more about what you mean by this and how it informs your thinking on the norms that can, could or should inform the way we structure our economies?

Herman: In the index of standard neoclassical textbooks you will find entries under “goods” and “wealth”, but no entries under “bads” and “illth”. Bads are the opposite of goods and illth is the opposite of wealth. The production flow of goods accumulates into a stock of wealth, and the production flow of bads accumulates into a stock of illth. The term illth comes from John Ruskin and the term bads probably was introduced by Kenneth Boulding. Bads are undesired joint products with goods. Producing a car inevitably also produces pollution, depletion, tired laborers, depreciated capital equipment, and accidents. Our national accounts (GDP) measure only goods. They do not count bads because there is no demand for bads, and therefore no market or prices for them. Instead they count “anti-bads” – the defensive expenditures to protect ourselves against the bads, treating them as if they were net goods.

And depletion of natural capital is treated as if it were current income. Ecological economists have developed alternative national accounts that seek to rectify these and many other anomalies. (See for example the Index of Sustainable Economic Welfare, and the Genuine Progress Indicator.) These indicators show that after about 1970 in many developed countries illth was growing faster than wealth. There is always debate about the accuracy of empirical measures, but the big question is, why was the need for these theoretical corrections not also recognized and attempted by mainstream economists? Anything that is even potentially unfriendly to growthism is selected against in the present struggle for survival of growth as usual. Imagine if we should discover that growth at the present margin created more illth than wealth! What would we do then? Safer not to measure illth, or even talk about it.

Jamie: Yes, there is a certain degree of “I told you so” about this now, but still resistance at a basic level – almost like a kind of cognitive dissonance. Illth follows from the general consequences of pursuit of quantity, not just over quality but with consequences for quality – excess etc. Your own background work on this goes back decades and there are, of course, numerous other early interventions – empirical, conceptual, forecasting etc (for example, Meadows et al., 1972; Schumacher, (1973) [1993]; Porritt, 1984). This seems an important reminder that social science is often not neutral. New ideas enter into a given world of knowledge formation. Objectively, if I was to simply suggest any adequate social science ought to have a concept that accounted for potentially counterproductive or harmful consequences from the processes of change it studies – since it is manifestly the case that not all change can be expected to be beneficial – few would balk at this; and yet when specified in regard of an existing economic framework of theory and practice and stated with descriptive accuracy (“illth”) the connotations have proven unpalatable. Equally, of course, it is because there is a glaring and *cumulative* problem hiding in plain sight that critique of fundamental problems of the direction of travel of our economies has increased. Degrowth, what this might mean, whether it is desirable, necessary, achievable etc is a concept that has occupied similar territory. A degrowth movement has become one of the main sources of critique of growthism and it is this that Conway had in mind in the previous quote. Perhaps you might comment on how a steady-state approach sits in terms of current debates regarding degrowth?

Herman: Basically I think degrowth and steady-state advocates are allies against the neoclassical-Keynesian ideology of growthism.⁶ There are a few differences, however, that we might discuss. Serge Latouche (2010) one of the degrowth founders, referred to degrowth as a “slogan in search of a program”. Some might consider steady-state economics as a program in search of a slogan. I am not sure that degrowth is an apt slogan (consider Conway’s reaction), but it would be nice to have one. Ecological economics and steady-state economics developed together out of dissatisfaction with neoclassical growth economics felt by some academic economists and ecologists. The starting point was theoretical and the aim was policies that *do not* require growth, that are consistent with the classical stationary state of population and capital as defended by J.S. Mill.

