business leaders who voluntarily cut back on pollution and who in the process lessen profits for the corporation.[87]

The real danger of economic models is not that they may describe reality inaccurately (Friedman agreed that they do);[88] rather, it is that they 'justify,' and hence may induce, socially and environmentally deleterious behaviour. Economic models are templates to which real life may, over time, conform.

# 5 Environmental vs Ecological Economics

From its beginning at the turn of the twentieth century, neoclassicism has grown into a mighty force, challenged only at the fringes by such heterodoxies as institutional and evolutionary economics, marxian economics, and ecological economics.

To be sure, over the century 'fissures' in the mainstream doctrine became evident, but these invariably spawned new subdisciplines to address the problems within the bounds of the neoclassical paradigm.[1] For example, the basic neoclassical model presumes 'perfect competition,' whereas the real economy is characterized in certain sectors by monopoly and oligopoly; *public utility economics*, however, proposes that even in the face of monopoly, competitive results can be simulated through 'marginal cost pricing' as enforced by a regulator; the problem of monopoly is reduced to a question of appropriate pricing. Again, once it was acknowledged that the real world is beset by uncertainty, *information economics* arose to proffer as a 'solution' the commodification of information, so that it too would be produced and sold in markets in optimal amounts;[2] although a vast literature on the topic exists, nowhere have economists conceptualized information in a way that lends rigour to this proposal. Yet a third fracture, the one addressed in this book, has concerned 'externalities,' and again there arose a new subfield – *environmental economics* – which, like the aforementioned, endeavours to salvage neoclassicism through policies that induce 'correct' prices.[3]

In this chapter, I carry neoclassicism's story forward into the present as it concerns this last-mentioned problem – 'externalities' – which I then compare to an emerging but still heterodox discourse, ecological economics. These are, we will see, disparate discourses concerning

economy-ecosystem interactions. The former focuses on prices and market exchanges, and sees in these both the source of and solution to environmental problems. The latter views environmental issues as being too complex to warrant merely price adjustments, and hence recommends a panoply of non-market, non-price-based policies – including a phasing back of market activity.

The present chapter assesses these two discourses in the context of ecological principles, that is, from the standpoint of a culture of ecology. It bears emphasizing, however, that neoclassical approaches remain the orthodoxy; as John Foster bluntly puts it, 'The mainstream neoclassical version [being] the only version of green economics with a respectable pedigree in terms of "economic science," has commanded the field.'[4]

## Environmental Economics

A core assumption of neoclassical economics is that humanity consists of rational, utility-maximizing individuals with given tastes and preferences. 'Rational' in this context means that people know what they want and are able to act in ways that best satisfy their wants, given such constraints as the size of their income. This presupposition, dating back to the utilitarianism of Jeremy Bentham and others, engenders policy approaches hinging on the presumption that tastes and preferences are sacrosanct ('De Gustibus non est disputandum').[5] In terms of the environment, neoclassicists treat such fundamentals as air and water quality as 'preferred goods and services.' Anything that reduces the availability of these environmental amenities is an 'externality,' the avoidance of which is likewise treated as a 'preference.' In elaborating this approach, there are essentially two traditions, the first inaugurated by A.C. Pigou, and the second, decades later, by Ronald Coase.

### *Forerunners*

#### A.C. PIGOU

Retrospectively, A.C. Pigou's landmark tome, *The Economics of Welfare* (1920), marked the birth of environmental economics. Pigou had been inspired by his mentor, Alfred Marshall, who in *Principles of Economics* (first edition, 1890) opened the door for economists to consider economy-ecosystem interactions. There, Marshall introduced the concept of *external economies*, which he defined as cost savings per unit of production accruing to a firm as a result of increases in industry-wide production.[6] Marshall conjectured that a more highly skilled labour force, higher health standards, and improved infrastructure might accompany industry-wide growth, and that the ensuing cost savings would redound to individual firms. It needs to be noted, however, that from an ecosystem perspective, Marshall's conception of external economies, seminal though it was, is quite deficient insofar as he posited only third-party savings or benefits, omitting entirely consideration of third-party costs or harms. For that reason Marshall cannot be credited with inaugurating environmental economics.



Subsequent to Marshall, the notion of external economies (and hence, of course, diseconomies) remained largely dormant within the mainstream literature until Pigou reintroduced them in 1920 through the term 'externalities.' Pigou focused on discrepancies between individual economic interests and those of the community, explaining that even in purely competitive economies, private and social interests can diverge. He defined an externality as a cost or benefit that is not considered by the person taking the action. For instance, Pigou elucidated that smoke from a factory imposes costs on third parties in terms of 'injury to buildings and vegetables, expenses for washing clothes and cleaning rooms, expenses for the provision of extra artificial light, and in many other ways,'[7] but, he noted further, the egoistic, maximizing producer will be undeterred by such occurrences. In all such instances, Pigou proposed, collective well-being can be increased if governments intervene by implementing a system of taxes and subsidies – taxes in cases of negative or harmful externalities, subsidies in instances of beneficial ones – to narrow the gap between 'marginal social net product' and 'marginal private net product.' Running through Pigou's analysis, then, is an appeal for an activist government; Pigou simply did not believe that market forces automatically generated optimal prices.[8]

As well, however, his analysis supported the contention that, in principle, corrected prices are sufficient to resolve issues posed by externalities. It is this presumption that qualifies Pigou as a neoclassicist, and the founder of environmental economics.

#### RONALD COASE

Nobel laureate Ronald Coase's classic piece, 'The Problem of Social Cost,' published in 1960, may be regarded as a libertarian economist's rejoinder to Pigou. Coase's preference was very much for unadulterated market prices; he had an obvious antipathy to taxes and subsidies. Coase prepared the ground for a long line of environmental economists by

delineating the extension of private property rights as a means of addressing environmental issues.

According to Coase, a polluter cannot inflict damage unless people are present to suffer injury, which is to say, in his view, that polluter and victim are *reciprocally responsible* for environmental harms, the former for producing noxious emissions, the latter by virtue of mere propinquity. Therefore, Coase concluded, justice does not require that parties *emitting* pollution should bear legal liability; victims are also to blame.

Coase turned next to the criterion of economic efficiency, contrasting two situations. The first was characterized by 'perfectly functioning markets' (i.e., pure competition, perfect knowledge, zero transactions costs), for which, Coase opined, all possibility of externalities, by definition, is precluded. He 'proved' his contention with a simple numerical example of cattle destroying neighbouring crops. If legal liability for damages resides with the polluter (here, the cattle rancher), free contracting would enable the polluter to bribe those harmed into agreeing to the harm, and the polluter will have incentive to proffer a bribe of such magnitude that the marginal benefit of being able to continue the noxious activity at any given level (i.e., number of cows) just compensates for the added costs experienced on account of having to pay additional money in a bribe. Likewise, those harmed by pollution will find it advantageous to accept a bribe of such magnitude that the last dollar received just slightly more than compensates for damages wrought by the incremental pollution. Conversely, if the legal system does not impose on the polluter liability for damages, free contracting, Coase averred, will nonetheless permit those being damaged to bribe the polluter into cutting back production (i.e., decrease the number of cows); and, moreover, aggrieved parties will find it beneficial to offer bribes of such magnitude that the marginal benefit they attain from a small decrease in pollution just exceeds the cost of bribing the polluter into cutting back the activity (here, the herd by one more cow). After comparing the two situations– the first with liability residing with the polluter, the second envisaging no such liability – an obviously satisfied Coase exclaimed: 'The ultimate result (which maximizes the value of production) is independent of the legal position if the pricing system is assumed to work without cost.'[9] For 'perfectly competitive' markets, Coase (and other neoclassicists) concluded, it does not matter whether or not the law ascribes liability for pollution, since markets will commodify pollution, ensuring thereby that only 'optimal' amounts of pollution are produced.



Coase next addressed imperfectly competitive markets, and in particular ones beset by transactions costs (the costs of concluding an agreement between polluter and victims). In such circumstances, he conceded, private bargaining will not automatically bring about 'optimal' results. Nonetheless, he cautioned, it could still be better for governments *not* to act than to impose liability on the polluter, as recommended by Pigou. The imposition of such liability, Coase remonstrated, would affect third parties (employees, suppliers, and customers) as 'externalities.'[10] Better, perhaps, that those experiencing the consequences of pollution bear the full cost.

