

## Analytical philosophy and ecological economics

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Analytical philosophy has had a long but little noted influence on the development of ecological economics. The work of the left Vienna Circle, in particular of Otto Neurath, defended two central claims of ecological economics: first, economics needs to address the various ways in which economic institutions and relations are embedded within the physical world and have ecological preconditions that are a condition of their sustainability; second, reasonable economic and social choices cannot be founded on purely monetary valuations. Both of these claims were developed in two distinct but related debates that Otto Neurath engaged in. The first was the socialist calculation debate. The arguments of the Austrian critics of the possibility of socialism there, in particular Ludwig Mises and Friedrich Hayek, were aimed not only at socialism but at these two central claims of ecological economics. The second was the little known debate between the left Vienna Circle and the Frankfurt School in the 1930s. In this debate one can discern the origins of two distinct traditions of political ecology that still remain in tension in subsequent debates: a science-based approach that is concerned with the material and ecological conditions for human well-being and social relationships; and a science-sceptical approach that takes the environmental crisis to be founded in a technocratic commitment to the domination of humans and nature that is built into the constitution of scientific reason. In this chapter we explore these different debates and show the continuing significance of the analytical tradition to a defensible ecological economics. As shall be evident, running through the debates is a common theme about the nature and limits of scientific and practical reason, a theme that retains its importance for understanding the relationship between ecology, democracy and political economy.

### 1. Neurath, Mises and Weber: Choice in the absence of monetary units

We begin by establishing Neurath's role in the development of ecological economics by exploring the connection between his work and that of K. William Kapp.<sup>1</sup> One of the central claims of social ecological economics concerns the limits of monetary exchange values in making social and environmental decisions. Consider the following formulation of that claim by Kapp:

The formulation of environmental policies, the evaluation of environmental goals and the establishment of priorities require a substantive economic calculus in terms of social use values (politically evaluated) for which the formal calculus in monetary exchange values fails to provide a real measure – not only in socialist societies but also in capitalist economies. Hence the 'revolutionary' aspect of the environmental issue both as a theoretical and a practical problem. In short, we suggest that environmental values are social use values for which markets provide neither a direct measure nor an adequate indirect indicator. (1974: 38)

Neurath and Weber are marked out by Kapp as the major figures whose work could found an understanding of these claims. Why is this? The origins of this claim can be traced back to Kapp's own earlier work on the socialist calculation debates. His doctoral dissertation *Planwirtschaft und Aussenhandel* (1936) engaged with Mises' critique of socialism. A distinctive feature of Kapp's understanding of the socialist calculation debates is the observation that the turn it had taken in the discussion of market models of socialism by Lange, Taylor and others had obscured what was at issue in the original debates between Neurath, Mises and Weber: 'the controversy initiated by O. Neurath, von Mises and Max Weber got sidetracked in various attempts to calculate the prices of productive factors by

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<sup>1</sup> The relevance of Neurath's argumentation for ecological economics was first noted in Martínez-Alier (1987) and the parallel between Neurath and Kapp was stated in Martínez-Alier (1991a) and (1991b); the influence of the former on the latter was observed in his (2002: 33).

means of Walras' and Cassel's systems of equations and O. Lange's later elaboration of a theoretical model of "competitive socialism".' (Kapp, 1955: 682).

What was at stake in the earlier debate and was lost in the shift to market models of socialism was precisely the question about whether human well-being and its environmental conditions could adequately be captured by the monetary valuations of the market.

This question was raised by Neurath's post-World War I proposals for socialization to which both Mises and Weber responded. As Kapp notes, for Neurath a socialist planned economy was based on social use values:

By stating that 'useful effects' or free 'disposable time' are the measure of real wealth and thus of the quality of life Engels and Marx must have been convinced to have specified at least in general terms the alternative criteria for the planning and decision-making process in a socialist planned society. Few marxist writers have taken up these hints while many have simply followed the general trend toward a subjective theory of value and price. The great exceptions were Otto Neurath and Max Weber... (1974: 38)

Neurath's own plans for total socialization were radical in drawing out possible implications of an economy based on use-values. A socialist economy, since it was to consider the use-value of goods only, would have to be a non-market 'economy in kind', an economy *in natura*, in which there would exist no role for monetary units to compare options to guide decisions of resource allocation. In a socialized economy, while physical statistics about energy use, material use and so on would be required, there would be no need for a single unit of comparison: 'There are no units that can be used as the basis of a decision, neither units of money nor hours of work. One must directly judge the desirability of the two possibilities.' (1919/1973: 145). In the absence of a single unit of measurement for decision

making, choice requires direct comparisons of alternatives in various dimensions. The consequence is that there is no possibility of excluding political and ethical judgements from even 'technical' decisions.