Degrowth has its origins more in social activism than in the history of economic thought, and is impatient with theory and specific policy. As some degrowthists put it, degrowth is a “missile word” aimed at blowing up conventional discussion and creating a vocabulary for new ideas. I can see the logic of their approach, and maybe they were understandably impatient with the

⁶ Note from Jamie: For the post-Keynesian response and dialogue with ecological economics see Holt et al., 2009.

slowness of steady-state economics to gain adherents, but I personally wish that they would advocate some specific policies around which we might cohere, or lend their support to steady-state policies. They have not always done so and I believe their reason for not doing so is the fact that at current scale the economy is too large to be maintained as a steady state. It is well beyond optimum or even sustainable scale. However, this was recognized from the beginning in steady-state economics – the optimal scale is smaller than the present scale, so an initial period of negative growth is called for. But, before we can degrow we *must stop* growing. Furthermore, degrowth as a policy norm is at least as unsustainable as growth (it too cannot last forever). Indeed, even the steady-state economy cannot last forever, but it can provide longevity with sufficiency to a much greater extent than either growth or degrowth. Also, I am surprised by many degrowthists' apparent unwillingness to consider population as a part of the scale issue. But the degrowth movement is young, and I am old. The future belongs to the young, so I am hopeful that they will both develop conceptually and grow in numbers.⁷ A strong alliance would seem logical and mutually beneficial.

Jamie: So, you seem to be suggesting that there is at root an affinity between steady-state economics and degrowth as a movement, at least based on purpose and perspective? This is in so far as a steady-state approach specifically references scale, and given the current state of affairs and direction of travel of economies, its mechanisms should be positioned to achieve an appropriate scale following not just a halt to growth but necessary negative growth. There is, of course, an additional commonality, ecological economics in general and both degrowth and steady-state economics, continue to be marginalized by mainstream economics. Discourse, debate, the potential for dialogue seem to be undermined by training and socialization that remain entrenched in core concepts, frames of reference, and methods rooted in the legacy of neoclassicism -- even as the field diversifies. This marginalization is both readily comprehensible in terms of the selective processes of the sociology of knowledge (insiders-outsiders where fundamental critique is involved), and deeply disturbing because this is a subject where the stakes could not be higher.

The mainstream continues to act as though environmental economics (informed by mainstream concerns) had appropriate concepts from which solutions have and continue to emerge in a *timely fashion*. Environmental economics has focused on discount rates, marginal abatement, externalities, etc. Its concepts are rooted in time but the weight of conceptual argument has been towards minimal intervention and maximum delay – anything but *timely*. As such, the consequences of our economic activity have accumulated as evidence to the contrary regarding the adequacy of dominant ways of conceiving an economy (each successive UN Global Environmental Outlook report has confirmed this).⁸ Permissive and misdirected seem to be reasonable judgements regarding theory and policy: A basic premise that it makes sense to do harm and then seek to fix it, as though a sane society is one that ducks *after* it is punched. From this point of view, standard economics and environmental economics as a sub-discipline have been part of the problem and not ready sources of solutions. Given the environmental damage done and still being done the position of mainstream economics seems deeply irrational (if only as evidence refusal), ironic perhaps since the whole of mainstream economics begins from concepts of appropriately calculative

⁷ For good discussions, see Perez-Carmona (2013), Kerschner (2010). Note from Jamie: for useful additional insight on steady state issues see Dietz and O'Neill (2012); and see also Part X in the *Routledge Handbook of Ecological Economics*, which has essays on post-growth, degrowth, the steady state etc. that any student will find informative (Spash, 2017).

⁸ GEO 6 was published 2019 and is available: <https://www.unenvironment.org/resources/global-environment-outlook-6>

self-interested rational conduct. You more than most have experienced this complacency over the decades. What do you make of it?

Herman: I make of it that standard economics is a very sick discipline. I first saw this in the way that they treated my teacher, Nicholas Georgescu-Roegen, who had been a darling of the mathematical economists until he wrote *The Entropy Law and the Economic Process* (1972), which criticized the isolated system vision and the neglect of the metabolic flow of resources from and back to the environment, as we have already discussed. From then on Georgescu was considered a non-economist – a very smart guy who had studied economics under Joseph Schumpeter and statistics under Karl Pearson, and used to be a good economist, but then went off into physics, biology, and philosophy. Too bad, but since he is not really “an economist” any more we need not pay attention to his criticisms. And so, in 1997, some 25 years after the publication of the *Entropy Law*, and having seen no effect on standard economics, I decided to push the issue rather aggressively in an article and related symposium in *Ecological Economics* on “Georgescu-Roegen vs Solow/Stiglitz” (Daly, 1997). I restated the critique that Georgescu (by then deceased) had made of the neoclassical production function, and specifically his criticism of Solow and Stiglitz for their continued adherence to a theory that effectively denied the importance of natural resources. The editors of *Ecological Economics* invited replies from Solow and Stiglitz. The replies were brief and condescending restatements of their own positions, without engaging Georgescu’s criticisms at all, and indeed without even mentioning his name. I could give other examples of stonewalling complacency, but let this one suffice since it can be easily looked up. Complacent arrogance of leaders is only half the problem – the other half is the unwillingness of the rest of us to challenge complacent error when we see it, especially in leaders who in other ways deserve respect.