Coase of course can be critiqued on several grounds. Objections can be raised, for instance, to his rather infantile conception of justice (blame the victim), and to the blind eye he casts, perhaps unwittingly, on the prospect of extortion ('Bribe me or I'll pollute').

In any event, those suffering ill effects from pollution are not necessarily just those living near the site of production – a circumstance Coase presumed and upon which he based his doctrine of co-responsibility. In the case of Chernobyl, for example, nuclear fallout extended far beyond the USSR to the Netherlands, Belgium, Great Britain, the Balkans, Austria, eastern and southern Switzerland, parts of southern Germany, and Scandinavia.[11] More generally, as Rachel Carson has informed us, contaminants spread globally through the food chain as well as through wind and water currents. The polar ice caps, likewise, are melting due in part to automobile emissions from Southern California. The Earth is effectively a single, integrated ecosystem; thus the victims include all of humanity, both present and future generations.

Second, even assuming that purely competitive conditions exist, the Coasean system of bribery can *increase* pollution levels. As noted by Fisher and Peterson, 'under plausible assumptions, though the bribe does indeed reduce emissions *per* firm, it will tend to *increase* them at the industry level.' New firms will find it profitable to enter an industry now enriched by bribes.[12]

Third, the Coasean examples were all typically trivial. In addition to cattle trampling a neighbour's crops, Coase explored, for instance, a case where damages were inflicted 'by a person keeping an unusual and excessive collection of manure in which flies bred and which infested a neighbour's house,' for which Coase pronounced that the economic problem centred on 'ownership of the flies.'[13] In the Coasean world, in other words, there are no Three Mile Islands, no Love Canals, no Persian Gulf Wars, no Chernobyls, no Exxon Valdezes, no Bhopals. Coase's marginal-

ist techniques confined him to weighing the merits of one less cow versus one more cow; a slightly smaller or a slightly larger pile of manure. As well, there are no thresholds or limits in Coase's schemata. One can always reverse the consequences of pollution, he implied, by simply reducing the size of, for example, a herd of cows or a pile of manure.

Fourth, Coase did not incorporate in his analysis considerations of ecological balance. Indeed, his illustrative benefit/cost example presumed perfect knowledge of outcomes flowing from alternative courses of action, a most inappropriate assumption for ecosystem relations that, by their very nature, are complex, evolve, and are in many respects unpredictable. He was concerned, rather, only with felt irritants on the part of human agents from whom assent had not been attained. As a related point, he presumed that all relevant information can be incorporated into market prices and that market transactions constitute sufficient means for communicating such information – highly dubious assumptions, as we have seen.

Fifth, the Coasean system of bribes can be tantamount to an invitation to corruption, as when the Aborigines in the Kakadu Conservation Zone in Australia are asked how much they would require for the use of their burial grounds for mineral exploration (or, in the case of the Mohawks at Oka near Montreal, to permit construction of a golf course).[14]

One could dismiss Coase as simply a crank were it not for the regard in which he is held in neoclassical and certain policy-making circles. George Stigler, likewise a Nobel Laureate, thought so highly of Coase's environmentalist contribution that he afforded the so-called Coase Theorem (a neologism, incidentally, for which Stigler proudly assumed credit) a full chapter, suitably entitled 'Eureka,' in his slender autobiography.[15] Indeed, Coase's Nobel Prize in 1991 was based largely on the work just described.[16] And the Coasean approach remains influential, infusing such policy approaches as tradeable carbon rights and trade settlement provisions.[17]

*Case Study:* Ethyl Inc. v. Canada

The Coasean principle of compensation for not polluting is applied increasingly in trade treaties. Under Chapter 11 of the North America Free Trade Agreement (NAFTA), for example, private investors and corporations can sue NAFTA-signatory governments in special tribunals for recompense for government policies or actions that investors believe violate their new rights under NAFTA.[18] Two of these new rights are



1. *Compensation for direct and indirect expropriation.* Article 1110 entitles foreign investors to compensation from NAFTA governments for both direct expropriation (nationalization) and for actions deemed to be 'tantamount to' expropriation.
2. *No performance requirements.* Article 1106 prohibits domestic content rules, regulations concerning environmental conduct, or directions to ensure that local economies benefit from an investment by a corporation from a NAFTA country.[19]

The first case brought under NAFTA Chapter 11 was *Ethyl Inc. v. Canada.*[20] In the 1950s, the Ethyl Corporation replaced lead, finally admitted to be a health hazard after decades of use, with MMT (methylcyclopentadienyl manganese tricarbonyl) as an additive for gasoline. MMT, however, contains manganese – a known human neurotoxin. In 1977, therefore, both the state of California and the U.S. Environmental Protection Agency (EPA) prohibited the addition of MMT to gasoline in their jurisdictions, and by 1995 'all developed countries' except Canada had banned the use of MMT as a gasoline additive.[21] Although the detrimental health hazards of airborne MMT from automobile exhausts had not been definitively proven, by the precautionary principle – namely, 'in cases where there is a risk to public health or the environment, but the current data is insufficient to fully quantify or assess that risk, government has a right and a responsibility to err on the side of safety'[22] – the bans were justified. Canada, however, continued to import MMT from the Ethyl plant in the United States, the chemical's only point of manufacture. Finally, in 1995 and again in 1996, the Canadian government introduced bills to disallow both the importation and the interprovincial transport of MMT. In addition to the health concerns described above, the government was cognizant that automobile manufacturers recommended that MMT not be added to gasoline as they alleged the product could damage catalytic converters and other pollution-control devices. Finally, MMT was believed to contribute to the build-up of greenhouse gases.

Even as the prospective import ban was being debated in Parliament, however, Ethyl Corporation announced it would seek recompense under NAFTA's Chapter 11 if the legislation was enacted. Nonetheless, Parliament passed the bill in April 1997, and Ethyl immediately filed a NAFTA 'investor-to-state' claim for $251 million, claiming *inter alia* that the ban was tantamount to an expropriation of assets. Receiving an unfavourable initial ruling from the United Nations Commission for

International Trade and Law, Canada withdrew its ban on MMT in 1998, paid Ethyl Corporation $13 million for legal fees and damages, and released a statement for use in Ethyl Corp's advertising that 'current scientific information' did not demonstrate MMT's toxicity or that MMT impairs functioning of automotive diagnostic systems.[23]

It is apparent that by entitling corporations to sue for damages arising from legislated attempts to curb environmental degradation, the NAFTA treaty fulfils at least two elements of the Coase Theorem. First, Ethyl Corp exemplifies the capacity of corporations to intimidate legislatures, just as the Coase Theorem opens possibilities for extortion. Before the bill banning importation of MMT had even been enacted, Ethyl announced it would sue. As Friends of the Earth remarks, such threats can have 'a chilling effect on future public interest policies being considered by governments and [can] result in governments preemptively conceding and changing a policy to avoid a trade challenge – as Canada did in this instance.'[24]

Second, the NAFTA provision established the principle of 'pay the polluter,' an explicit feature of the Coase system. Whereas Coase alleged, however, that in perfectly functioning marketplaces it really does not matter which party – polluter or victim – the law supports, in the case study presented here we see that this is in fact at the heart of the issue. The policy of 'pay the polluter' severely constrains the capacity of governments to enact environmental legislation.

*Case Study:* Methanex

In June 1999, the Canadian company Methanex initiated a claim for compensation of nearly $1 billion under NAFTA's Chapter 11 from California as recompense for the state's phasing out of the gasoline additive MTBE (methyl tertiary butyl ether), suspected to be a 'carcinogen that renders water foul tasting and undrinkable when it leaks out of gas storage tanks.'[25] Numerous cities in California felt compelled to truck in water after ground water became contaminated. Methanex is a producer of methanol, which it sells to companies that manufacture MTBE.[26] It claimed before the tribunal that phasing out MTBE would adversely affect its sales of methanol, and that it should be compensated for an action that was tantamount to an expropriation. As part of its defence brief, the State of California declared: 'If [Methanex's claim is] accepted by this Tribunal, no NAFTA Party could carry out its most fundamental governmental functions unless it were prepared to pay for each and every economic impact occasioned by doing so. The NAFTA Parties never intended the NAFTA to bring about such a radical change in the way they function, and Methanex cannot show otherwise.'[27] Hearings were held before the tribunal in June 2004, but no decision had been issued at the time this book was prepared.