Mises accepted one claim that Neurath made, that in a socialist economy monetary exchange values cannot be used to choose between different plans, but then drew a very different conclusion, that this shows that no rational economic choices can be made within a socialist society. While choice in the absence of a single cardinal measure was possible for final consumption goods, it was not possible for higher order production goods.

It is an illusion to imagine that in a socialist state calculation *in natura* can take the place of monetary calculation. Calculation *in natura*, in an economy without exchange, can embrace consumption goods only; it completely fails when it comes to dealing with goods of a higher order. And as soon as one gives up the conception of a freely established monetary price for goods of a higher order, rational production becomes completely impossible. Every step that takes us away from private ownership of the means of production and from the use of money also takes us away from rational economics. (1922/1981: 13)

Rational choice concerning higher order production goods requires commensurability, that is, rational economic decision-making requires a single measure on the basis of which the worth of alternative states of affairs and uses of productive resources could be calculated and compared. Only then can rational choices be made between 'the bewildering mass of intermediate products and potentialities of production' (ibid.). In market economies money provides a common unit of measurement for comparing options: 'calculations based upon exchange values enable us to reduce values to a common unit' (ibid.: 99). Exchange values can impute the relative worth of different productive factors on the basis of consumer

valuations. In the absence of private ownership of the means of production, there could be no market price on the factors of production: since ‘it is impossible to use money as an expression of the price of the factors of production (including labor), money can play no role in economic calculation’ (ibid.: 15). Non-market economies, beyond simple householding economies, lack a common unit of comparison between different uses of productive factors. Like Neurath, Mises rejected labour-time and energy units as alternative commensurating units. Hence, Mises concluded, rational economic choices are only possible in market economies; socialist economies do not allow for rational choices. In this chapter we will not consider in detail whether or not Neurath’s plans for a marketless economy *in natura* can be defended. Our purpose here is narrower – to show how his arguments point to weaknesses in both the Austrian and neo-classical arguments for market modes of environmental governance. As Kapp (1974) puts it: ‘environmental values are social use values for which markets provide neither a direct measure nor an adequate indirect indicator’. Neurath’s defence of this claim remains important.

Environmental considerations about the use of resources across generations were central to Neurath’s argument from his first contributions to the socialist calculation debates.<sup>2</sup> In denying that there exist any single unit for making choices across different plans, Neurath was criticizing not only the market and monetary measures, but also socialist alternatives to the market that employ single units in making decisions, employing labour time as a unit of calculation or the early precursors of an energy economics such as Popper-Lynkeus and Ballod-Atlanticus, that advocate the use of energy units for making comparisons between different plans. Using labour time alone allows for no consideration for the effects of the use of energy and resources for future generations.

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<sup>2</sup>See Uebel (2005) and (2008).

Some had the idea to introduce a certain amount of labour as a unit. But how could this make it possible for the excessive exploitation of a coal mine to figure as a negative entry in the balance? How could a quantity of electricity which a river provides us with be entered as an increase in amounts of labour units? Or the increase in wind power used in the running wind mills? (Neurath, 1925/2004: 468)

However, similarly, consideration for energy alone fails to properly consider the effects of choice on the quality and quantity of labour time allowed. An economy that was considered with use-values would have no single unit to make comparisons over different plans:

The question might arise, should one protect coal mines or put greater strain on men? The answer depends for example on whether one thinks that hydraulic power may be sufficiently developed or that solar heat might come to be better used, etc. If one believes the latter, one may 'spend' coal more freely and will hardly waste human effort where coal can be used. If however one is afraid that when one generation uses too much coal thousands will freeze to death in the future, one might use more human power and save coal. Such and many other non-technical matters determine the choice of a technically calculable plan ... we can see no possibility of reducing the production plan to some kind of unit and then to compare the various plans in terms of such units... (Neurath, 1973, 263)

To put the argument in more recent terms, decisions across different plans would of necessity need to employ multi-criteria decision tools and judgements. There is no single unit of comparison that will do the work required.

