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Ecological Economics xx (2004) xxx–xxx

ECOLOGICAL
ECONOMICSwww.elsevier.com/locate/ecocon

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2 Visions and scenarios: Heilbroner's worldly philosophy, Lowe's 3 political economics, and the methodology of ecological economics

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Received 1 July 2003; received in revised form 6 April 2004; accepted 26 July 2004

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Abstract

9

Ecological economics is a transdisciplinary alternative to mainstream environmental economics. Attempts have been made to outline a methodology for ecological economics and it is probably fair to say that, at this point, ecological economics takes a “pluralistic” approach. There are, however, some common methodological themes that run through the ecological economics literature. This paper argues that the works of Adolph Lowe and Robert Heilbroner can inform the development of some of those themes. Both authors were aware of the environmental challenges facing humanity from quite early on in their work and quite ahead of its time. In addition, both Lowe's *Economics and Sociology* (and related writings) and Heilbroner's “Worldly Philosophy” (itself influenced by this work of Lowe) recognized the endogeneity of the natural environment, the impact of human activity on the environment, and the implications of this for questions of method. Lowe and Heilbroner also became increasingly concerned with issues related to the environment over time, such that these issues became of prime importance in their frameworks. This work deals directly with ecological and environmental issues; both authors also dealt with other issues that relate to the environmental challenge, such as technological change. But it is not only their work that explicitly addresses the environment or relates to environmental challenges that is relevant to the concerns of ecological economists. Heilbroner's Worldly Philosophy and Lowe's Political Economics offer insights that may prove useful in developing a methodology of ecological economics. Ecological economists have taken a pluralistic approach to methodology, but the common themes in this work regarding the importance and nature of vision; analysis (including structural analysis); scenarios; implementation; the necessity of working backwards; the role for imagination; rejecting the positive/normative dichotomy; and so on, all are issues that have been elaborated in Lowe's work, and in ways that are relevant to ecological economics. The goal of the paper is actually quite modest: to make ecological economists aware of the work of the two authors, and get them interested enough to explore the possible contribution of these ideas to their methodological approach.

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Keywords: Vision; Scenario; Analysis; Adolph Lowe; Robert Heilbroner; Methodology of ecological economics

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native to mainstream environmental economics. 32
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 35 that, at this point, ecological economics takes a
 36 “pluralistic” approach (see [Norgaard, 1989](#)). There
 37 are, however, some common methodological themes
 38 that run through the ecological economics literature.
 39 This paper argues that the works of Adolph Lowe and
 40 Robert Heilbroner can inform the development of
 41 some of those themes.

42 1. Environmental awareness in the works of Lowe 43 and Heilbroner

44 Adolph Lowe and Robert Heilbroner both were
 45 aware of environmental-economic challenges from
 46 remarkably early on, and these issues gained an
 47 increasingly important place in their thought over the
 48 years. In his 1935 *Economics and Sociology*, Lowe
 49 wrote that:

50 In every epoch of human civilization, economic forces
 51 and institutions have deeply influenced the structure
 52 and evolution of society as a whole. But in modern
 53 history the economic process is, as we have seen, the
 54 dominant factor. . . The technique of the industrial age
 55 has broken through the traditional borders between the
 56 social and the natural world and has subjected more
 57 and more sections of organic and inorganic nature to
 58 human influence. This expansion, however, has
 59 reacted on the psychological and institutional constitu-
 60 ents of modern society in a strange way. The more
 61 nature has become socialized, the more society has
 62 become naturalized. ([Lowe, 1935](#), p. 153)

63 This idea that the economic system and economic
 64 process transforms not only the social, technical, and
 65 institutional, but also the natural environment, and
 66 that the latter therefore cannot be taken as “given” in
 67 economic analysis, remained an important theme in
 68 Lowe’s work for the remainder of his life and
 69 influenced Heilbroner’s own thinking. This posi-
 70 tion—already articulated in Lowe’s early work—was
 71 crucial for both authors’ thinking about the relation
 72 of the economy and the natural environment, and the
 73 impact of economic processes on the natural
 74 environment.

75 Heilbroner also expressed awareness of environ-
 76 mental challenges from an early date. In 1950, 3
 77 years before the publication of his first book and 13

79 years before he received his PhD, he wrote an
 80 article for *Harper’s Magazine* called “What Goes
 81 Up the Chimney,” inspired by the famous Donora
 82 incident ([Heilbroner, 1950](#)). In the article, Heilbr-
 83 oner outlines the problems of pollution, its causes,
 84 and recommends some possible policies. Among his
 85 suggestions, he writes that “we must force large
 86 industry to add to its smoke-control equipment,”
 87 “we need better smoke prevention,” and “we need
 88 smoke control enforcement.” This, 20 years before
 89 the first Earth Day.

90 While Lowe and Heilbroner both expressed
 91 awareness of environmental-economic challenges
 92 from very early on, in the late 1960s it moved to
 93 an even more prominent place in their thinking, with
 94 concern increasing over the next decades. In a widely
 95 reprinted 1970 article, “Ecological Armageddon,”
 96 Heilbroner writes that “[t]he ecological issue. . . may
 97 indeed constitute the most dangerous and difficult
 98 challenge that humanity has ever faced” ([Heilbroner,](#)
 99 [1970](#), p. 270) and calls “the ecological crisis,
 100 unquestionably the gravest long-run threat of our
 101 times” (p. 285). He speaks of “[t]he necessity to
 102 bring our economic activities into a sustainable
 103 relationship with the resource capabilities and
 104 waste-absorption properties of the world,” and insists
 105 that “[t]he cult of disposability must be replaced by
 106 that of reusability,” writing that “[m]any of these
 107 problems will tax our ingenuity, technical and socio-
 108 political, but the main problem they pose is not
 109 whether, but *how soon*, they can be solved” (1970,
 110 pp. 281–282). Throughout this period, Heilbroner
 111 devoted considerable thought to the environmental
 112 challenge, including his frank testimony before the
 113 U.S. Congress on the National Energy Conservation
 114 Policy Act of 1974 ([Heilbroner, 1974b](#); see also, e.g.,
 115 [Heilbroner, 1972, 1973](#)).