*Environmental Economics Today*

A COASEAN CONTEMPORARY

Today's environmental economists follow very much in the footsteps of Coase and/or Pigou. Ian Willis is one such who typifies the Coasean approach. He opens his *Economics and the Environment* by acknowledging the inspiration he received from F.A. Hayek's classic paper 'The Use of Knowledge in Society.'[28] Willis suggests that the level of complexity Hayek dealt with, however, is dwarfed once economy-ecosystem interactions are taken into account.[29] Given this added complexity, Willis advises, prices become even more eminently suited for coordinating human interactions.[30]

Difficulties begin, however, with Willis's very definition of an 'environmental problem.' 'Environmental problems occur,' he writes, 'when some people are unhappy with other people's use of the natural environment, because it imposes harms on them to which they have not consented.'[31] As he notes, this definition implies that the focus of any analysis and the policy recommendations that ensue are on harms for which there is no prior consent, a position resonating completely with Coase. Environmental problems for Willis, then, do not include human-ecosystem interactions that damage the environment but of which humans are unaware; nor do they include environmental harms of which humans are aware but to which they accord little importance; nor do they even include all environmental degradations of which humans are cognizant and over which they are distressed. 'Environmental problems' for Willis are confined to those for which no bargain has been struck between those inflicting the damage and those upon whom it is inflicted. 'Scarce resources mean that harms to others are unavoidable,' Willis explains; hence, 'the issue is not whether such harms occur but whether they are subject to prior community agreement.' On that basis Willis concludes that environmental problems 'involve a lack of social coordination or consensus between resource users and those harmed,'[32] thereby deftly setting up prices, whether market based or adjusted, as the preferred 'solutions' to 'environmental problems.'

Referring specifically to both Chernobyl and *Exxon Valdez*, Willis writes: 'Commonly, although not always, [environmental problems are due to] the absence or distortion of signals about and incentives to respond to other people's concerns over the environment.'[33] Well, yes. One suspects that the nuclear reactors at Chernobyl, for instance, would never have detonated were the explosions somehow contingent upon the prior consent of the victims located in various countries of the world.

Willis acknowledges that neither economists nor ecologists fully understand the consequences of present-day policies and economic decisions on the capacity of ecosystems to renew and perpetuate themselves. He declares, correctly: 'Neither economists nor ecologists know enough about combined economic-environmental systems to understand all the future consequences of today's resource use ... There are so many possible interactions within and between the economy and the environment over space and time that it is simply impossible to know the future outcomes of today's use of the environment.'[34] One might have thought that in being aware of the radical uncertainty confronting economists, ecologists, and by implication average citizens, Willis would have abandoned price-based and market-based 'solutions'; given radical uncertainty, 'correct' prices are both impossible to estimate and will not result from the commodification of pollution. Willis, however, takes the exact opposite tack. Incredibly, he declares: 'If economic-environmental systems are so complex that it is impossible to know what actions will promote sustainability, the signalling and incentive system itself may be the best indicator of sustainability – of ability to adapt to changing economic and environmental circumstances.'[35] This is, shall we say, peculiar advice, given that the very same system of signals and incentives mired us in our present environmental morass in the first place.

Willis agrees with Coase that in a world of exclusive property rights, zero transactions costs, and perfect knowledge, markets and prices are sufficient to eliminate *all* environmental problems,[36] or, more accurately, those falling within Willis's/Coase's truncated definition. Given the theory, and despite the radical uncertainty, Willis's 'preferred' policy response to real-world environmental problems is, wherever possible, to 'find ways of lowering cost, technological and organizational barriers to exclusion.'[37] 'Barriers to exclusion' are defined by the author as factors that preclude the delineation and enforcement of private property rights. Property rights, of course, are a requirement for market prices as



exchange transactions cannot take place in their absence, and as we have seen it is Willis's view that in market prices lies humanity's best hope for environmental well-being.

Scientific/technological advances, he continues, give rise to new ways of forging desirable exclusions ('the introduction of barbed wire greatly reduced the costs of excluding other people's livestock from grazing land ... the introduction of devices that can scramble and decode television signals has created a market for pay television programming'),[38] thereby permitting market exchanges and market prices to penetrate areas from which they had previously been precluded due to the impossibility of enforcing exclusive claims. This trend in technology, Willis asserts, is highly desirable as market exchanges can increasingly provide the incentives and signals necessary to coordinate production and consumption of non-collective goods.

For cases where exclusive ownership remains impossible, he advises, policy makers must decide among (a) doing nothing, (b) introducing direct controls, and (c) creating marketable permits and taxes. These are the only options that Willis presents. He argues that marketable permits and taxes are preferable to direct controls, as these operate through the marginal conditions of the individual producers and thereby affect the prices of items offered for sale. Moreover, marketable permits, unlike direct controls, make use of each 'polluter's private information about their individual MBP [marginal benefits of pollution] curves,'[39] and hence are a more cost-effective way of reducing pollution. Pollution taxes, likewise, 'enlist private information to achieve least cost emissions reductions.'[40] Willis advises that the size of the taxes and the cost of the permit allocations should reflect the costs in money terms of the harms experienced by victims[41] – not an easy amount to estimate. (More on this below.)

I turn now to Willis's account of human nature, which, like his faith in the efficacy of market prices even in the context of monumental uncertainty, predicates his entire analysis. Willis is in agreement with standard economic doctrine that human desires are 'effectively unbounded.'[42] 'In all known societies,' he declares, 'with desires unbounded, resources (natural, created and human) are inadequate to produce all the goods and services necessary to satisfy all human wants; this is the economist's definition of scarcity.'[43] Having proposed unlimited wants as endemic to societies of every time and place, he then turns to the variable nature of those wants: 'People's wants include privacy, clean air and water, preservation of flora, fauna and ecosystems and so on,'[44] he writes. Unfortu-

nately, rather than ask how such ecologically friendly 'wants' can attain higher priority, which would be to pose a deeply ecological question, the author merely repeats the standard neoclassical position of *De Gustibus non est disputandum*: 'How these wants are weighted relative to wants for powerful cars or hamburgers,' he declares, 'is determined by communities' ethical norms and the values which result from those norms, not by the economist, who takes people's likes and dislikes as given.'[45] Of course, no one has suggested that economists 'determine' people's hierarchy of desires; but economists' acceptance of that hierarchy as sacrosanct, and as being the base criterion for all economic policy – despite possibly disastrous environmental consequences – is one of the reasons for declaring environmental economics, as currently constituted, extremely anti-environmental.

From the perspective of a culture of ecology, human wants are not simply given; they are, rather, the heart of the matter. Nor is it simply a question of the finiteness vs infinite expansibility of wants that is at issue; it is also very much the composition of wants that, as the author remarks, is a function in part at least of the 'communities' ethical norms.' These 'norms' through human history have varied immensely from community to community, as anthropologists (and advertisers) well know, although in the age of global media one suspects a homogenization to be under way. But that is not to say that through concerted effort wants cannot be made more environmentally sound, and that the doctrine of 'unbounded desires' cannot be reined in as well.

To illustrate by just one example how important community norms are in individual want formation, consider the North American indigenous peoples of the West Coast. According to Houghton Mifflin's *Encyclopedia of North American Indians*:

> Throughout native North America, gift giving is a central feature of social life. In the Pacific Northwest of the United States and British Columbia in Canada, this tradition is known as the *potlatch*. Within the tribal groups of these areas, individuals hosting a potlatch give away most, if not all, of their wealth and material goods to show goodwill to the rest of the tribal members and to maintain their social status. Tribes that traditionally practice the potlatch include the Haidas, Kwakiutls, Makahs, Nootkas, Tlingits, and Tsimshians. Gifts often included blankets, pelts, furs, weapons, and slaves during the nineteenth century, and jewelry, money, and appliances in the twentieth.
>
> The potlatch was central to the maintenance of tribal hierarchy, even as it allowed a certain social fluidity for individuals who could amass enough material wealth to take part in the ritual ...
>
> When Canadian law prohibited the potlatch in 1884, tribes in British Columbia lost a central and unifying ceremony. Their despair was mirrored by the tribes of the Pacific Northwest when the U.S. government outlawed the potlatch in the early part of the twentieth century. With the passage of the Indian Reorganization Act of 1934 in the United States and the Canadian Indian Act of 1951, the potlatch was resumed legally. It remains a central feature of Pacific Northwest Indian life today.[46]



### CONTEMPORARY PIGOUVIANS

The essential difference between Coase and Pigou, it will be recalled, is that the former expressed faith in unadjusted market prices to resolve environmental problems provided that property rights are adequately delineated so as to enfold 'externalities' within the ambit of markets, whereas the latter contended that market prices need to be 'adjusted' through taxes and/or subsidies to resolve environmental issues. What the two theorists share in common, however, is an avowed faith in the efficacy of prices to resolve environmental issues, qualifying each as a forerunner of neoclassical environmental economics. In this section I explore contemporary exponents of the Pigouvian position, which invariably entails as a first step estimating the costs or benefits of an externality in order to determine how large the tax or subsidy should be.