The arguments between Neurath and Mises turn on a number of issues that retain their importance for ecological economics: (1) the limits of market demand as a guide to

defensible choices within and between generations; (2) the problems of value incommensurability, and more specifically the adequacy of monetary valuations to capture the goods and losses at stake in both social and environmental choices; (3) the nature of rational choice between different social plans and outcomes.

1. Mises' arguments against socialism claim that, in the absence of markets and private property in the means of production, it is not possible to impute the relative worth of different productive factors on the basis of consumer valuations. Neurath's rejection of the imputation problem in this form is in part a rejection of the claim that valuations of current consumers provide an adequate basis for judging the relative values of different uses of productive factors. A major distinctive feature of Neurath's contribution was the explicit introduction of intergenerational concerns. Not only was it the case that, as socialists had long noted, within any generation the social well-being of actors who lack monetary means disappears from social choices, it was also the case that across generations, the well-being of future generations who are necessarily absent from current markets cannot be directly captured in market exchange. Intergenerational decision making could not be left to market mechanisms. Nor could alternatives like labour time units do the job. It required socially informed multi-criteria decision making procedures that included the full range of the dimensions of well-being and domains of affected agents to be included.
2. Neurath's arguments here are based on assumptions about the incommensurability of the different dimensions of human well-being. Neurath argues that no monetary measure, or indeed any other single measure, is able to capture changes in well-being. Welfare concepts, such as the standard of living, are multidimensional: 'The attempts to characterize the standard of living are like those which try to characterize the "state of health". Both are multidimensional structures' (1937/2004: 520). The point is one that Neurath had already made in an early lecture which rejected the possibility of units of pleasure providing such a

metric for utilitarianism (1912). This claim that the standard of living is multidimensional is combined with a second claim, that the measures of these different dimensions of well-being cannot themselves be treated as separable items that can be added: ‘We cannot regard [the standard of living] as a weight made up of the sum of the weights of the various parts’ (1937/2004: 516). Choices between options are a matter not of assessing the value of different dimensions and then adding them to coming to an aggregate score, but rather considering each ‘as a whole.’ (1909: 244).

3. A third central point of contention in this debate is the nature of practical rationality. Two central claims are of importance here. The first concerns the nature and limits of rational choice in the use of productive resources. Mises assumed here an algorithmic conception of rationality. The rational use of resources requires a single cardinal measure through which their optimal uses can be computed. The absence of monetary measures in a socialist economy on this account rules out the possibility of rational economic decisions. Neurath rejected the possibility of any such computation given the distinct dimensions of value that a choice must confront. More generally, Mises’ assumptions about the nature of rationality exhibit what Neurath called ‘pseudorationalism’. For reasons we outline further below, Neurath took the knowledge that informs decision making to be uncertain and incomplete, and even given what is known, the norms of rationality rarely determine a unique answer. A proper rationalist recognizes the boundaries of the power of reason in arriving at decisions: ‘Rationalism sees its chief triumph in the clear recognition of the limits of actual insight’ (1913/1983). It is a mark of the pseudorationalist to believe that there exist technical rules of choice that determine optimal answers to all decisions including those about resources. No such decision procedure exists. Thus, to employ again his environmental examples, given a choice between alternative sources of energy – say coal and hydraulic power or solar energy – a variety of ethical and political judgements, for example about inter-

generational equity and the distribution of risks, comes into play. One cannot arrive at some optimal outcome through some technical procedure employing some single unit, either monetary or non-monetary.

These disputed assumptions about rationality also figure in the important differences between the contributions of Weber and Mises to the socialist calculation debates. Weber's criticisms of Neurath and the possibility of rational calculation in socialism parallel some of those by Mises. However, his contribution is marked by a distinction that is absent in Mises' argument, that between formal and substantive rationality. It is this distinction that grounds Kapp's assertion of Weber's importance to the debates.<sup>3</sup> Weber drew the distinction as follows:

The term 'formal rationality of economic action' is used to designate the extent of quantitative calculation or accounting which is technically possible and which is actually applied. The 'substantive rationality', on the other hand, is the degree to which the provisioning of a given group of persons (no matter how delimited) with goods is shaped by economically orientated social action under some criterion ... of ultimate values, regardless of the nature of these ends (1921–22/1978: 85)