116 Lowe’s increasing concern in the same period was
 117 inspired by his reading Geoffrey Vickers’ book,
 118 *Freedom in a Rocking Boat*. In a 1968 letter to
 119 Vickers, Lowe writes:

120 [T]he significance of the book for my own work lies
 121 in. . . your emphasis on ecology in the widest sense,
 122 and on the limits this sets to ‘progress’. As several
 123 times before, your work is a most important corrective
 124 for my own thinking, and after having digested your
 125 warnings I shall have to modify a good deal of what I

126 have been provisionally committing to paper. (Vick-
127 ers, 1991, p. 51)

128 From the late 1960s and early 1970s and onward,
129 there is an explicit attempt by Lowe to incorporate
130 environmental factors into his analysis. Thus, Part III
131 of his 1976 book, *The Path of Economic Growth* is
132 devoted to the analysis of natural resource inputs and
133 the recycling of the residuals of both consumption and
134 production (Lowe, 1976). In his “Postscript” to the
135 updated edition of his *On Economic Knowledge*,
136 published 1 year later (1977), Lowe would write:

137 Recognition of the ecological triad—population
138 explosion, gradual exhaustion of essential material
139 resources, and progressive deterioration of the envi-
140 ronment—has radically changed this picture [of
141 economic growth]... [T]here is at this point no
142 conceivable solution that would not imply a gradual
143 reduction of the growth rate of the mature econo-
144 mies...[S]imultaneous industrial progress in all
145 regions of the globe may well be incompatible with
146 the available and even the potential supply of natural
147 resources. Even more important, the ecosphere may
148 not be able to absorb the heat that the energy required
149 for universal industrialization will emit. The answer
150 can only be a gradual redistribution of the world’s
151 resources in favor of non-Western regions...resulting
152 in a deceleration of Western economic expansion.
153 (1977, pp. 340–341)

154 In the meantime, Heilbroner’s own position
155 expressed in the 1970 article was more fully
156 elaborated in *An Inquiry into the Human Prospect*
157 (Heilbroner, 1974a; hereafter HP). In HP, he includes
158 population growth and environmental crisis as two of
159 the three great challenges facing humanity in the 21st
160 century. While Heilbroner feels that problems stem-
161 ming from population growth and war might be
162 avoided, he considers the environmental challenge as
163 being in another category:

164 [T]here is an ultimate certitude about the problem of
165 environmental deterioration that places it in another
166 category—from the dangers we previously exam-
167 ined... [U]ltimately there is an absolute limit to the
168 ability of the earth to support or tolerate the process
169 of industrial activity, and there is reason to believe
170 we are now moving toward that limit very rapidly.
171 (1974a, p. 47)

In his Afterword added to the 1980 edition, 172
Heilbroner affirmed his view that “the crucial element 173
today, as eight years ago, remains the environment— 174
the ability of the planet to sustain the mushrooming 175
of industrial output and to absorb the destruction that 176
is the consequence of that vast human effort.” (1980, 177
p. 67). And in his comments added to the 1991 178
edition, he remarks that “If anything, there is an 179
uncomfortable feeling that environmental challenges 180
are becoming worse,” although he adds with some 181
hope that environmental awareness is also on the rise 182
(1991, p. 75–76). 183

By 1988, Lowe’s position had also solidified in this 184
regard. In *Has Freedom a Future?*, he writes: 185

[W]e find ourselves confronted with a host of 186
difficulties that make it doubtful whether, in the long 187
run, even the new technological revolution can 188
achieve the required rate of economic growth. The 189
impediments of which we are speaking are *ecolog-* 190
ical: the triad of worldwide population explosion, 191
gradual exhaustion of essential material resources, 192
and the pollution of the environment. The signifi- 193
cance of this complex is much wider than the context 194
in which I introduce it here. Though slow in its 195
advance, it may over the long run greatly modify 196
mankind’s style of life. All I want to demonstrate 197
here, is that even under the most optimistic assump- 198
tions, it is an ecological factor that may ultimately 199
block the growth of the west, as it is conventionally 200
understood. (1988, pp. 48–49) 201

Heilbroner’s position, too, has become increasingly 202
clear in this recent period. In 1992, in his Foreword to 203
the *Gaia Atlas of Green Economics*, Heilbroner 204
embraces the “core...insistence” that “economics 205
cannot be considered separately from...ecological 206
concerns” (1992, p. 5). 207
208

Adolph Lowe and Robert Heilbroner have both 209
clearly understood the challenges that humanity faces 210
regarding the environment. Both expressed concerns 211
long before economics as a discipline or society at 212
large began to address these issues. And by the time 213
the environmental challenges were more widely 214
recognized, both were at the forefront in insisting 215
that environmental issues be placed high on the 216
agenda of economists and policymakers. Awareness 217
of these and related concerns is what motivated the 218
founding and development of ecological economics. 219

220 Full consideration of biophysical and ecological
221 realities leads to sustainability conditions or rules for
222 a sustainable economy.

223 The insights of Lowe and Heilbroner are akin to
224 those found and elaborated in the ecological econom-
225 ics' literature. Most ecological economists recognize
226 that ecological and biophysical realities impose
227 certain conditions on economic activity if sustain-
228 ability is to be achieved (see, e.g., [Lawn, 2001](#);
229 [Holmberg et al., 1996](#); [Prugh et al., 2000](#)). This
230 recognition has led to investigations of the appro-
231 priate methodological foundations for ecological
232 economics. But it is not only their work that explicitly
233 addresses the environment or relates to environmental
234 challenges that is relevant to the concerns of
235 ecological economists. Heilbroner's *Worldly Philoso-*
236 *phy* and Lowe's *Political Economics* offer insights
237 that may prove useful in developing a methodology of
238 ecological economics.

239 2. Adolph Lowe and Heilbroner's *Worldly* 240 *Philosophy*

241 As readers of Heilbroner's *The Worldly Philoso-*
242 *phers* may recall, Heilbroner became interested in the
243 lives, times, and ideas of the great political economists
244 after registering for a class on Smith, Ricardo, and
245 Marx at the New School for Social Research in the
246 mid-1940s with Adolph Lowe. It was not simply that
247 Lowe inspired an interest in political economy;
248 Heilbroner adopted Lowe's basic *vision* as outlined
249 in the latter's *Economics and Sociology*, his article
250 "The Classical Theory of Economic Growth" (1954),
251 and related writings. This included not only the
252 interpretation of the great Classical Political Econo-
253 mists such as Smith, Ricardo, and Marx (both
254 considered Marx in many ways the zenith of Classical
255 Political Economy), but the interpretation of later
256 writers such as Keynes, Schumpeter, and Veblen as
257 fundamentally in this same tradition, and the sharp
258 contrasting of this tradition with that of neoclassical
259 economics, with its ahistorical, overly formalist,
260 methodological individualist, and positivist character.

261 For Lowe, the static equilibrium models of neo-
262 classical economics were inadequate to analyze the
263 "dynamic chain of reciprocal causation" at work in
264 industrial capitalism ([Lowe, 1935](#), pp. 138–139).