Jamie: This last point brings us to contemporary policy and activism. It seems to me that there are grounds for optimism and pessimism. Divisive and punitive variants of populism, strident ethno-nationalism and conflict seem to be on the rise (see, for example, the World Economics Association edited collection on Trump, including an essay by Herman; Fullbrook and Morgan, 2017). It seems that every other week some new calamity is reported and as the IPCC and UNEP reports of late 2018 indicate, the timescale to achieve necessary structural transformations to prevent catastrophic climate change is now short (net zero by 2040 to 2050, subject to hothouse Earth scenarios etc.). One might be overwhelmed. And yet there are also signs of positive change.

I am not sure what the situation in the USA is like, but in the UK, the positioning of climate change in the media seems to have undergone a shift – especially at the BBC. Until recently there was a kind of punctuated publicity – a flood somewhere, another instance of erratic weather, another record temperature; but there was no cumulative narrative structure or thread. Rather there was dissipation. Items just came and went and were lost in the news-cycle. And there was a concomitant reporting of events whose format often involved a talking heads situation: drawing on a climate change sceptic (typically not a climate scientist) who was given equal footing with an actual expert (from the Tyndall Centre or some equivalent). This commitment to “balance” conveyed the impression that there was undecidability between two positions despite the basic asymmetry of evidence and the underlying call to prudential action versus complacency as tacit recklessness. What the climate scientists wanted to convey was caution regarding precision of findings, where so many natural processes that could be affected were involved, not reasons to delay: uncertainty *between* models that all

showed the same overall direction of travel in terms of the actual data (subject to this or that possible temporary offsetting factor).

This dissipation seems to no longer be the case – events still come and go in the news-cycle, but each event is now introduced or concluded with statements that emphasize that this is *another* instance of climate change; a consequence etc. So, the shift seems to be towards a narrative structure or thread that accepts climate change is real, climate change is here, it is one instance of a set of environmental consequences of the way our economies are constructed and we (increasingly) need to recognize and deal with the real problems that are beginning to manifest. This, at least, seems (tentatively) positive, despite Trump, Bolsonaro etc. Moreover, increasing numbers of ordinary people – especially the young are becoming impatient with the lack of action and political parties and governments do seem to now be thinking about basic solutions – they are beginning to be on the agenda, and it seems increasingly possible that some serious disaster may compel this. Some places are more down the road than others, of course, and real commitment is hard to assess (in a world where “greenwash” has been a default mentality for some). With this in mind, perhaps you might comment on the Green New Deal as well as new campaigning organizations of civil dissent, such as Extinction Rebellion?

Herman: The Green New Deal and Extinction Rebellion are encouraging signs of an awakening to the urgency of the problems that growthism has created. But there is still an unwillingness to identify growth as *the* root cause. What is the root cause of climate change? Not growth it is assumed, but just the fact that we are too dependent on non-renewable fossil fuels – we just need to shift to renewable sources of energy, it is said. A reasonable suggestion within limits, but when growth leads to exploitation of renewables beyond their sustainable yield they effectively become non-renewables. And unlike fossil fuels which come from underground, renewables come from the surface of the earth where their cultivation directly competes with food production. And when burned renewables too emit carbon. And even solar collectors take up space, and their material structure wears out and must be replaced by newly mined materials, an activity that after years of depletion could require most of the energy they collected over their lifetime. Never mind, some say, soon fusion power will give us energy so abundant that it will be “too cheap to meter,” to recall the false promise of nuclear fission advocates. That didn’t happen. But suppose we *do* achieve free energy by fusion or some other unknown “backstop energy source” – that will simply enable the growth economy to more quickly cut the last tree, catch the last fish, and strip mine the last mountain.⁹ In a steady-state economy free energy would be a boon, in a growth economy it would be a curse.