On this account then an economic system is 'formally' rational 'according to the degree in which the provision for needs, which is essential to every rational economy, is capable of being expressed in numerical, calculable terms, and is so expressed' (ibid.). Like Mises, Weber took money-based economy to be required for formal rationality within any complex changing economy: 'From a purely technical point of view, money is the most "perfect" means of economic calculation. That is, it is formally the most rational means of orienting economic activity. Calculation in terms of money, and not its actual use, is thus the

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<sup>3</sup>For useful a discussion of the influence of Weber and the later Menger on Kapp, see Berger (2008).

specific means of *instrumentally* rational economic provision.’ (ibid.: 86; italics indicate a term restored. We owe to Christian Scholz the observation that in the English translation by Talcott Parsons still being used, the word ‘instrumental’ is absent, undermining the actual meaning of the statement. In the original German version Weber speaks explicitly of ‘*Zweckrationalität*’ (instrumental rationality) (1921–22/1972: 45).)

A Neurathian economy in kind, Weber argued, would be inferior to a market economy in terms of its formal rationality. However, Weber, unlike Mises, allowed that this does not rule out criticisms of market economies in terms of their substantive rationality according to some wider ends in which the “purely formal” rationality of calculation in monetary terms is of quite secondary importance or even is fundamentally inimical to their respective ultimate ends’ (1921–22/1978: 86). Mises’ argument contrasts with Weber’s in assuming that formal instrumental rationality exhausts the scope of rationality in economic activity, a difference obliterated by the available translation (as noted).

The distinction between the types of rationalities is central to later ecological economics. It is the reason why the debate between Neurath and Weber was taken by Kapp to be so central to understanding the failures of standard economic analysis of environmental problems. The failure of standard economic analysis of the economy in terms of monetary exchange and the attempt to catch all values within monetary prices is that it is concerned only with the formal rationality of the economy and not its substantive rationality (Kapp, 1963/1977: 306–7). The importance of the contributions of Neurath and Weber lies precisely in the focus of one, Neurath, on the need for multiple non-monetary measures of human well-being and his acknowledgement of the physical embeddedness of the economy on wider environmental conditions, and of the other, Weber, on the claim that while markets may be superior to other economic systems in terms of formal calculability, this is independent of the

question of whether they are substantively rational. The later debates get sidetracked since they concern simply questions of different models of economic calculability, of whether socialist economies can match the formal rationality of capitalism. The importance of the environment for Kapp lies in the way it highlights the need for economics to focus again on problems that concerned the original debates between Neurath and Weber:

The challenge to economics is due to the complexity of the causal chain which gives rise to environmental disruption and the magnitude of the social costs. These defy any treatment in terms of such traditional concepts as 'externalities', GNP, etc. – and, moreover, put in question the validity of our traditional measures of efficiency and optimization by economic units or subsystems of the economy. The answer to this challenge will have to be found not by means of formal welfare criteria but in terms of concepts defining a substantive rationality reflecting actual human needs and requirements of human life. (Kapp, 1970: 847)

Kapp's own programme of research can be called broadly Neurathian. Well-being should be conceptualized in terms of a series of 'existential minima representing minimum adequate levels of satisfaction of essential human needs.' (Kapp, 1965: 77). Indicators of those minima and the specification of the physical and social conditions for meeting those minima should form the object of both decision making and the comparative judgements of different social organizations.<sup>4</sup>

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<sup>4</sup>There are also clear differences between Kapp and Neurath. Kapp operates within an objective state account of well-being, whereas Neurath remains Epicurean, concerned with subjective states. However, in practice the approaches converge. Neurath's own measures are concerned with the objective measures of the conditions of life. Kapp also acknowledges with the Vienna Circle the need for an approach that brings together different disciplines into such choices, although he rejects the specific models of the unity of the sciences offered by Neurath and Carnap (see Kapp, 1988: 60–64).

## Neurath and Hayek: political economy and epistemology<sup>5</sup>

The problems about the nature and scope of rational choices that were central to the debates between Neurath and Mises were also central to Neurath's debates with Hayek. Hayek's criticisms of Neurath, like those of Mises, address themes that have been central to ecological economics. His arguments aim in part against *in natura* calculation, calculation in kind. However, Hayek's arguments against Neurath also raise wider and distinct epistemic themes. These themes about the nature and limits of science in decision making mattered not just in his debate with Hayek, but also in the debate with very different participants – the Frankfurt School – to be discussed later in this chapter. Both started from criticisms of the scientism that Neurath is taken to exhibit.