265 Instead, what was required was a theoretical approach
266 that could endogenize the structural factors taken as
267 given in standard presentations. Economic analysis
268 must be accompanied "by a theory of the evolution of
269 its...data" since "[t]he essential variations of those data
270 [are] effected" by economic processes themselves
271 ([Lowe, 1935](#), pp. 93–96). Lowe was even dissatisfied
272 with 20th century work on economic dynamics
273 precisely due to the fact that the "time honored
274 distinction between dependent and independent vari-
275 ables—that is, between an economic process and the
276 underlying meta-economic forces which drive it on
277 and change it—is generally maintained" ([Lowe, 1954](#),
278 p. 128). Even "dynamic process analysis" was "but a
279 dim reflection" of what is found in the Classics and
280 Marx ([Lowe, 1954](#), p. 128). In fact, Lowe argued that
281 it is the "issue of endogeneity versus exogeneity,
282 rather than conflicting theories of value" that separates
283 "genuine classical theory" from "post-Millian eco-
284 nomic reasoning, including all versions of neoclassi-
285 cal analysis" ([Lowe, 1954](#), p. 129). The issue regards:

286 the entire possible range of deductive reasoning. Let
287 us be quite clear about the disputed region. It concerns
288 the whole natural, social and technical environment of
289 the economic system...and...the changes in these
290 elements through time. [For the Classical Economists
291 and Marx] the explanation of the order and changes of
292 these data itself formed part of the theoretical work of
293 economists. ([Lowe, 1954](#), pp. 129–130)

294 For Lowe, then, the classical economists applied
295 their method over a much wider range than the
296 neoclassical authors, to include the social–historical
297 and environmental context of economic processes.
298 Thus, for Lowe an evolutionary approach would aim
299 to once again "extend the range [of analysis]... to the
300 sphere of the natural and social data of the market
301 process, and thus to facilitate an estimate of the
302 direction and limits of possible dynamic changes of
303 the system as a whole" (1935, p. 67). In this view, the
304 classical approach considers areas thought to be
305 outside the scope of economics in the neoclassical
306 view—areas falling broadly under the headings of the
307 social–historical and environmental contexts of eco-
308 nomic processes—as legitimate targets of analysis (for
309 more on this, see [Forstater, 2003](#)).

310 This dynamic, sweeping vision of capitalism as a
311 deterministic social system where impersonal forces
312

313 move history and endogenous processes result in
 314 ongoing systemic transformation was clearly adopted
 315 by Heilbroner. In *The Worldly Philosophers*, he
 316 outlined their dramatic scenarios depicting the almost
 317 inexorable movement of the capitalist system, with its
 318 ‘laws of motion’—systematic tendencies leading to
 319 some predetermined conclusion. Underlying the sys-
 320 tem’s movement were a variety of factors, both
 321 economic and non-economic. In other words, the
 322 trajectory of the system was inseparable from the
 323 wider sociopolitical and environmental context within
 324 which the economy is situated.

325 In his analysis, Heilbroner adopted his own
 326 versions of Schumpeter’s (1954) notions of “vision”
 327 and “analysis.” Whereas for Schumpeter (also a
 328 former professor of Heilbroner) analysis had a kind
 329 of “cleansing” effect, which prevented the necessarily
 330 ideological nature of the “pre-analytical cognitive act”
 331 from tainting the scientific endeavor, for Heilbroner
 332 economic theory is inescapably value-laden. Biases
 333 are always present, at times lurking just beneath the
 334 surface but often emerging in the form of assumptions
 335 that determine the content of their analytical catego-
 336 ries and the direction of their prognostications, thus,
 337 the importance of his notions of scenario, vision,
 338 analysis, and ideology. A scenario is a “complex
 339 narrative. . . combining many prognoses” (Heilbroner,
 340 1990, p. 1111). Visions are not scenarios; rather, they
 341 are “the source, but not the determinants of social
 342 prognoses” (Heilbroner, 1990, p. 1111). Neither are
 343 visions the result of scenarios; they are “pre-analy-
 344 tical.” The directions of the prognoses are the result of
 345 logical analysis, which, however, can never be
 346 completely independent of either vision or ideology.
 347 Scenarios thus “combine powerful analytical frame-
 348 works with highly personalized visions concerning the
 349 motives and behaviors of the actors within those
 350 frameworks” (Heilbroner, 1993, p. 122). The distinc-
 351 tion between vision and ideology depends on whether
 352 one’s pre-conceptions and sociopolitical orientation
 353 are made explicit, or whether they are hidden and
 354 even denied: “That which we call ideology is there-
 355 fore perhaps best understood as unrecognized vision,
 356 and that which I call vision as consciously embraced
 357 ideology” (Heilbroner, 1994, p. 329).

358 In recent years, Heilbroner has questioned whether,
 359 under present contemporary circumstances, Worldly
 360 Philosophy is still possible. He believes that scenarios

and visions do not lend themselves to formal 361
 analytical procedures. More importantly, he believes 362
 that the economic behaviors that set the system on its 363
 path have become less dependable, while political 364
 intervention has become more strategic. Lowe, too, by 365
 the mid-1950s, began to develop the thesis that 366
 historical changes in the structure of capitalist society 367
 had altered the object of inquiry in such a way as to 368
 necessitate the abandoning of the traditional approach, 369
 requiring that analysis henceforth be conducted within 370
 an alternative, “instrumental” methodological frame- 371
 work. Rather than taking only the initial conditions as 372
 given and addressing theory to predicting outcomes, 373
 Lowe proposed also taking as given a pre-determined 374
 end-state: a vision of the desired outcomes. The task 375
 then becomes the derivation—the discovery—of the 376
 technical and social path(s) by which these outcomes 377
 might be achieved (structural analysis), the behavioral 378
 and motivational patterns capable of setting the 379
 system onto a suitable path (force analysis), the 380
 environmental context(s) capable of encouraging or 381
 inducing these patterns, and policies shaping/creating 382
 the environmental context(s). 383

384 Heilbroner similarly came to the conclusion that an
 385 instrumental approach, in Lowe’s sense, had become
 386 more appropriate, with “blueprints depicting possible
 387 routes from present realities to desired destinations”
 388 replacing “scenarios depicting a future immanent in
 389 the present” (Heilbroner, 1992; Heilbroner, 1992, p.
 390 381; see also, Heilbroner and Milberg, 1995, p. 118ff;
 391 Forstater, 1999). A key issue for Heilbroner is the
 392 increasing ‘openness’ of the system. The determinism
 393 of the Classical system was rooted in ‘laws’ which
 394 were seen to govern relations between such factors as
 395 population (labor supply), subsistence (wages), natu-
 396 ral resources, employment, and technical change. The
 397 ‘iron law of wages,’ the ‘law of population,’ ‘the
 398 (Classical) law of diminishing returns,’ were seen as
 399 natural, so unalterable. As Lowe observed, in the
 400 Classical era, “impersonal forces or ‘laws’ which
 401 might be observed or interpreted, but which *could not*
 402 *be altered*” appeared to govern such relations, but
 403 scientific and technological advance later transformed
 404 most of these law-like relations into variable ones,
 405 capable of human influence: “That which once
 406 ‘happened,’ can now be made to happen, or prevented
 407 from happening” (Lowe, 1971, p. 568). Furthermore,
 408 having created the technological potential to both