The Green New Deal cannot be a new way to keep on growing. It has to be a new recognition of limits and willingness to live within them by sharing, and cutting waste and extravagance. The Green New Dealers in the US, to their credit, show considerable willingness to share, by their advocacy of expansion of the welfare state and tax increases for the wealthy. However, their simultaneous implicit advocacy of open borders, undercuts welfare state expansion in the absence of either further growth, or unlikely transfer payments from foreign governments

⁹ Note from Jamie: this invokes a variant of the Jevon’s paradox – some forms of efficiency enhancement lead to net increases in exploitation of resources or further systemic consequences based on scale etc. Note also, “backstop resource” is a concept invoked over the decades by Solow, Nordhaus and various others to ground the claim that there is always an exit strategy to some other (imaginary) resolving technology and activity; a mindset that tacitly positions the present – not having to solve the problem we can observe being created now. See Herman’s comment on the Jevon’s effect later.

to meet the extra welfare costs imposed by their emigrating poor. The fact that some of Trump's immigration policies are bad ones does not make open borders a good policy. The US *de facto* cheap-labor policy of lax enforcement of our immigration laws (greatly aided by off-shoring and automation) was what got Trump elected in the first place, and the Green New Deal Democrats really should worry about handing him the same issue again. It is common sense that, like rain, some immigration is good and too much is bad – one should not have to advocate open borders to “prove” to the politically correct that one is not a racist! The “progressive” media is often unwilling to do the work necessary to understand and explain the complex immigration debate, and so they treat it as simply another manifestation of racism for which they have a ready-made vocabulary, and which requires no further effort to understand and explain to their viewers. Yes, there really is such a thing as racism, but default appeal to such *ad hominem* explanation simply provokes understandable resentment and populist reaction in the working class.

Jamie: There is, of course, a great deal more that might be said on this subject regarding the positive impact culturally, economically and socially of immigrants (the discursive positioning of the issue that leads to the *construction* of race as a matter of division) and also more that might be said regarding the contemporary politicized conflation of immigration and economics with asylum-seeking and universal human rights and responsibility. But your point is well taken, the scope for the Green New Deal cannot evade issues of scale and so from an ecological economics point of view population size is a key issue – not least once growth is curtailed and distributions become a main focus, so policy here has multiple and differing considerations, some of which perhaps advocates have not yet considered. We, meanwhile, have considered the basic worldview of ecological economics and how it differs from the neoclassical-Keynesian growth synthesis whose policies have led us to near collapse. To conclude our discussion, it seems pertinent to ask what are the policies suggested by ecological economics?

Herman: Yes, indeed. To do this let us go back to the three goals we started with, and in the same necessary sequence, namely: sustainable scale, just distribution, and efficient allocation. Briefly, what policies correspond to each goal?

First, *Sustainable scale* is defined by a population and a per capita stock of wealth maintained by a metabolic throughput that is within nature's capacity for waste absorption and resource regeneration. One way forward here are cap-auction-trade systems for key resources. These auctions could mainly start with energy. They would limit throughput in a gross way, and raise considerable revenue. Resource severance taxes could be used as a substitute or supplement. As a general rule, the tax base should be shifted away from value added and on to that to which value is added, namely the depletion-pollution throughput. We want more value added, so stop taxing it. We want less depletion-pollution, so tax it.¹⁰ Higher resource prices induce resource-saving technical progress. Taxes are easier to administer, but quotas are environmentally safer. Quotas block the Jevons effect and convey the message that there is a limited amount that must be *rationed*, not the message that we can have as much as we want as long as we pay the price plus tax. Of course, we do not know the optimal scale in advance, but we know that it is smaller than at present, and by trial and error could approximate an optimal, or at least sustainable scale. We already have some experience with

¹⁰ Note from Jamie: bearing in mind that, according to IMF research, energy including oil receive massive global subsidies, even though we think of oil as something that is taxed as a negative externality (Coady et al., 2015).

cap-auction-trade and with severance taxes. Population is also a major determinant of scale. Policies limiting population range from China's one-child family to laissez faire reliance on the "automatic demographic transition," with all sorts of incentive programs in between.