Advocates of 'cost-benefit' analyses contend that to make rational, non-arbitrary decisions regarding environmental services, some common measuring unit must be applied to make comparisons. According to Pearce et al., for example, 'Physical accounts are useful in answering ecological questions of interest and in linking environment to economy ... However, physical accounts are limited because they lack a common unit of measurement and it is not possible to gauge their importance relative to each other and non-environmental goods and services.'[47] Consistent with Alfred Marshall's famous dictum, contemporary advocates of cost-benefit analysis propose that in money one finds just such a universal measure. In an oft-cited piece,[48] Robert Costanza and associates endeavoured to apply the money measure to *all* of 'nature's services.' A forest, for example, renders such 'services' as soil retention, waste storage, soil formation, and habitat provisioning, among many others. The total figure Costanza and associates came up with for 'nature's services' was U.S.$33 trillion annually, about twice the world's GDP for 1997.

Costanza's study is, of course, fully consonant with the approach to environment and externalities recommended by neoclassical economists, namely, enfolding as much of nature as possible into the ambit of the price system. Indeed, the authors write: 'If ecosystem services were actually paid for, in terms of their value contribution to the global economy, the global price system would be very different from what it is today.'[49]

While Costanza's approach is certainly of interest insofar as it calls attention to a range of ecosystem interactions usually disregarded by environmental economists, it is nonetheless quite misguided in presuming that monetary value can meaningfully be ascribed to these 'services.' Costanza et al. err, in brief, in presuming that ecosystem interactions can and should be conceptualized as subsets of the economy. The authors declare: 'Ecosystem services provide an important portion of the total contribution to human welfare on this planet; we must begin to give the natural capital stock that produces these services adequate weight in the decision-making process.'[50] The authors, in brief, fail utterly to recognize that there would be no 'contribution to human welfare' without 'ecosystem services.' Without the earth's 'services,' no humans would exist to impute value to anything.

Let us turn next to *The Measurement of Environmental and Resource Values* by environmental economist A. Myrick Freeman III. This is an award-winning tome published in 2003 by Resources for the Future.[51] The book sets out to 'provide an introduction and overview of the principal methods and techniques of resource valuation.'[52] Through its quantitative techniques the author intends to enable policy-makers to come up with well-reasoned answers to the following types of questions:

- Is the diversion of resources mandated by the US Congress to improve air and water quality worth the cost?
- Are the restrictions on development in ecologically sensitive areas such as Arctic National Wildlife Refuge worth the costs they impose on society in reduced availability of and higher prices for energy and minerals?
- What degree of reduction in greenhouse gas emissions is warranted by the benefits of slowing or preventing global warming?[53]

The underlying premise of the book is as follows:

> Natural resources, such as forests and commercially exploitable fisheries, and environmental attributes, such as air quality, are valuable assets in that they yield flows of services to people. Public policies and the actions of individuals and firms can lead to changes in the flows of these services, thereby creating benefits and costs. Because of externalities and the common-property and public-good characteristics of at least some of these services, market forces can be relied on neither to guide them to their most highly valued uses nor to reveal prices that reflect their true social values.[54]



Freeman, then, is much less sanguine than Coase or Willis regarding the capacity of market prices to resolve environmental issues. However, he does not forsake pricing as a key to alleviating environmental problems, qualifying him as an 'environmental economist' in the tradition of Pigou. Freeman explores 'shadow pricing' as an aid to centralized decision making regarding large-scale projects. To reach a determination on environment related issues, Freeman writes, the analyst needs to ascertain the 'true' monetary value of the 'services' that nature provides as a first step toward deriving the value of the natural resource asset in question. The economic value of an environmental resource such as a forest is, according to Freeman, 'the sum of the discounted present values of the flows of all of the services' it yields.[55] (Among the 'services' yielded by a forest, according to Robert Costanza, are climate regulation, water regulation, water supply, soil erosion control, soil formation, nutrient cycling, waste treatment, biological control, food production, raw materials, genetic resources, recreation, and cultural services.)[56] The 'quantity' of these 'services' over time needs to be estimated, then a money value ascribed to each; these money amounts must then be discounted (by a 'suitable' rate of interest, whatever that means), and the 'present values' of all the services aggregated to arrive at the estimated value of the forest as an economic asset.

The foregoing, of course, begs the question of exactly how each of the 'services' is to be imputed with a monetary value. Freeman provides a discussion on the meaning of value to an economist: 'In economics, the goal is increased human well-being. The economic theory of value is based on the ability of things to satisfy human needs and wants or to increase the well-being or utility of individuals. The economic value of something is a measure of its contribution to human well-being. The economic value of resource-environment systems resides in the contributions that the ecosystem functions and services make to human well-being.'[57] Once more the persistence of anthropocentrism in environmental economics is apparent.

Freeman next notes there are broadly two (and, I hasten to add, methodologically individualist and anthropocentric) expressions of

value. One, 'willingness to pay' (WTP), is 'the maximum sum of money the individual would be willing to pay rather than do without an increase in some good such as an environmental amenity.' The second, 'willingness to accept compensation' (WTA), is 'the minimum sum of money the individual would require to voluntarily forgo an improvement that otherwise would be experienced.'[58] Freeman's implicit indebtedness to Coase is quite clear.

According to Freeman, moreover, there are also two basic methods of measuring value, whether WTP or WTA. One is to observe the actual behaviour of consumers in the marketplace in terms of the types of substitutions they make in their everyday activities (a method termed 'revealed preferences') and to infer on the basis of these observations the value of the services of a natural asset. The other is to ask people what they would hypothetically pay for, or accept in lieu of, some benefit (the 'stated preferences' method).[59] In this latter regard, a voluminous, technical literature has arisen on the merits of various forms of questionnaires, modes of questioning, and interpretation (for example, 'contingent valuation methods');[60] these need not detain us here since the very premise of evaluating nature's resources on the basis of commodity substitutions is the far more basic, and problematic, issue.

Freeman himself remarks, however, on yet further complexity inherent to the proposed method. While a given policy may well increase the present value of one or some 'services,' it may also decrease the flow of others.[61] To be complete, therefore, it would appear that nothing short of a total modelling of the world as an ecosystem (with the human economy as a component) is required, and values (prices) imputed to all components as they interact. The impossibility of accomplishing such a task is what persuaded Willis to rely on market prices as the best available proxy for social benefits and costs. The distance between Willis and Freeman, then – both environmental economists – is cavernous indeed.

But let us return to the basic strategy of imputing value to nature's assets on the basis of 'consumers'' willingness to make substitutions, the premise underlying both WTP and WTA. Some of the deficiencies of this approach I have noted previously in chapter 2. Vatn and Bromley, however, make a highly significant additional point: 'individual preferences are context relative.' Hence, there is 'a fundamental problem [of] which of many "contexts" is pertinent to any particular choice problem.' They continue: 'In essence, individuals are both consumers and citizens and environmental choices uniquely span both domains.'[62] Neoclassical economists by definition, of course, cast people in the individualistic mode of hedonistic consumers, and neglect or efface people's capacity to make disinterested decisions as citizens.