409 induce and prevent disaster, humankind has “no
410 alternative to accepting the challenge of the new era”:

411 In the face of this tremendous enlargement of human
412 capabilities, there is no possibility of turning away.
413 Even doing nothing, or outlawing the advance of our
414 further capabilities, would be as much an act of
415 intervention as exploiting our newfound capabilities
416 to our utmost. (Lowe, 1971, p. 568)

417 More than anything else, it may be this existential
418 predicament that concerns Heilbroner. As Lowe put it:
419 “From now on, the future will have to be more and
420 more the result of our deliberate choices, at every
421 level of human activity” (Lowe, 1988, p. 2).

423 3. The methodology of ecological economics

424 The methodology of ecological economics utilizes
425 the notions of vision, analysis (including structural
426 analysis), scenarios, and implementation (synthesis):

427 ...making sustainability operational requires the
428 integration of three elements: (1) a practical, shared
429 vision of both the way the world works and of the
430 sustainable society we wish to achieve; (2) methods of
431 analysis and modeling to the new questions and
432 problems this vision embodies; and (3) new institu-
433 tions and instruments that can effectively use the
434 analyses to adequately implement the vision. (Cos-
435 tanza et al., 1996, p. 1)

436 This is reflected in the section headings of the book
437 from which the above quote is taken, *Getting Down to*
438 *Earth*, a key text in ecological economics. Chapters in
439 the book are organized under three themes: “Vision,”
440 “Analysis,” and “Implementation” (1996, Table of
441 Contents).

442 Ecological economists are virtually unanimous in
443 their view that work must begin with *vision*:

444 If most policy discussion focuses on implementation,
445 virtually all the rest focuses on modeling and
446 information. This leaves just about no room for the
447 remaining step of policy formation, which should be
448 first—the establishment of clear, feasible, socially
449 shared goals. (Meadows, 1996, p. 118)

450 It is no surprise, then that one of the most common
452 methodological principles found in ecological eco-

nomics regards the importance and necessity of 453
vision: 454

A broad, overlapping consensus is forming around the 455
goal of sustainability, including its ecological, social, 456
and economic aspects. . . . But movement toward this 457
goal is being impeded not so much by lack of 458
knowledge, or even lack of “political will,” but by a 459
lack of a *coherent, relatively detailed, shared vision of* 460
what a sustainable society would actually look like. 461
Developing this shared vision is an essential prereq- 462
uisite to generating any movement toward it. The 463
default vision of continued, unlimited growth in 464
material consumption is inherently unsustainable, 465
but we cannot break away from this vision until a 466
credible and desirable alternative is available. (Cos- 467
tanza, 1997, pp. 177–178) 468

Note the similarities between Costanza et al.’s 469
notion of the “default vision” and Lowe’s argument, 470
quoted above, that “even doing nothing. . . . would be as 471
much an act of intervention.” 472

Here we see that the notion of vision, which many 473
ecological economists—like Heilbroner—explicitly 474
draw from Schumpeter, is used both as a means of 475
deconstructing the inadequacies of the mainstream 476
approach and building a positive alternative. Lawn 477
writes that: 478

in many ways, the development of an ecological 479
economic paradigm has been a concerted attempt to 480
overhaul the standard neoclassical approach by bring- 481
ing the many false “pre-analytical visions” under- 482
pinning its assumptions into line with biophysical and 483
existential realities. (Lawn, 2001, p. 3) 484

But the ecological economist must be careful that 485
recognizing the biophysical realities does not result in 487
being overwhelmed by them: “Responsible vision 488
must acknowledge, but not get crushed by, the 489
physical constraints of the real world” (Costanza, 490
1997, p. 179). 491

As with Heilbroner and Schumpeter, ecological 492
economists view vision as “pre-analytical.” Visions 493
are not the result of analysis, and crafting a vision 494
requires imagination: 495

Building a responsible, desirable vision of a sustain- 496
able world is partly a rational process, subject to 497
analysis of what is possible over what time frame. But 498

499 it is also a non-rational or perhaps supra-rational task
500 of imagination, one that comes not only from logic but
501 from values. (Meadows, 1996, p. 117)

502 As Prugh et al. (2000) put it: “The rational process
503 of figuring out how to achieve a sustainable world
504 must begin with a nonrational act of imagination” (p.
505 41). As we will see, nonrational mind will play an
506 important role also in analysis and scenario building
507 as well.

508 But what is being developed here is not some kind
509 of vision/science dichotomy: “This need for appro-
510 priate vision applies to every aspect of human
511 endeavor. Far from being immune to this need for
512 vision, science itself is particularly dependent on it”
513 (Costanza et al., 1996, p. 3). In fact, another important
514 characteristic of the ecological economics approach is
515 a rejection of the positive/normative dichotomy.
516 “Vision” includes both positive and normative ele-
517 ments; in ecological economics, the relationship of
518 positive and normative is “best viewed as a complex
519 interaction across a continuum, rather than a simple
520 dichotomy” (Costanza et al., 1996, p. 2).

521 In such an approach, “[v]ision has to be flexible
522 and evolving” (Costanza et al., 1997, p. 179). This
523 allows vision—like analysis, as we shall see—to
524 become both a skill that can be improved: “The skill
525 of visioning is one that can be developed, like any
526 human skill, through practice” (Meadows, 1996, p.
527 117); and itself a method of problem-solving:

528 Vision has an astonishing power to open the mind to
529 possibilities. . . Vision widens my choices, shows me
530 creative new directions. It helps me see good-news
531 stories, pockets of reality that could be seeds of a
532 wider vision. (Meadows, 1996, p. 123)

533 Visions and envisioning are at the heart of the
534 methodology of ecological economics (see also
535 Costanza, 2001). A vision of a sustainable society is
536 a necessary pre-requisite to devising policies for its
537 attainment. Moreover, visions and the envisioning
538 process can assist in the discovery of such policies.
539 Vision is where everything starts—it is pre-analytical.
540 As such, what follows the vision is *analysis*. Analysis
541 attempts to link the imagined future back to the
542 present reality:

543 visions can heighten the contrast between what is and
544 what might be. They also can suggest starting points

for effecting a transition from the one to the other. 547
(Prugh et al., 2000, p. 44) 548

Ecological economics uses structural analysis to 549
build scenarios. Scenario here is used somewhat 550
differently that in Heilbroner’s discussion of the 551
worldly philosophers’ scenarios. In the latter case, 552
a scenario was a dramatic set of prognoses 553
concerning where the system was heading; scenario 554
here is a possible route leading to the vision of the 555
future: 556

In structural economics each scenario about the future 557
could (if one wished) be viewed as a hypothesis or an 558
experiment. But the feasibility at issue is mainly that 559
of the scenario itself, or perhaps of a family of related 560
scenarios, rather than the validity of the theory or 561
model. (Duchin, 1998, p. 6) 562

Like visions, scenarios combine elements tradi- 563
tionally viewed as either positive or normative: 565

Scenario storylines can embody a mixture of pro- 566
spective elements (these being descriptive of a 567
possible future) and normative elements (these being 568
‘intended’ or ‘desired’ aspects); but the way these 569
elements combine together can vary a lot. (Ryan et al., 570
1998, p. 239) 571

Thus, analysis in ecological economics does not 572
employ the traditional hypothetico-deductive method 573
(Duchin, 1998, p. 6). Crafting scenarios, like visions, 574
also draws on imagination: 575
576

[T]he fundamental challenge facing civic society 577
today is to figure out what our options are for 578
dealing with social and environmental problems. 579
This requires an act of imagination—the ability 580
to describe novel, untried, but plausible solutions 581
that could represent dramatic departures from 582
present practices. . . Interestingly, the scientific tradi- 583
tion explicitly acknowledges the importance of 584
curiosity about how things work, but not of 585
imagination—the ability to conceive of how 586
things might work differently. Subsequently, the 587
alternative options, based on imaginative scenar- 588
ios, require systematic analysis to determine their 589
feasibility and other characteristics. . . The scenarios 590
are a translation of the acts of imagination about 591
what could be done into the language of the 592
model. (Duchin, 1998, p. 5) 593

- 594 Thus, imagination works in tandem with analysis, 642
 595 including multiple forms of problem-solving 643
 596 approaches: 644
- 597 Not only imagination but also inductive reasoning and 644
 598 intuition play a large and explicitly recognized role in 645
 599 the development of theory in structural economics. 646
 600 (Duchin, 1998, p. 6) 647
- 602 The nature of environmental challenges means 648
 603 that we cannot afford to allow economics to 649
 604 determine the “ends” as in the traditional approach, 650
 605 which claims to find the “optimal level of pollution” 651
 606 through Pigouvian taxes or fees. Instead, the ends are 652
 607 derived through careful consideration of available 653
 608 scientific information and the “precautionary 654
 609 principle” of erring on the side of caution. Analysis 655
 610 then “works backwards” from the vision of the 656
 611 desired ends to find suitable sustainable paths for its 657
 612 attainment: 658
- 613 Pervasive externalities, such as the possibility of 659
 614 global climate change, have countless facets and 660
 615 are created by such a vast, complex, interdependent 661
 616 and difficult-to-assess web of economic actions that 662
 617 the calculation of the myriad taxes necessary to get 663
 618 the price right is beyond human capability and 664
 619 would be meaningless even if possible. In these 665
 620 cases, *it would be more sensible to work back-* 666
 621 *wards* (my emphasis) from a determination of the 667
 622 maximum possible *scale* (or better yet, the 668
 623 optimum desirable scale) of the global economy, 669
 624 which is more readily definable, and then let 670
 625 [economics work] within those limits. (Prugh et 671
 626 al., 1995, pp. 132–133) 672
- 628 Of course, “ends” are not static, and the means– 673
 629 ends dichotomy is also rejected. Rather, an adaptive 674
 630 and flexible approach is taken that continuously re- 675
 631 evaluates each situation in the light of new develop- 676
 632 ments and new information: 677
- 633 The path toward a vision reveals new information, 678
 634 models, and possibilities as one moves along. 679
 635 (Meadows, 1996, p. 123) 680
- 636 Movement toward sustainability will have to be 681
 637 incremental and adaptive (open to feedback). (Prugh 682
 638 et al., 2000, p. 61) 683
- 640 The principles of flexibility and adaptability 684
 641 emphasized by ecological economists mean that 685
- the researcher must remain open to making 642
 adjustments: 643
- the implementation path is never clear at first. It only 644
 reveals itself, step by step. . . holding to the vision and 645
 being flexible about the path is the only way to find 646
 the path. (Meadows, 1996, p. 122) 647
- This is especially important given ecological econ- 648
 omists recognize radical or fundamental uncertainty: 649
- [Adaptive management is] an approach to natural 650
 resource policy that embodies a simple imperative: 651
 policies are experiments; learn from them. In order to 652
 live, we use the resources of the world, but we do not 653
 understand nature well enough to know how to live 654
 harmoniously within environmental limits. Adaptive 655
 management takes that uncertainty seriously, treating 656
 human interventions in natural systems as experimen- 657
 tal probes. (Kai Lee, 1993, p. 9, quoted in Prugh et al., 658
 2000, p. 32) 659
- While ecological economics has taken a pluralistic 660
 approach to methodological issues, there are common 661
 themes that can be found in the ecological economics 662
 literature. The importance of vision, analysis (includ- 663
 ing structural analysis), scenarios, and implementation 664
 are discussed over and over again by ecological 665
 economists. The meaning of these terms in ecological 666
 economics is related but not identical to their use in 667
 Heilbroner’s worldly philosophy. But the ecological 668
 economists’ use of the terms is very close to their use 669
 in Lowe’s Political Economics or instrumental anal- 670
 ysis, also supported by Heilbroner as the appropriate 671
 method for the contemporary era. 672
- 4. Lowe’s political economics and instrumental 673
 analysis 674**
- Heilbroner and Lowe both came to the conclusion 675
 that, in a sense, worldly philosophy is no longer 676
 possible. Nevertheless, rather than the notions of 677
 “vision”, “analysis”, and “scenario” being thrown 678
 away, they need only to be modified in the context 679
 of Lowe’s instrumental analysis. *Vision* in this context 680
 refers to Heilbroner’s “desired destinations”—goals 681
 such as a sustainable society. *Scenarios* here are 682
 possible routes connecting the vision of the desired 683
 future back to the present—Heilbroner’s “blueprints.” 684

687 *Analysis* in this context is the method of discovery—
688 the means by which scenarios are discerned. The
689 distinction between vision and ideology still holds—a
690 vision is not ideology (in the negative sense) as long
691 as it is consciously stated and critically examined.
692 Thus, Heilbroner’s worldly philosophy remains rele-
693 vant as well.