Curiously, the logic of the cap-auction-trade system just advocated for basic resources was first imagined by Kenneth Boulding (1965) in the context of population. That is, limiting aggregate births by establishing quota rights to reproduce, in an aggregate amount corresponding to replacement fertility. The rights would be distributed equally rather than auctioned, but could then be voluntarily re-allocated among individuals by sale or gift in the interest of efficiency. Sustainability would be served by setting the aggregate quota at replacement fertility; justice served by distributing the individual quotas equally; efficiency respected by allowing subsequent exchange to better meet individual preferences. Needless to say, the quota plan has no political support when applied to limiting human reproduction, but does find support as a way to limit, distribute, and allocate the yield of renewable resources at a sustainable level, in addition to limiting the rate of depletion of non-renewable resources. For all its difficulties, the Boulding plan would be far less drastic than the Chinese one-child policy, but more drastic than voluntary family planning with financial incentives.

Jamie: In the societies we live in the idea of auctions for fertility rights seems shocking (and the concept of efficiency applied to people carries connotations that would make many uncomfortable). But it is worth emphasizing here that the whole issue is motivated by pragmatic recognition that there is a problem to be addressed: the population of the world has risen from 1.6 billion in 1900 to over 7.5 billion now; global GDP has risen from \$1.1 trillion to over \$80 trillion; we are now a planet of consumers (planetary consumers, literally eaters of worlds); which is no more than to say there are many more of us living lives that once few did. The consequences are now manifesting (1.75 Earths). It is not punitively or callously Malthusian to recognize that numbers are a factor we must think about. As Lester Brown and others concur, what is viable is contingent, but that there are consequences is undeniable. Since we cannot negotiate with the planet only amongst ourselves it makes sense to rationally collectively agree to limit ourselves on a finite planet. Contingency though speaks to your prior point regarding coevolution of societies and the environment, which brings us to other aspects of scale you have considered.

Herman: Yes. Scale could also be maintained constant with a growing population by proportionate reduction in per capita resource use, but that too is currently politically non-viable. Although world population has twice doubled in my lifetime I doubt that it will ever double again. But if it does, the birth quota plan might then become politically viable. While Boulding's plan is viewed with horror (misunderstood as buying and selling babies), the public seems strangely willing to accept the buying and selling of ova from healthy young women at elite universities, and sperm from young men, or from Nobel Laureate sperm banks, along with rent-a-womb services from surrogate mothers. Little objection is raised to the implicit embrace of eugenics entailed by the marketization of actual biological reproduction – yet simple exchange of reproduction quota rights is considered abhorrent. At the same time, transhumanist billionaires are planning to increase population by living forever once the "Singularity" arrives, and their cryogenically preserved brains can be thawed and their information content resurrected in silicon "bodies". This techno-fantasy is widely admired as "death defying". Lest I be misunderstood, I should say that I think more people are better than fewer – as long as they are not all alive at the same time! Let's strive to maximize the cumulative number of lives ever lived over time at a level of per capita resource consumption sufficient for a good life. That is a better approximation to responsible stewardship and

sustainability than is a world of declining carrying capacity provoked by an excess of current people and their excessive possessions.

Jamie: Yes, it would be unfortunate if a reader were to get the impression that you harbored anti-egalitarian and authoritarian proclivities (the Dr Strangelove of eugenics).