For John Ralston Saul, perhaps the most significant falsity spread by 'elites' today is denial of the existence of a 'public' or 'common good,' which is to say a subject matter for the citizenry. Elites do this, he writes, on the one hand by largely disregarding (or neglecting even to mention) the common or public good, and on the other by continually promoting its opposite – self-interest. Seldom, he writes, do elites encourage the citizenry to adopt a 'disinterested' perspective from which to contemplate the larger well-being of society as a whole.[63] What Saul states regarding elites is certainly true of neoclassical environmental economists.

Environmental economists' penchant of asking people how much they value nature's essential 'services' is deficient in another important way as well. As people normally do not have to pay for these 'services,' they never enter people's cost calculations. (What value would the reader ascribe to the soil-retaining 'services' of a nearby forest, for example? Is this not a ludicrous question?) By contrast, many market-based items are heavily promoted and consumers continuously have to make monetary decisions on these. The very method of valuation chosen by environmental economists, then, is extremely biased toward favouring increased consumption of private goods and services, as opposed to conservation and preservation of natural assets.

An alternative, of course, is to afford citizens-in-community an opportunity to arrive collectively, and through processes of debate, discussion, and education, at a consensus concerning the valuations of nature's 'assets' and 'services.'

One further serious flaw to the cost-benefit methodology as forwarded by neoclassicists such as Freeman concerns the discounting into the present of future costs and benefits. Once a money value has been assigned to the flow of environmental services over time, these amounts must be discounted to arrive at an estimate of present value. One level of debate concerns what the discount rate should be. The more basic issue, however, is the fact that future generations – those who will actually experience the consequences of today's decisions – are rendered voiceless by the procedure.

## Ecological Economics

For most ecological economists, the price solutions proffered by neoclassical environmental economists are quite inadequate and often per-

verse. Ecological economist Robin Grove-White remarks: 'Economic theory has provided – indeed continues to provide – the underpinning for many environmentally destructive practices.'[64] Ecological economics differs from environmental economics, therefore, in the first instance, by contending that pricing as a solution to environmental problems is at best inadequate, if not indeed perverse. Ecological economists, moreover, have reformulated what is taken to be the economic problem. Whereas mainstream economists concentrate primarily on efficient allocation of resources and on maximizing economic growth, ecological economists focus fundamentally on the issue of scale – on how big is too big.[65] However, as noted by Daly, by insisting that there are limits to growth, ecological economists necessarily, even if but inadvertently, become closely embroiled in issues of wealth distribution: 'As long as the economy is growing, we can always offer to the poor the future prospect of a slice of a larger pie.' Daly continues: 'As soon as we call for an end to growth, this option is gone ... Thus distribution is of central importance to ecological economics.'[66]

Most fundamentally, however, ecological economics proposes a different initial postulate than does neoclassical economics generally and environmental economics in particular. For mainstream economists, the 'whole' is the human economy. Ecological economics, in contrast, insists that the human economy is but a component or subset 'of a larger enveloping and sustaining Whole – namely, the Earth, its atmosphere, and its ecosystems.' Moreover, 'that larger system is finite [and is] nongrowing.'[67]

I begin this discussion of ecological economics, an umbrella term used here to encompass the non-neoclassical approaches to environmental issues, of three forerunners: Kenneth Boulding, Nicholas Georgescu-Roegen, and Herman E. Daly.

*Forerunners*

KENNETH BOULDING

In 1966 Kenneth E. Boulding (1932–93), a former president of the American Economics Association, presented a seminal paper, 'The Economics of the "Coming Spaceship Earth,"' to an environmental conference in Washington, DC. In his paper – subsequently widely published – Boulding proposed that humans' image of their place in the world is rapidly changing, from the belief that we live in an open system, which he whimsically termed the 'cowboy economy,' to the belief that we live in a closed system, for which he coined the term the 'spaceman economy.'[68]



These metaphors, Boulding continued, are in opposition to one another. The 'cowboy economy' is emblematic of 'reckless, exploitative, romantic, and violent behavior.' In the cowboy economy, consumption and production are regarded as good things, and the success of the economy 'is measured by the amount of the throughput from the "factors of production."'[69] The greater the flow of throughputs (inputs of factors of production, outputs of goods and services), the better the economy's performance. In the 'spaceman economy,' by contrast, the earth is likened to 'a single spaceship, without unlimited reserves of anything, either for extraction or for pollution.' According to the spaceship metaphor, 'throughput is ... to be minimized rather than maximized.' In the spaceman economy, moreover, 'what we are primarily concerned with is stock maintenance.'[70] Boulding then added, 'This idea that both production and consumption are bad things rather than good things is very strange to economists, who have been obsessed with the income-flow concepts to the exclusion, almost, of capital-stock concepts.'[71]

While Boulding's metaphor of 'Spaceship Earth' and his focus on the capital stock remains foreign to mainstream economists, even forty years later, they form the cornerstones for an emerging, insurgent ecological economics. Had these two notions been Boulding's only contributions to formulating an environmentally sound economics, he would still be honoured in the pantheon of forerunners to modern ecological economics.

Still in reference to his influential speech, 'Spaceship Earth,' however, Boulding introduced two other seminal ideas to economics discourse. One was *entropy*, the second law of thermodynamics, according to which order decreases, or randomness increases, as a result of any process; there is a tendency for states to become more probable, more chaotic, less ordered, less differentiated according to this second law. Entropy has been accepted by many ecological economists as basic to their field. The other revolutionary idea mentioned in 'Spaceship Earth' was to reformulate the factors of production. The two ideas are, as we will see, inextricably connected and, I would argue, fundamental to integrating economics and ecology in a manner consistent with a culture of ecology. I begin now with the latter idea.

In 'Spaceship Earth' but also in other texts – most significantly in his seminal book, *Ecodynamics: A New Theory of Societal Evolution* – Boulding proposed that land-labour-capital – the orthodox triad of factors of production – be replaced by information-matter-energy. For Boulding, production, 'whether of a chicken from an egg or of a house from a

blueprint,' is a process whereby 'some kind of information or knowledge structure is able to direct energy toward the transportation, transformation, or rearrangement of materials into less probable structures than those existing at the start of the process.'[72] When a seed germinates in the ground, Boulding maintained, its informational structure (DNA) utilizes and directs stored energy to draw selectively upon nutrients or 'building materials' in the soil to produce its *phenotype* (the plant). Likewise for animals, *genomes* (that is, the total inherited genetic information) utilize energy and materials in directing processes of growth and development. Similarly, Boulding contended, a housing contractor studies a blueprint and from the knowledge or instructions embedded therein utilizes energy to assemble construction materials, which he or she then rearranges to produce a more complex or improbable structure than had existed previously. Boulding therefore also defined production as the realization of phenotypes from genotypes.

In justifying this proposal, Boulding merely stated: 'I am arguing that the classical economic taxonomy of factors of production into land, labor, and capital is ... too heterogeneous to be useful and that know-how, energy, and materials are a much more useful taxonomy in understanding productive processes.'[73] From the standpoint of a culture of ecology, however, what makes the new taxonomy so potentially useful is that it appears to correspond precisely with David Suzuki's depiction of ecology as the study of the 'pathways' through which matter, energy, and information circulate within ecosystems. We do indeed glimpse here the beginnings of an ecological economics.

Boulding attributed a tremendous role to information in evolutionary/developmental processes. He declared, for instance, that 'It is a powerful and accurate metaphor to see the whole evolutionary process from the beginning of the universe as a process in the increase of knowledge or the information structure.'[74] He even defined 'evolution' as 'a process of cumulative change of know-how.'[75]

Analogous to Paul Ehrlich's distinction between genetic and extragenetic information, Boulding distinguished between *biogenetic evolution* and *noogenetic evolution*. The former occurs when genetic information (or know-how) undergoes mutation, the mutant phenotype then being subject to selection processes in its environment. The latter occurs when knowledge transmitted from one generation to another undergoes change and becomes subject to cognitive social selection processes.[76]

Despite the huge role in social, cultural, and economic development/evolution that he accorded information (or know-how), Boulding did not treat it thoroughly or even consistently, and this undoubtedly explains the reluctance of ecological economists to pursue his suggested line of analysis. Below I critique Boulding's conception of information and propose a modification that could be incorporated into ecological economics. But before temporarily parting company with Boulding, I must acknowledge yet another set of his marvellous and seminal insights that helped inspire ecological economics.