694 In Lowe’s instrumental method, rather than taking
695 only the initial conditions as given and addressing
696 theory to predicting outcomes, he proposed also
697 taking as given a pre-determined end-state: a vision
698 of the desired outcomes. The task then becomes the
699 derivation—the discovery—of the technical and
700 social path(s) by which these outcomes might be
701 achieved (structural analysis; note Lowe uses this term
702 in the same sense as Duchin, not surprising since the
703 latter was a protégé of Lowe’s colleague at Kiel
704 University in the 1920s, Leontief), the behavioral and
705 motivational patterns capable of setting the system
706 onto a suitable path (force [i.e., motivational and
707 behavioral] analysis), the environmental context(s)
708 capable of encouraging or inducing these patterns, and
709 policies shaping/creating the environmental con-
710 text(s). The instrumental method is thus a *regressive*
711 procedure, beginning from where we want to go (pre-
712 analytical vision) and working backwards (analysis)
713 to our present state, or a state within our present reach
714 (Lowe, 1977 [1965]: 143–44). The derivation of a
715 suitable path is a scenario. It is derived by working
716 backwards. Now the execution of the plan may
717 commence, working forward from our present state
718 along the path we have outlined via the analysis.

719 Lowe briefly mentions in several places the affinity
720 of his instrumentalism with certain ideas of others. In
721 particular, he cites the pragmatist philosopher
722 Charles Sanders Peirce’s concept of “retroduction”
723 (and especially Norwood Hanson’s elaboration of that
724 concept), the mathematician Georges Polya’s work on
725 “heuristics”, and physical chemist and philosopher of
726 science Michael Polanyi’s explorations of “tacit
727 knowledge” as all bearing strong family relationships
728 with aspects of his instrumentalism (see Forstater,
729 1999).

730 Polya devoted much work to heuristics, whose aim
731 he states is to “study the methods and rules of
732 discovery and invention” (1957 [1945], p. 112).
733 Central to heuristics is the regressive procedure Polya
734 refers to as “working backwards.” Polya notes that the

Greek geometers, who called the procedure “analysis” 735
(meaning “solution backwards” in Greek), attributed 736
its discovery to Plato (Polya, 1984 [1958], pp. 575– 737
76). Consider Polya’s translation of a passage from 738
the seventh book of Pappus’ *Collectiones* concerning 739
“analyomenos,” which Polya translates as “Treasury 740
of Analysis,” “Art of Solving Problems,” or 741
“Heuristic” (Polya, 1957 [1945], p. 141): 742

In analysis, we start from what is required, we take it 743
for granted, and we draw consequences from it, and 744
consequences from the consequences, till we reach a 745
point we can use as a starting point in synthesis. For in 746
analysis, we assume what is required to be done as 747
already done (what is sought is already found, what 748
we have to prove as true). We inquire from what 749
antecedent the desired result could be derived; then 750
we inquire again what could be the antecedent of that 751
antecedent, and so on, until passing from antecedent 752
to antecedent, we come eventually upon something 753
already known or admittedly true. This procedure we 754
call analysis, or solution backwards, or regressive 755
reasoning. (Polya, 1957 [1945], p. 142) 756

This procedure is contrasted with synthesis: 758

[I]n synthesis, reversing the process, we start from the 759
point which we reached last of all in the analysis, from 760
the thing already known or admittedly true. We derive 761
from it what preceded it in the analysis, and go on 762
making derivations until, retracing our steps, we 763
finally arrive at what is required. This procedure we 764
call synthesis, or constructive solution, or progressive 765
reasoning. (Polya, 1957 [1945]) 766

Synthesis, Polya writes, is “translation of the ideas 768
into action,” or implementation (Polya, 1957 [1945], 769
p. 145): 770

The same objects fill the analysis and synthesis; . . . the 771
analysis consists in thoughts, the synthesis in acts. 772
There is another difference; the order is reversed. . . 773
[T]he first desire from which the analysis starts. . . is 774
the last act with which the synthesis ends. . . Analysis 775
comes naturally first, synthesis afterwards; analysis is 776
invention, synthesis execution; *analysis is devising a* 777
plan, synthesis carrying through the plan. (Polya, 778
1957 [1945], pp. 145–46). 779

“Observe,” urges Polya (1981 [1962], “planning 780
and execution proceed in opposite directions” (p. 23). 782

783 “[T]he aim is the first thing we thought of and the last
784 thing we laid hands on” (Polya (1981) [1962]).

785 Ecological economists such as Costanza have
786 emphasized the importance of both analysis and
787 synthesis:

788 The arts focus on teaching people to *synthesize*, the
789 sciences focus on teaching people to *analyze*. All
790 human activities require a balance between synthesis
791 and analysis... our educational system could ben-
792 efit... by a much more explicit attempt to teach both
793 synthesis and analysis skills... across the entire
794 academic spectrum. (1997, p. xiii)

796 Here the notions of analysis and synthesis are left
797 underdeveloped. It may be that, given ecological
798 economists’ recognition of the necessity of working
799 backwards from a pre-analytical vision of the desired
800 future to the present state, adoption of the Lowe/Polya
801 notions of analysis and synthesis may aid in the
802 development of the methodology of ecological eco-
803 nomics.

804 In addition to Polya’s heuristics, Lowe also likens
805 the instrumental method to Peirce’s abduction or
806 retrodution. These terms refer to what Peirce
807 described as a third type of inference in addition to
808 deduction and induction. For Peirce, retrodution is
809 the only kind of inference that is capable of creating
810 new knowledge. Peirce follower and elaborator Nor-
811 wood Hanson finds the following distinction useful:

812

813 (1) reasons for accepting some hypothesis H

814 (2) reasons for entertaining some hypothesis H

815

816 Retrodution concerns the second; it is about
817 hypothesis formulation and selection, rather than
818 rejecting or accepting some already formulated
819 hypothesis. Retrodution is complementary to deduc-
820 tion and induction, but retrodution is the “first step in
821 scientific reasoning” (Fann, 1970, p. 35). Once a
822 hypothesis is adopted, the next step is “to trace out its
823 necessary and probable consequences. This step is
824 deduction” (Peirce, CWVII, p. 203). The next step is
825 to compare the actual results with what was expected,
826 that is induction. Likewise, Lowe also sees a role for
827 deductive and inductive reasoning as complementing
828 retrodution. We have seen that ecological economists
829 refer to other types of reasoning (Duchin’s reference
830 to “not only imagination but also inductive reasoning

and intuition” above), but they have not (to my
knowledge) explored the role of retrodution. Since
Peirce refers to retrodution as reasoning from
consequent to antecedent, or inferring a cause from
its effect—i.e. working backwards—it may assist
ecological economics in developing its methodology
to explicitly explore the notion.