Hayek's papers 'The counter-revolution of science' and 'Scientism and the study of society' (Hayek, 1941/1979; 1942–44/1979) are of particular significance for the tradition of ecological economics. In those papers Hayek criticizes various forms of scientism in the social sciences, in particular what he calls 'objectivism', represented by the physicalism of logical positivism. Those criticisms are directed not just at socialist planning but also at the tradition of ecological economics.<sup>6</sup> Hayek questions the two assumptions central to the tradition of ecological economics outlined at the start of this chapter: (1) that economics should be concerned with the ways in which economic institutions and relations are embedded within the physical world and have real physical preconditions which are a condition of their sustainability; (2) that rational economic choices between options cannot be founded upon purely monetary valuations but require direct reference to their physical characteristics. Precursors of ecological economics such as Ostwald, Geddes, Soddy and Solvay are all objects of criticism, their work on energy units taken to exemplify 'scientific

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<sup>5</sup>This section draws on O'Neill (2004).

<sup>6</sup>For further discussion see Martínez-Alier (1987).

objectivism' typical of an engineering mentality. Their objectivism is exhibited in their belief in the desirability for calculations in kind in economic choices as against calculations in monetary valuations (Hayek, 1942–44/1979: 90 and 171). The work of Neurath becomes a primary target of Hayek's criticism, since in his work objectivism, socialism and *in natura* calculation most clearly come together: 'The most persistent advocate of ... *in natura* calculation is, significantly, Dr. Otto Neurath, the protagonist of modern "physicalism" and "objectivism"' (ibid.: 170).

Neurath responded to these criticisms in a set of unpublished notes and letters to Hayek in 1945 which Neurath had hoped would form the basis for a public exchange (Neurath, 1945). The public exchange never occurred. Neurath died in late 1945 and it is difficult to discern in Hayek's letters much enthusiasm for the exchange.

Hayek claimed that scientism in the social sciences provides a central example of an illusion about the scope of human reason and knowledge that underpins the socialist project. The doctrine of 'objectivism', typified in Neurath's 'physicalism', is an exemplar of such scientism. The terms 'objectivism' and its opposite 'subjectivism' are used in a variety of logically independent senses within the Austrian economic tradition.<sup>7</sup> In Hayek's scientism essay, 'subjectivism' is used primarily to capture a hermeneutic thesis about the nature of social objects, that they are in part constituted by beliefs and social meanings. The objects of the social sciences are constituted by beliefs and ideas that individuals have about them: 'Neither a "commodity" or an "economic good", nor "food" or "money" can be defined in physical terms but only in terms of views people hold about things.' (1942–44/1979: 53). Objectivism, by contrast, is the view that such references to mental states can and should be eliminated. Hayek asserted that the demand that social science requires the elimination of all

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<sup>7</sup>See O'Neill (1998: ch.3).

terms that cannot be given a characterization in a purely physical language characterizes Neurath's physicalist programme (ibid.: 78).

The doctrines of objectivism and physicalism, Hayek claimed, provide support for the belief in the possibility of '*in natura*' calculations in economics discussed in the last section. Objectivism is expressed in 'the characteristic and ever-recurrent demand for the substitution of *in natura* calculation for the 'artificial' calculation in terms of price or value, that is, of a calculation which takes explicit account of the objective properties of things' (ibid.: 170). The central political implication of Hayek's arguments against objectivism is the denial of the existence of any physical units for planning economic production, including the energy units offered by earlier precursors of ecological economics such as Ballod-Atlanticus, Popper-Lynkeus, Ostwald, Soddy and Solvay (ibid.: 90–91). Hayek rejected the eliminativist physicalist claim that all economic activities 'can be ultimately reduced to quantities of energy, [and] man should in his plans treat the various things...as the interchangeable units of abstract energy which they "really" are.' (ibid.: 91). However, Hayek, in rejecting objectivism, also defended a logically independent, stronger and less plausible form of subjectivism that inverts the physicalist eliminativism he criticized. He rejected 'the more widespread... conception of the "objective" possibilities of production, of the quantity of social output which the physical facts are supposed to make possible' (ibid.: 91).

The belief in objectivism and *in natura* calculation is for Hayek an expression of an illusion about the scope of knowledge and reason that is typical of the social engineer. The belief in the realizability of a technical optimum, derived from the notion of objective possibilities of production, represents an illusion since it fails to acknowledge the limits of knowledge that any particular individual can possess.