For Boulding, organic species and human artefacts (which he termed 'social species') are components of *ecosystems*, defined as 'interacting populations of different species in which the birth and death rates of each population are a function of its own size and the size of the other populations with which it is in contact.'[77] Species, whether organic or social, occupy *niches*, defined as equilibrium populations of phenotypes in their ecosystems.[78] Social species are similar to organic species in the sense that both are 'selected' for occupancy of niches. Commodities, for instance, at any moment have a population or stock that increases through production and decreases through consumption, and, like biological species, they interact continuously, influencing each other's birth, growth, and death rates.

Modes of species' interaction for Boulding are various. Petroleum and automobiles, for example, are in continuous symbiotic interaction, whereas inter-city trains and buses tend to interact competitively. Social artefacts may also be competitive with organic species (e.g., automobiles with horses), or co-operative with them (e.g., chemical fertilizers with domesticated crops). Boulding also analysed predator-prey relations and host-parasite relations. Here again we see, in its incipiency, a new discipline integrating economics and ecology.

Boulding was a pioneer, and an inspiring one at that. Herman Daly, considered a co-founder of ecological economics, acknowledges his indebtedness to Kenneth Boulding as one of the teachers of his generation from whom he learned the most. The other was Nicholas Georgescu-Roegen.[79]

### NICHOLAS GEORGESCU-ROEGEN

Like Boulding, Nicholas Georgescu-Roegen (1906–94) was well respected within mainstream economic circles before veering into environment-related analyses in about 1966. His life's work is often divided into two parts. In the first, he made contributions to neoclassical consumer and production theory and on growth modelling; in the second, he endeavoured to incorporate entropy into economic models, a rather

subversive exercise estranging him from the economics mainstream. 'Only economists,' Georgescu-Roegen once wrote, 'still put the cart before the horse by claiming that the growing turmoil of mankind can be eliminated if prices are right. The truth is that only if our values are right will prices also be so.'[80]

In his introductory essays to *Analytical Economics* (1966), Georgescu-Roegen set out to establish that 'the economic process as a whole is not a mechanical phenomenon.'[81] He began by recounting the origin of the first two laws of thermodynamics: Sadi Carnot in 1824 had observed that heat always moves from hotter to colder bodies and that only a fraction of heat energy can be transformed into work; since 'the [Newtonian] laws of mechanics cannot account for a unidirectional movement, ' Georgescu-Roegen continued, a 'new branch of physics using nonmechanical explanations had to be created.'[82] The result was thermodynamics, with two laws formulated by Rudolf Clausius in 1865:

> *The energy of the universe remains constant* [law of conservation]
>
> *The entropy of the universe at all times moves toward a maximum* [law of entropy].[83]

Updating the second law from Clausius's formulation, Georgescu-Roegen noted the entropy law is now applied to matter as well as energy; he summarized: 'As physicists put it in nontechnical terms, *In nature there is a constant tendency for order to turn into disorder.*'[84]

The entropy law, Georgescu-Roegen continued, is 'strictly an evolutionary law with a clearly defined time's arrow.' Indeed Clausius coined the word 'entropy' from a Greek word meaning 'transformation.'[85] Incorporation of the idea of entropy into economics discourse transforms economics from a mechanistic science of static equilibrium into an evolutionary science. 'Only in thermodynamics,' Georgescu-Roegen explained, 'of all branches of physics [are] laws functions of $T$ [that is, history, or the flow of time through the observer's consciousness].'[86] In the rest of physics, time, denoted by $t$, means duration as measured by a mechanical clock, and this $t$ can have both a positive and a negative sign.[87] The invocation of physics is important because, as Mirowski argued (and as Georgescu-Roegen well knew),[88] neoclassical economics is closely related to classic physics.[89] As we saw in chapter 2, one reason for declaring neoclassical economics to be anti-environmental is the doctrine of reversible or unlimited bidirectional substitutions, whereas life processes, Georgescu-Roegen insisted, are irreversible: 'The idea that the life process can be reversed seems so utterly absurd to almost every human mind that it does not appear even as a myth in religion or folklore. The millenary evidence that life goes always in only one direction suffices as proof of the irreversibility of life for the ordinary mind but not for science [or, evidently, for neoclassical economics].'[90]



Georgescu-Roegen drew out further economic implications from entropy, including the following. First, 'Thermodynamics ... explains why the things that are useful have also an economic value – not to be confused with price ... The amount of low entropy within our environment (at least) decreases continuously and inevitably, and ... a given amount of low entropy can be used by us only once ... [It is not] possible, say, to burn the same piece of coal over and over again *ad infinitum*.'[91]

Second, 'From the purely physical point of view, the economic process is entropic: it neither creates nor consumes matter or energy, but only transforms low into high entropy.'[92] In *The Entropy Law and the Economic Process*, Georgescu-Roegen made the same point in starker terms: 'The product of the economic process is waste [pollution].'[93]

Third, and most significantly, 'there can be no doubt about it: any use of the natural resources for the satisfaction of nonvital needs means a smaller quantity of life in the future; if we understand well the problem, the best use of our iron resources is to produce plows or harrows as they are needed, not Rolls Royces, not even agricultural tractors.'[94] As Alain Alcouffe, Sylvie Ferrari, and Horst Hanusch summarize, for Georgescu-Roegen 'only negative growth can save a world governed by the entropy law.'[95] Robert L. Nadeau summarizes Georgescu-Roegen's contributions as follows: 'The writings of Georgescu-Roegen are well known and appreciated by Ecological Economists, but there are, to my knowledge, no discussions of his work in standard textbooks on mainstream economics.'[96]

### HERMAN E. DALY

Herman Daly, too, was a forerunner of ecological economics, in the sense that he first proposed a 'steady state economy' in 1968,[97] two decades before ecological economics became an organized movement.[98] That plea was enlarged upon in his 1977 book, *Steady State Economics*. Daly also co-founded with Robert Costanza in 1989 the journal *Ecological Economics*, and in the same year he published with John C. Cobb what may be regarded as the foundational text, *For the Common Good*. Since that time he has authored, co-authored, and co-edited a

series of books on ecological economics, including *Beyond Growth: The Economics of Sustainable Development*,[99] *Natural Capital and Human Economic Survival*,[100] *An Introduction to Ecological Economics*,[101] and *Ecological Economics and the Ecology of Economics: Essays in Criticism*,[102] and most recently (with Joshua Farley), *Ecological Economics: Principles and Applications*,[103] an undergraduate textbook, which I review at the close of this chapter.

### *Ecological Economics Today*

Ecological economics became a formal movement in the late 1980s, near the end of Kenneth Boulding's life. It has been aptly termed 'a transdisciplinary field of study.'[104] According to Jeroen van den Bergh, 'EE integrates elements of economics, ecology, thermodynamics, ethics, and a range of other natural and social sciences to provide an integrated and biophysical perspective on environment-economy interactions.'[105] It is, of course, in the concluding section of a single chapter impossible to canvass thoroughly such a huge field, although some of that breadth will already be evident from the discussion of forerunners. However, I will in the following pages reference a few outstanding works in the field.

#### MALTE FABER, REINER MANSTETTEN, AND JOHN PROOPS, ECOLOGICAL ECONOMICS: CONCEPTS AND METHODS

According to these authors, phenomena such as the thinning of the ozone layer, pollution, habitat destruction, and species extinctions, 'although very important, reflect only the *external* [i.e., manifest] aspects of the environmental crisis.'[106] For them, the human predicament runs far deeper: it concerns the very 'dynamics of modern society.' Only by comprehending the roots of these dynamics, they claim, will we arrive at helpful responses to environmental problems; otherwise, our responses will themselves be 'infected ... by the dynamic which produces such problems.'[107] (By implication, the authors might agree that by proposing to extend the reach of markets and prices, environmental economists are 'infecting' their responses to environmental problems with the very contaminants that gave rise to the problems in the first place.)

Faber, Manstetten, and Proops define ecological economics as 'studies [investigating] how ecosystems and economic activity interrelate,'[108] a definition that clearly fits that of environmental economics too. What distinguishes the two camps, then, is not divergence in definitions, but differences concerning the range of factors that are deemed fixed and/or outside the proper realm of their respective discourses.