Like ecological economists, Lowe’s framework
rejects the positive/normative dichotomy. Lowe refers
to the approach that begins analysis without consid-
eration of a vision of the future as “a radical
positivism interested only in the explanation and
prediction of movements ‘wherever they might lead’”
(Lowe, 1969, p. 7). For Lowe (1967), the separation
of the positive and normative “can no longer be
justified;... recent developments demand the con-
scious integration of the analytical and normative
aspects” (p. 180).

Peirce and Hanson disagree with the common view
that there is no “logic of scientific discovery.” For
Peirce, retrodution is not bogged down by rules, but
it does have a logical form:

The surprising fact C is observed.

If A were true, C would be a matter of course.

Hence there is reason to expect that C may be true.

(CWV, p. 189)

Here, Peirce is retroduting from the present to the
past, while Lowe’s instrumental inference, like eco-
logical economics, is moving from the vision of the
desired future to the present, but both are employing
the regressive procedure.

We have seen above that Duchin contrasts the
ecological economists’ method of structural analysis
with the hypothetico-deductive method. Lowe and
Hanson similarly reject hypothetico-deductive reason-
ing as irrelevant for instrumental or abductive
inference (Lowe sees a role for deduction, but this is
what he calls instrumental-deduction rather than
hypothetico-deduction, since the conditions are not
given, but must be stated by the vision).

Hanson, following Peirce, has investigated the
difference between retroductive and deductive reason-
ing to highlight both that there is a logic to
retrodution and that its logic is distinctive. One
scientist argues from premises A, B, C and hypothesis
H to conclusion D. Another encounters an anomaly D,
and “cojoins this statement with A, B, and C so as to

879 ‘corner’ an hypothesis H which, when bracketed with
 880 A, B, and C will possibly ‘explain’ D. Both scientists
 881 are arguing, both have been using their brains.
 882 Differently!” (Hanson, 1965, p. 64). Whether one
 883 works the problem from the bottom up or the top
 884 down, the question is whether there is a route
 885 connecting A, B, C with D. The logical form of the
 886 argument once we have worked backwards to the
 887 beginning looks the same: some logical route connects
 888 A, B, C, H with D. We can state this regardless of
 889 whether we have arrived at this state via progressive
 890 reasoning from A, B, C, H to D or regressive
 891 reasoning from D back to A, B, D, H. Likewise,
 892 Hanson argues, if no route connects A, B, C, and H to
 893 D then neither retrodution from D or hypothetic-
 894 deduction from A, B, C, H will be forthcoming (1965,
 895 p. 58). But, he insists, the “de facto conceptual
 896 development within the problem-solving con-
 897 text...are different” in the two cases, “and not only
 898 psychologically so!” (1965, p. 61).

899 Insight into a key difference is provided by
 900 Hanson:

901 From...A, B, C, H, any two result[s]... (e.g., D_1 and
 902 D_2) must themselves be consistent. Whereas, given
 903 any two sets of premises—A, B, C, H as against A', B',
 904 C', H'—either of which may resolve...D, it is not the
 905 case that these be mutually consistent. (1965, p. 61)

906 The point is to get to D. Working backward from
 907 D, we may find a number of routes, say A, B, C+ H_1
 908 or H_2 or H_3 , where there is no need for the H s to be
 909 mutually consistent—they are alternative suitable
 910 paths (Hanson, 1965, pp. 60–61). Working forward
 911 from A, B, C+H, all the members of the attainable set
 912 $D_1, 2, 3, \dots, n$ must be mutually consistent; there may be
 913 better paths, but we will not find them working
 914 forward: we may not find a suitable path, or we may
 915 not find the best suitable path. Moreover, Lowe
 916 stresses that it is through the instrumental procedure
 917 that we discover the H s themselves:

918 If it is true that...rules are indispensable data for
 919 instrumental analysis, why bother with a regressive
 920 derivation of the suitable path instead of deducing
 921 them in the usual fashion from the knowledge of the
 922 rules and the initial conditions? The answer is simple.
 923 Once we know which members of the total set
 924 of...rules are goal-adequate, we can indeed deduce

the path in the conventional manner. *The first step of* 926
instrumental analysis is to provide us with precisely 927
this knowledge. (Lowe, 1969, p. 183). 928

Like the ecological economists, Lowe’s notion of 930
 instrumental inference recognizes that problem solv- 931
 ing requires going beyond the rational. Instrumental 932
 inference is characterized by Lowe as a “search 933
 procedure” and “a mental technique of problem- 934
 solving” in which solutions are “discovered” or “hit 935
 upon...through what [Michael] Polanyi calls a logical 936
 ‘leap’” (Lowe, 1977 [1965], p. 145): “But they are not 937
 leaps in the dark... [O]ur search is guided by past 938
 experience, analogies, and other clues. Yet it remains 939
 true that our ultimate insight springs from a non- 940
 rational act of ‘imagination’” (Lowe, 1992, p. 327). 941

Lowe and the ecological economists share an 942
 emphasis on the role of non-rational imagination. 943
 While ecological economists mention it, and many 944
 certainly exercise imagination, the literature does not 945
 really explore it much further. Lowe, drawing on 946
 Polya, Peirce, Polanyi and others, explores the 947
 procedure further, and in ways that may assist 948
 ecological economists. Polya (1984) [1971] has 949
 identified the “first task” as that of “collect[ing] and 950
 classify[ing] such problem solving procedures” and to 951
 “develop a repertory of problem solving techniques” 952
 (p. 590). Even this will not solve the problem 953
 comprehensively, because there is still the task of 954
 choosing among the available techniques, a decision 955
 that will require that the investigator “use personal 956
 judgment, as Polanyi would say.” This is similar to 957
 Lowe’s discussion of choosing from among alter- 958
 native hypotheses: 959

There are no binding rules, according to which the 960
 researcher could decide in favor of one among many 961
 possible hypotheses. Which one he chooses in the 962
 end, adopting...Einstein’s ‘free creation of the mind’, 963
 is neither a strictly determinable nor an arbitrary 964
 decision. (Lowe, 1992, p. 327). 965

For Polanyi (1958), appreciation of a problem is 966
 itself part of the act of discovery (p. 121). Seeing a 968
 problem “is a definite addition to our knowledge,” and 969
 “to recognize a problem that can be solved and is 970
 worth solving is a discovery in its own right” (1958, p. 971
 120). In the process, a “heuristic stress” builds, which 972
 is akin to an emotional strain on the part of the 973

974 investigator. Discovery leads to a release, e.g.,
975 running through the streets crying “Eureka!” (1958,
976 p. 122).