Herman: Which brings us to the issue of *Just Distribution*. This requires fairness in the initial ownership of the limited depletion rights to be auctioned. Fairness suggests collective ownership by the government. The revenue from the auction, or from the severance taxes, goes first into the general treasury. Various redistributions have been suggested. Some favor a revenue neutral equal social dividend to all citizens. Others favor a revenue neutral reduction in other taxes, specifically the most regressive taxes so as to benefit the poor. Alternatively, and more radically simple, is the suggestion of a limited range of income inequality bounded by a minimum and a maximum – say for example an annual minimum of \$20,000 and maximum of \$2,000,000. A factor of 100 difference should give ample space for incentives and differential reward for different contribution, and yet significantly reduce the extreme inequality generated by our present system. Plato thought the richest citizen should be four times as wealthy as the poorest. For now the important thing is to establish the principle of limits to inequality. Over time, and on the basis of experience the range could be reduced or expanded. There is considerable political support for a guaranteed minimum income, but not for a maximum. This may well change given the outrageous size of incomes at the top today, and the job-reducing consequence of automation.¹¹

Jamie: And you and others have argued for this as not just necessary but also desirable: an antidote to the negative aspects of consumption-focused societies where identity and status are imbued into what one has (and the act of getting it) rather than the meaningful things one does or pursues – something that Wilkinson and Pickett (2010) and others establish does not necessarily make us happier and in some ways can make us ill (invoking such classical contrasts as internal and external goods, praise and praise worthiness etc).

Herman: Yes, though to be clear this is not at the expense of economic reasoning. The third issue is *Efficient Allocation*. Once sustainable scale and just distribution have been collectively set, then, for resources that are rival and excludable, the individualistic market can be relied on to allocate them efficiently – that is, in accordance with preferences and ability to pay. Within these constraints, the market seems better than a central planner. Considerable burden has already been placed on the central government to set and administer scale and distributional limits, as well as to allocate public goods and break up monopolies, so we should be grateful for some help from the market in the important task of allocating private goods.

Jamie: This brings us to a final point. Not so much a critique of your stance than it is an unavoidable problem of transitions irrespective of what route is taken. It strikes me that the existential ecological challenge invokes a variant of Rousseau's classic social contract dilemma – and this time not as a retrospective thought experiment regarding how we got to where we are, more as a how can we get to where we need to go. That is, what individual freedoms are we going to be prepared to forego to create grounds for others?¹² Policy

¹¹ See, for example, Brynjolfsson and McAfee (2014); Ford, (2015); Morgan (2019).

¹² Note from Jamie: Rousseau thought of these as higher (rational) freedoms, critics, however, focus on the tyranny of the general will that can also follow.

proposals such as auctions and quotas and high levels of taxation on some activities seemingly require strong rule systems and a shift in attitudes toward law and regulation (our socialization acting as the software of institutions – what we are prepared to engage with and how). It seems likely we will have to vote for prohibitions on some kinds of conduct – a broader public sphere of what we *cannot* do. What do you think about this as a problem for societies like the US, which adhere to the mythic rugged individualism ideal (despite much of the reality of life in the US)? It seems that there is a great deal more to say about what kind of individualism we will be comfortable with in the future. This surely extends also to your point about markets. Markets are rooted in institutions and can have many different qualities. For example, a reasonable question to ask in the context of ecological economics and the steady-state is what forms of ownership are *least* likely to encourage subversion of our collective interest in a steady-state at an appropriate scale; which type is most likely to provide the required information to make the whole work and which type is most likely to act in the spirit of the system rather than based on other mechanisms?

Herman: As you say, this is a fundamental question, and was well stated by Edmund Burke: *“society cannot exist unless a controlling power upon will and appetite be placed somewhere, and the less of it there is within, the more there must be without....Men of intemperate minds cannot be free. Their passions forge their fetters.”*¹³ The less voluntary self-control there is, the more coercive police control there must be. If we want less police coercion, then we must have more voluntary self-control and discipline by conscience. Conscience and self-control require a commitment to value as the motive of action. Not preferences, but value. Value is objective and as such must elicit basic consensus; preference is subjective and varies widely among individuals. Standard neoclassical economics serves preferences, and by its doctrine of consumer sovereignty reduces value to the level of preference. Without objective value, what controlling power on will and appetite (preferences) can there be? Only external police power, or the Malthusian positive constraints of nature’s coercion. In C. S. Lewis’s words, *“A dogmatic belief in objective value is necessary to the very idea of a rule which is not tyranny or an obedience which is not slavery.”* This sounds extreme, but is logic itself. If you and I disagree on a policy, and both of us deny objective value, then there is nothing for either of us to appeal to in an effort to persuade the other, or to accede to in being persuaded. Your preferences mean little to me, and mine mean little to you. And a “fair compromise” requires appeal to the objective value of fairness. What then prevents resort to force or deceit (tyranny) to settle the issue?