For Faber et al. ecological economics is an evolutionary, dialectical science that deals not simply with 'interactions between humans and the natural world,' but acknowledges as well that these interactions are themselves 'ever evolving as the very interactions impact upon the ecosystem and alter it, and as perceptions of the environment also change.'[109] They add: 'One could say that Ecological Economics seeks to understand the human position in the world, where that world is being simultaneously created and destroyed by humans.'[110]

For ecological economics, according to the authors, the *unit of evolution* is 'the entire set of interacting economic agents and their institutions and artefacts.'[111] That being said, it is also to be remarked that in practice even ecological economists seldom explore changes in the full panoply of cultural artefacts or engage in textual interpretation ('discourse analysis' or 'cultural studies') of those artefacts; this self-imposed limitation goes a long way toward differentiating ecological economics from what I refer to here as a culture of ecology. Implicit in the culture of ecology is the critique that much of our symbolizing, not just mainstream economics discourse, has a direct, and often negative, impact on the environment. That being said, ecological economics certainly constitutes an important component of a culture of ecology.

In addressing the evolution of economic systems, Faber et al. distinguish between *phenotypic evolution*, by which they mean changes that incline an economy toward equilibrium, and *genotypic evolution*, which entails changes in tastes, techniques, and economic institutions that transform the nature of the economy itself.[112] The former, phenotypic evolution, is typically the domain of neoclassical economics; the latter, genotypic evolution, is quite beyond neoclassicism's pale.

In the inanimate ('physical') world, the authors note, genotypic evolution has all but ceased (perhaps they would agree, however, that radioactive decay remains one manifestation of genotypic evolution in the physical sphere); hence the focus there is on phenotypic evolution, which is often described quite adequately by mechanical laws (e.g., laws of motion, of gravity, of magnetic attraction, and so forth). The stability of the potentialities of physical systems, they write, has allowed physics to become an accurately predictive science.[113]

Genotypic evolution persists, of course, in the biological sphere, but here species evolution as guided by genetic mutations in the context of natural selection is quite slow. Moreover (as noted by Arthur Koestler[114]

among others), genotypic evolutionary theory makes no predictions, only after-the-fact explanations. In contrast, predictions are often a part of biospheric phenotypic evolution, for instance, the behaviour of Pavlov's dogs.

The authors pronounce that the genotypic evolution of economic *systems* can be quite rapid,[115] making economic predictions unreliable and mathematical modelling hazardous. Neoclassical economics, and by implication environmental economics, then, is quite misguided in patterning itself on physics, as it presumes that final equilibrium outcomes can be predicted on the basis of knowledge of existing states. One of the main variables leading to genotypic change in economies is shifting tastes and preferences, which environmental economists insist are not to be disputed or their causes even inquired into, but which in contrast ecological economists take to be the heart of the matter.

A related question these ecological economists ask is 'What *attitude* has led humankind to the continued endangering of nature and thus of its livelihood?' Faber et al. propose that the driving force has been 'the attempt to create a human world which is closed against the influence of uncontrollable nature'[116] – a position with which ecologist Rachel Carson, as we saw, would wholeheartedly agree. For Faber et al., ecological economics must entail an investigation into this drive, to be undertaken within the evolutionary framework of novelty, openness, and uncertainty.[117]

The authors, however, optimistically affirm that the environmental crisis consists not just of dangers, but also of opportunities: 'It offers us the chance to transcend those concepts and attitudes which block us from access to more openness, and thus to the true fullness of life.'[118] They suggest the cardinal rule for economic/environmental policy should be that 'economic activities are acceptable only to the extent that they do not destroy the health (the capacity for self-organising activity) of the larger ecological system within which the economy operates'[119] – a fundamental departure, to be sure, from environmental economics as well as from its offspring, sustainable development, as interpreted by the business and government mainstream, both of which premise their doctrines on human valuations of environmental impacts.

Recalling Georgescu-Roegen, Faber et al. also afford a central place in their analysis to entropy, writing that the entropy law informs us of 'the restrictions of the way we live in our world.'[120] They conclude: 'We believe the entropy concept to be fundamental to Ecological Economics; it gives insights into economy-environment interactions which are not otherwise available,' adding that 'The main strength of the entropy concept lies not in analytically *solving* problems, but in *detecting* problems and giving insights into their solution.'[121]



Finally, the authors propose that there needs to be developed 'a new language and a set of concepts to allow us to formulate the problem of economy-environment interactions ... All these concepts will allow us to go directly from the ecological sphere to the economic one, and vice versa. If we succeed in this endeavour, this will enable us to use one language to speak on problems of both economy and ecology.'[122]

### LESTER R. BROWN, ECO-ECONOMY

Lester R. Brown, founder and former president of the Worldwatch Institute and currently president of the Earth Policy Institute, based in Washington, DC, provides a practical agenda for approaching an 'environmentally sustainable economy,' or an 'eco-economy.'[123] According to Brown, at present there is 'no shared vision even within the environmental community, much less in society at large.' His purpose in writing *Eco-Economy* was to 'outline the vision,'[124] admitting, however, that a conversion 'is a monumental undertaking.'[125] Indeed, he asserts, the conceptual shift required for this 'Environmental Revolution' is comparable to that of the Copernican revolution.[126]

An eco-economy, according to Brown, entails phasing out certain old industries ('sunset industries'), restructuring some existing ones, and creating new ones ('eco-economy industries'). Industries to be phased out include coal mining, oil pumping, nuclear power generation, clearcut logging, the making of disposable products, and automobile manufacturing. Industries that need to grow include fish farming, bicycle manufacturing, wind farm construction, wind turbine manufacturing, hydrogen generation, fuel cell manufacturing, solar cell manufacturing, light rail construction, and tree planting.[127] An eco-economy, according to Brown, will require increased numbers in the following professions: wind meteorologists, family planning midwives, foresters, hydrologists, recycling engineers, aquacultural veterinarians, ecological economists, geothermal geologists, environmental architects, bicycle mechanics, and wind turbine engineers.[128] The last half of Brown's book essentially enlarges on the foregoing.

### BRIAN MILANI, DESIGNING THE GREEN ECONOMY

Brian Milani is a former carpenter and builder who for about a decade has been active with the Coalition for a Green Economy in Toronto. In his book *Designing the Green Economy*, Milani proposes 'eco-design' as an

umbrella term for means of moving toward a 'green economy.' 'Ecological design,' he writes, is 'a process of making human and ecosystem regeneration both the *means* and the *ends* of economic development.'[129] One aspect of a 'green service economy' that resonates with earlier material in this book, is to 'dethrone' money as 'the goal of the economy': 'Just like matter, [money] is a means and not an end, and just like matter, its open-ended accumulation is a force destructive to both society and nature.'[130]

More generally, however, Milani proposes that 'design' entails recognizing the importance of culture in economic life. Examples include restructuring human organization to let, so far as possible, nature do the work within natural processes and modelling human organization on the ecosystem.

Here are six principles Milani forwards that convey the idea of a green economy:

1. *The primacy of use-value, intrinsic value and quality.* Milani here is implicitly hearkening back to Aristotle in denigrating exchange value due to its stimulation of accumulation. Rather, he remarks, the focus should be on the end uses or satisfactions, and on various means to satisfy these. Once products are recognized as *means*, he explains, 'we can creatively minimize the matter and energy embodied in them.'[131]
2. *Following natural flows.* A green economy requires that political and ecological boundaries coincide more closely with ecosystem boundaries. Society is to become 'more bioregional.'[132]
3. *Waste equals food.* Human industrial processes need to conform more closely to the biospheric principle that in nature there is no waste: 'every process output is an input for some other process.'[133] Conforming to this principle means substituting as byproducts nutrients in place of toxins.
4. *Appropriate scale/linked scale.* Even the smallest activities, Milani notes, may have larger impacts. A green economy will recognize and account for this and integrate regenerative processes across multiple scales.
5. *Diversity.* Health and stability seem to depend on diversity, and a green economy will account for this.
6. *Localism.* For flexibility and resilience, local observation, participation, and control form important components of a green economy.

### COLIN HINES, LOCALIZATION: A GLOBAL MANIFESTO

Colin Hines, former head of Greenpeace International's Economics Unit and a Fellow of the International Forum on Globalization, enlarges on point 6 above. In *Localization: A Global Manifesto*, he proposes that for a sustainable ecosystem, as well as for democracy and authentic culture, there must be a sustained resistance to globalization. He writes: 'The global commandment that every nation must contort its economy to outcompete every other country's is an economic, social and environmental nonsense. It is a beggar-your-neighbour act of economic warfare.'[134] Among other detriments, according to Hines, globalization is environmentally destructive. Phasing back globalization and increasing local and regional production, he adds, will be environmentally beneficial, for the following reasons.