977 One heuristic tactic noted by Polanyi is to
978 continuously reorganize the problem “with a view to
979 eliciting some new suggestive aspects of it” (1958, p.
980 128). This is reminiscent of C. Wright Mills’
981 suggestion that “the re-arranging of the [researcher’s]
982 file... is one way to invite the [sociological] imagi-
983 nation (1959, p. 212):

984 Imagination is often successfully invited by putting
985 together hitherto isolated items, by finding unsuspect-
986 ing connections... As you re-arrange a filing system,
987 you often find that you are, as it were, loosening your
988 imagination. Apparently this occurs by means of your
989 attempt to combine various ideas and notes on
990 different topics. It is sort of a logic of combination,
991 and ‘chance’ sometimes plays a curiously large part in
992 it. In a relaxed way, you try to engage your intellectual
993 resources... Of course, you will have in mind several
994 problems on which you are actively working, but you
995 also try to be passively receptive to unforeseen and
996 unplanned linkages (Mills, 1959, p. 201, 212)

998 Both Polanyi and Mills relate this “reorganizing”
999 tactic with another, what Polanyi refers to as
1000 “ransack[ing] our memory for any similar problem”
1001 (1958, p. 128) and Mills calls “get[ting] a *compara-*
1002 *tive* grip on the materials” (1959, p. 215). Polya
1003 writes:

1004 Any conjecture, of course, must have been sug-
1005 gested... by somehow related ideas (special cases,
1006 analogies, etc.), although, perhaps, at the moment of
1007 conceiving the conjecture those ideas were not
1008 clearly and explicitly present. (Polya, 1984 [1948],
1009 p. 474)

1010 Thus, writes Lowe, in seeking to discover the
1012 suitable path or paths to the realization of the vision of
1013 the desired outcomes, “our search is guided by past
1014 experience, analogies, and other clues” (Lowe, 1992,
1015 p. 327).

1016 In the course of the heuristic search, we must look
1017 for “favorable signs,” which of course must not be
1018 mistaken for “proof” but which encourage “further
1019 investigation” (Polya, 1984 [1948], p. 490). Lowe
1020 cautions that “the findings of heuristic analysis can be
1021 accepted only provisionally” (1992, p. 327). Polya

invokes the notions of the “bright idea” and “feeling
we are ‘on the right track’” to get at the seemingly
intuitive aspects of the discovery procedure (Polya,
1984 [1948]). For Polanyi, “success depends ulti-
mately on the capacity for sensing the presence of yet
unrevealed logical relations between conditions of the
problem, the theorems unknown... and the unknown
solution...” (1958, p. 128). Polanyi invokes the
“common experience(s) of groping for a forgotten
name” and searching for a name or word that is said to
be “on the tip of the tongue” to illustrate the “sense of
growing proximity to the solution” that guides
discovery (1958, pp. 128–129). As Lowe puts it, the
“researcher ‘senses’ a structural relationship between
the hypothesis he chooses and the problem he wants
to solve” (1992, p. 327).

Equally important is Polanyi’s (1958) suggestion
that self-awareness of the capacity to sense the
“accessibility of a hidden inference,” as well as of
the ability to “invent transformations of the premises
which would increase accessibility” is a
“foreknowledge” which itself “biases our guesses in
the right direction” (p. 129). The discovery-enhancing
effects of our ability to discover is also related by
Polanyi to the fact that “a set purpose may automati-
cally result in action later on” as when we go to bed
resolved to wake up at a certain hour and then do
(Polanyi, 1958). These factors also help explain the
“self-accelerating manner of the final stages of
solution,” i.e., the closer we get the faster we progress
(Polanyi, 1958). These aspects of discovery are not
treated lightly by Polanyi, who takes the position that
“the whole process of discovery and confirmation
ultimately relies on our own crediting of our own
vision” (1958, p. 130).

Echoing the remarks of the ecological economists
above, Peirce also believed abductive reasoning to be
“a skill that could be improved by practice or
discipline” (Ochs, 1993, p. 61). And all the authors
also see important roles for both commonsense and
imagination in discovery.

Lowe’s Political Economics, with its instrumental
analysis, has some important points of contact with
themes raised in discussions of the methodology of
ecological economics. But while ecological econom-
ics has raised certain issues, it has not elaborated
them. It has been the purpose of this section to not
only point out some of the connections, but to give a

1070 peek at the elaborations that ecological economists
1071 may find useful.

10726. Conclusion

1073 Adolph Lowe and Robert Heilbroner were both
1074 aware of the environmental challenges facing
1075 humanity from quite early on in their work and
1076 quite ahead of their time. In addition, both Lowe's
1077 *Economics and Sociology* (and related writings) and
1078 Heilbroner's *Worldly Philosophy* (itself influenced
1079 by this work of Lowe) recognized the endogeneity of
1080 the natural environment, the impact of human
1081 activity on the environment, and the implications
1082 of this for questions of method. Lowe and Heilbr-
1083 oner also became increasingly concerned with issues
1084 related to the environment over time, such that these
1085 issues became of prime importance in their frame-
1086 works. This work deals directly with the ecological
1087 and environmental issues; both authors also dealt
1088 with other issues that relate to the environmental
1089 challenge, such as technological change. But it is not
1090 only their work that explicitly addresses the environ-
1091 ment or relates to environmental challenges that is
1092 relevant to the concerns of ecological economists.
1093 Heilbroner's *Worldly Philosophy* and Lowe's *Polit-*
1094 *ical Economics* offer insights that may prove useful
1095 in developing a methodology of ecological econom-
1096 ics. The connections are almost uncanny. Ecological
1097 economists have taken a pluralistic approach to
1098 methodology, but the common themes in this work
1099 regarding the importance and nature of vision, of
1100 analysis (including structural analysis), scenarios,
1101 implementation, of the necessity of working back-
1102 wards, of the role for imagination, rejecting the
1103 hypothetico-deductive method and the positive/nor-
1104 mative dichotomy, and so on, all are issues that have
1105 been elaborated in Lowe's work, and in ways that
1106 are relevant to ecological economics. There are
1107 additional issues that we have not had time to
1108 elaborate—Heilbroner's *Visions of the Future*, e.g.,
1109 would merit another whole section, at least. But the
1110 goal of the paper is actually quite modest: to make
1111 ecological economists aware of the works of the two
1112 authors, and get them interested enough to explore
1113 the possible contribution of these ideas to their
1114 methodological approach.

7. Uncited references

Heilbroner, 1953
Heilbroner, 1996
Peirce, 1931–1960

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