But where does our knowledge of objective value come from? I would say from religious insight, specifically in the West from the Judeo-Christian tradition whose historical dominance has been greatly weakened by attacks from the secular intelligentsia, and by its own internal failures and worldly corruptions. At the same time Scientism has taken the cultural place of religion, but promotes a materialist world view productive of power, but devoid of purpose or value. I think growth economics has stepped into this void arguing that even in the absence of objective value and right purpose we still have our preferences, and we should agree that *growth* in the satisfaction of those preferences, however uninstructed they may be, is the glue that will hold society together. At least until consequent ecological ruin tears it apart!

¹³ Note from Jamie: this is from Burke’s A Letter to a Member of the National Assembly and is typically taken to refer to our reflexive acceptance of moral chains, rationally accepted to exchange baser instincts for higher goods (justice etc.).

Jamie: A great deal to do then in terms of public action, discourse and deliberation in order to produce future societies we can live in, though of course the very act of producing them would be to exercise one of the chief characteristics of the human in a good society. How optimistic are you right now?

Herman: Well, I am hopeful, but not optimistic. The policy suggestions sketched above are far from a detailed blueprint, but should convey the general policy thrust. They aim for necessary macro control of scale and distribution, with the minimum sacrifice of individual freedom of choice at the micro or market level. They are hopeful, flickering candles to try to light the darkness just described. The need for such policies is *urgent*. But the neoclassical-Keynesian growth synthesis taught in nearly all economics faculties wants scale to increase faster, and sees inequality in distribution of income mainly as a source of investment funds and incentives to push growth. It insists on straining out gnats of inefficient allocation while swallowing camels of unsustainable scale and unjust distribution. It is past time for a big reform in economics!

References

- Boulding, K. (1965) *The Meaning of the Twentieth Century*. New York: Harper and Row.
- Brynjolfsson, E. and McAfee, A. (2014) *The Second Machine Age: Work, progress and prosperity in a time of brilliant technologies*. London: Norton.
- Coady, D. Parry, I. Sears, L. and Shang, B. (2015) *How large are global energy subsidies?* Fiscal Affairs Department, IMF Working Paper 105.
- Conway, E. (2019) "Talking up 'degrowth' is not clever or funny." *The Times* 9th August.
- Daly, H. (editor) (1973) *Toward a Steady-State Economy*. London: W H Freeman and Company
- Daly, H. (1974) "The economics of the steady-state." *American Economic Review* 64(2), pp. 15-20.
- Daly, H. (1977 [1991]) *Steady-State Economics*. Washington DC: Island Press.
- Daly, H. (editor) (1980) *Economics, Ecology, Ethics: Towards a steady-state economy*. London: W. H. Freeman and Company [update of Daly, 1973].
- Daly, H. (1992) "Allocation, distribution, and scale: towards an economics that is efficient, just, and sustainable." *Ecological Economics* 6, pp. 185-193.
- Daly, H. (1996) *Beyond Growth: The Economics of Sustainable Development*. Boston: Beacon Press.
- Daly, H. (1997) "Forum, 'Georgescu-Roegen vs. Solow/Stiglitz.'" *Ecological Economics*, 22, pp. 261-266.
- Daly, H. (1999) *Ecological Economics and the Ecology of Economics: Essays in Criticism*. Cheltenham: Edward Elgar.
- Daly, H. (2007) *Ecological Economics and Sustainable Development: Selected Essays of Herman Daly*. Cheltenham: Edward Elgar.
- Daly, H. (2014) *From Uneconomic Growth to a Steady-State Economy*. Cheltenham: Edward Elgar.
- Daly, H. (2015) *Essays Against Growthism*. London: WEA/College Books.
- Daly, H. and Cobb, J. (1989 [1994]) *For the Common Good*. Boston MA: Beacon Press.
- Daly, H. and Farley, J. (2003 [2011]) *Ecological Economics: Principles and Applications*. Washington DC: Island Press, Second Edition.
- Daly, H. and Townsend, K. (editors) (1993) *Valuing the Earth: Economics, Ecology, Ethics*. Boston MA: MIT Press [update of Daly, 1973].
- Dietz, R. and O'Neill, D. (2012) *Enough is Enough*. London: Berret-Koehler.