First, competition from countries with low or negligible environmental regulations would be minimized, reducing pressure on other countries to conform to the lowest common denominator. Hines notes that 'developed countries that used to be in the vanguard of environmental protection, such as Germany and the United States, are now putting the needs of being competitive before any "green" transformation of their economies.'[135] Sometimes relaxation of environmental regulations is actually forced on countries by the World Trade Organization (WTO). For example, Hines reports that in 1996 the WTO ruled in favour of Venezuela and Brazil, who had opposed provisions in the U.S. Clean Air Act as discriminating against their polluting refineries; in May 1997, the U.S. Environmental Protection Agency announced that the Clean Air Act would be amended to conform with the WTO ruling.[136] There are many similar cases on record.

Second, polluting industries would have less incentive to move to those parts of the world where pollution standards are the most lax. The Maquiladoras 'free trade zone' in Mexico is but one of many infamous examples of regions that have experienced industrialization by being lax in environmental and other standards.[137]

Third, 'relocalization' would reduce long distance transportation and concomitant energy use and pollution.

Fourth, with localization, any adverse environmental impact from production would be experienced locally where ownership and control reside; thereby the potential for improved standards of operations is increased.

Fifth, due to the present global division of production, environmental conditions have worsened dramatically in many parts of the world as 'small farmers have had to make way for intensive agriculture for exports.' As well, 'wood and fish exports are increasingly destroying for-

ests and collapsing fisheries.'[138] The alternative, namely, that as much as possible be produced within a nation or region, would go some distance in rectifying these ills.

### HERMAN E. DALY AND JOSHUA FARLEY, ECOLOGICAL ECONOMICS: PRINCIPLES AND APPLICATIONS

In 2004 Herman Daly and co-author Joshua Farley published *Ecological Economics*, which mediates the chasm between neoclassical environmental economics and ecological economics. Through this text, Daly seems to be attempting to bring ecological economics more into the mainstream. Altogether, the book is a formidable undertaking. Read selectively, it could constitute a mainstream intermediate textbook in both microeconomics and macroeconomics; read as a whole, it provides both a nuanced introduction to ecological economics and convincing arguments as to why neoclassicism should be considered, at most, a specialized subset of a more holistic ecological economics.

Part II convincingly sets out the fundamental postulates that define ecological economics and distinguish it from neoclassicism – namely, that the human economy is but a subset of a larger, finite ecosystem and that the law of entropy pertains to the human economy. Part III surveys thoroughly neoclassical marginalist approaches to resource allocation, and then proceeds to address 'market failure.' The analysis in this part is neoclassical insofar as marginalist techniques and monetary representations form a core of the discussion. It differs from mainstream neoclassical analyses in claiming that market failure is the rule rather than the exception.

Part IV reviews and critiques mainstream macroeconomics. Particularly telling is Daly and Farley's denial that Gross National Product (GNP) is an adequate indicator of well-being. For one thing, standard measures of GNP and growth in GNP do not subtract certain costs (pollution, commuting, stress, lost leisure, breakdown of community, and so on) entailed in the production of GNP. Nor is depletion of natural capital factored in. Moreover, GNP addresses but one aspect of well-being, namely, personal consumption, but is silent on a plethora of other needs such as physical and mental health, self-esteem, friendships, family, skills, peace of mind, and so on.

The authors devote a chapter to money. Money, they argue, is the one thing that does not obey the laws of thermodynamics. Money can be created and destroyed.[139] And this property of money, they conclude, gives rise to all sorts of environmental ills.



In Part V, the authors dispute the relevance of the economic theory of comparative advantage for an era with international mobility of capital; in today's world, capital seeks absolute advantage, not comparative or relative advantage, meaning that some countries may well face deterioration in their economies from globalization. Indeed, they note that one manifest consequence of globalization has been increased disparities in income, both within and among nations.[140] Furthermore, pursuit of freer markets weakens the capacity of nation states to enact environmental and social welfare measures. The authors also raise the issue of the appropriate scale of the economy relative to the ecosystem.

The final section concerns policy. The authors suggest that ecological economics has three overarching policy goals: sustainable scale, just distribution, and efficient allocation of resources.[141] Separate chapters on various policy approaches to these three major goals close the book.

*Ecological Economics* is a unique contribution to the economics/ecological economics literatures. For the uninitiated it provides an introduction to mainstream microeconomic and macroeconomic thought. It also critiques this thought based on the presumptions of ecological economics. The book is less radical in tone and substance than much of Daly's previous work. There is much less talk about a 'steady state' economy, for instance, and instead more talk about a sustainable scale, which we may or may not have reached. There is less discussion of the inherent deficiencies of markets and prices, and more about allowing them to allocate resources in certain spheres. The authors are explicit that policy-makers must approach an economic system as they find it, and hence make incremental changes only. They write: 'Even though our goal may be far from the present state of the world, the latter remains our starting point. We never start from a blank slate. Present institutions must be reshaped and transformed, not abolished. This imposes a certain gradualism. Even though gradualism is often a euphemism for doing nothing, it is nevertheless a principle that must be respected.'[142]

In keeping with gradualism, readers of *Ecological Economics* are not encouraged to sense the urgency that characterizes much of environmentalist literature. And by patiently explaining the logic of standard neoclassical models, albeit always with an ensuing critique, the authors may inadvertently lend support to neoclassical economics. For example, while arguing that in certain circumstances direct regulation (outright bans, emission standards, and so forth) may be suitable, the authors maintain that direct regulation does not satisfy the 'marginal condi-

tions' (marginal cost equals marginal revenue) for efficient allocation; therefore, they recommend Pigouvian taxes and subsidies – environmental economics policies![143] On the other hand, they are much less enamoured with the prospect of pricing non-market goods and services so as to bring them into the ambit of market activity.[144]

Daly and Farley's book is of monumental importance to the ecological economics movement and to a culture of ecology. It can be regarded as an introduction to ecological economics for economists trained in the neoclassical tradition. It is a bridge between environmental economics and a more radical ecological economics – an ecological economics to which Daly has contributed substantially in previous volumes.

As noted in chapter 1, ecological economics comprises a heterogeneous assortment of positions and modes of analysis. At its best, it is clearly distinguished from environmental economics through its holism, its insistence that the human economy is a subset of a finite and non-growing ecosystem, its refusal to consider price strategies as adequate to resolve environmental issues, its penchant for proposing that human economies conform to ecosystem principles, its consideration and incorporation of entropy into its analysis, and its understanding that events are not reversible. An evolving ecological economics will be an important component of a culture of ecology.

# 6 Information, Entropy, and Infinite Earth

In this brief chapter, I will take two ideas – the notion of an 'information economy/network society' and Boulding's proposal that information constitutes a component of a new triad of factors of production – and relate them to the contention that through information, knowledge, and technology the earth becomes essentially an infinite resource, meaning that over the long term there are no 'limits to growth.' Brundtland, the World Bank, Royal Dutch Shell, and others, it will be recalled from chapter 1, interpret 'sustainable development' as 'sustaining economic growth.' This must mean that they view human ingenuity as being capable, over the long term, of recombining the earth's elements in ways that mitigate or obviate the needs for conservation and for constraining consumption and production.[1] However, if human knowledge and ingenuity are in fact constrained, then the earth too will prove to be finite, and the proponents of an infinite earth are making suicidal policy recommendations.

The claim that human knowledge can indefinitely expand the earth's resources could be assessed in various ways. One way would be historical, and indeed in previous chapters we surveyed present indicators of environmental degradation ensuing from previous applications of human ingenuity to the earth's crust; much more, obviously, can be done from an historical perspective.[2] The challenge to this historical approach is always, however, the argument that matters are changing or have changed to such an extent that history no longer is reliable as an indicator of future trends. Alvin Toffler is but one of many who gained fame by staking out that position.[3] The present chapter largely eschews a historical approach, valuable though that is, in favour of investigating further two key categories: 'information' and 'entropy.'