Ford, M. (2015) *The Rise of the Robots: Technology and the threat of a jobless future*. New York: Basic Books.

Fullbrook, E. and Morgan, J. (editors) (2019) *Economics and the Ecosystem*. London: World Economics Association Books.

Fullbrook, E. and Morgan, J. (editors) (2017) *Trumponomics: Causes and Consequences*. London: World Economics Association Books

Georgescu-Roegen, N. (1972) *The Entropy Law and the Economic Process*. Cambridge and London: Harvard University Press.

Hickel, J. (2018) "The Nobel prize for climate catastrophe." *Foreign Policy* December

<https://foreignpolicy.com/2018/12/06/the-nobel-prize-for-climate-catastrophe/>.

Holt, R. Pressman, S. and Spash, C. (editors) (2009) *Post Keynesian and Ecological Economics*. Cheltenham: Edward Elgar.

IPCC (2019) *IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse gas fluxes in Terrestrial Ecosystems*. Summary for policymakers, August 7th.

Kerschner, C. (2010) "Economic de-growth vs. steady state economy." *Journal of Cleaner Production*, 18, pp. 544-551

Keynes, J. M. (1924) "Alfred Marshall, 1842-1924." *The Economic Journal*, 34(135), pp. 311-372.

Latouche, S. (2010) *Farewell to Growth*. Cambridge: Polity

Meadows, D. Meadows, D. Randers, J. and Behrens, W. (1972) *The Limits to Growth*. New York: American Library [Report to the Club of Rome].

Morgan, J. (2016) "Paris COP 21: Power that speaks the truth?" *Globalizations*, 13(6), pp. 943-951.

Morgan, J. (2019) "Will we work in twenty-first century capitalism? A critique of the fourth industrial revolution literature." *Economy and Society* (in press).

Nordhaus, W. (1991) "To slow or not to slow: The economics of the greenhouse effect." *The Economic Journal*, 101, pp. 920-937.

Perez-Carmona, A. (2013) "Growth: A Discussion of the Margins of Economic and Ecological Thought." Chapter 3 in Louis Mueleman, ed. *Transgovernance*, Springer.

Porritt, J. (1984) *Seeing Green*. Oxford: Blackwell.

Schumacher, E. F. (1973 [1993]) *Small is Beautiful: A Study of Economics as if People Mattered*. London: Vintage.

Solow, R. (1974) "The economics of resources or the resources of economics." *American Economic Review* 64(2), pp. 1-14.

Spash, C. (editor) (2017) *Routledge Handbook of Ecological Economics: Nature and Society*. New York: Routledge.

Wackernagel, M. and Rees, W. (1996) *Our Ecological Footprint: Reducing Human Impact on the Earth*. Gabriola Island, BC: New Society Publishers.

Wilkinson, R. and Pickett, K. (2010) *The Spirit Level: Why Equality is Better for Everyone*. London: Penguin [with new postscript].

Author contact: hdaly@umd.edu and jamiea.morgan@hotmail.co.uk

SUGGESTED CITATION:

Daly, Herman and Jamie Morgan (2019) "The importance of ecological economics: An interview with Herman Daly." *real-world economics review*, issue no. 90, **xx December**, pp. **xx-xx**, <http://www.paecon.net/PAERreview/issue90/DalyMorgan90.pdf>

You may post and read comments on this paper at <https://rwer.wordpress.com/comments-on-rwer-issue-no-90/>