The application of the engineering technique to the whole of society requires...that the director possess the same complete knowledge of the whole society that the engineer possesses of his limited world. Central economic planning is nothing but such an application of engineering principles to the whole of society based on the assumption that such a complete concentration of all relevant knowledge is possible. (ibid.: 173)

Objectivism and the belief in *in natura* calculation involve a commitment to the possibility of complete knowledge that Hayek rejects in his epistemological arguments against planning and in defence of the market.

The belief in planning involves an erroneous belief in the omnipotence of reason, a belief that Hayek variously calls ‘rationalism’, ‘superrationalism’ and ‘Cartesian rationalism’. Against such rationalism Hayek claims ‘it may ... prove to be far the most difficult and not the least important task for human reason rationally to comprehend its own limitations’ (ibid.: 162). What are the sources of human ignorance to which this argument appeals? The first is what Hayek calls ‘the division of knowledge’ in society, that is, the dispersal of knowledge and skills throughout different individuals in society. While Hayek framed the argument in terms of the division of knowledge in society, the key to his argument is the nature of the knowledge dispersed: practical knowledge embodied in skills and know-how that cannot be articulated in propositional form, and knowledge of particulars, local to time and place. Such knowledge cannot be passed on to a central planning body but remains inevitably dispersed throughout society. The market alone is claimed to solve this epistemic problem. The market acts as a coordinating procedure which, through the price mechanism, distributes to different actors that information that is relevant for the coordination of their plans (1937; 1942–44/1979: 176–7; 1945).

Central to that coordination is the activity of the entrepreneur who is alert to new opportunities in the market place but who is faced with a second source of ignorance, a future that at the point of decision is unpredictable. Wants change with the invention and production of new objects for consumption. Since the progress of human knowledge is in principle unpredictable – if we could predict future knowledge, we would already have it – and since human invention relies on the progress of knowledge, future human wants are also in principle unpredictable (Hayek, 1942–44/1979: 157–8; 1960: 40–41; cf. Popper, 1944–45). The market is presented as a discovery procedure in which different hypotheses about the future are embodied in entrepreneurial acts and tested (Hayek, 1978: 179–90; cf. Kirzner, 1985).

Given this view of the price system as a solution to the problem of ignorance, to give up prices for calculation in kind is to give up a solution to the problem of ignorance for the illusion of the possibility of complete knowledge required for central planning. There is no *in natura* alternative to the monetary measures. If Hayek is right, this is not just a criticism of socialist planning. It is a criticism of the wider tradition of ecological economics, which is concerned with the physical preconditions of economic activity and in particular its ecological preconditions, and which does defend the use of non-monetary measures and indicators of economic activity.

Neurath noted at the outset of his reply to Hayek that there is no dispute about whether he defends either physicalism or *in natura* calculation. What is in dispute is whether Hayek properly characterizes either and whether, once properly stated, they are open to the objections that he presents. Much of Neurath's response to Hayek is taken up with clarification of the meaning of physicalism.<sup>8</sup> 'Physicalism' in its basic sense refers to the

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<sup>8</sup>For a detailed discussion of the concept of physicalism, of its evolution and defensibility throughout the protocol sentence debate in the Vienna circle during the 1930s, see Uebel (2007a); of its role for Neurath in social science, see Uebel (2007b). In this chapter we will limit our discussion of the

doctrine that all statements in the sciences, social sciences and everyday life should be controllable by sentences whose terms refer to spatio-temporal particulars. In the context of his debate with Hayek, the significant point is that physicalism in the sense that Neurath employed was not the view that all the sciences could be reduced to physics, nor that all the terms of language could be translated into those of physics. Neurath's approach to sociology is not physicalist in the sense that Hayek outlines and his physicalism is not committed to the elimination of all 'intentional' vocabulary or mental terms from social science. Moreover, Neurath's social theory is institutionalist. It is a form of (non-eliminativist) social behaviourism which takes public institutions and social orders as the starting point for analysis. Hence, for example, his insistence that monetary exchanges be understood as parts of particular institutional arrangements like others and their study to be approached anthropologically. In developing the point, Neurath exploited the now well-trodden analogies between monetary exchange and games like chess which are constituted by certain public rules (1944: 39).

Clarification of the senses of 'physicalism' matters to the debate about the possibility of *in natura* calculation. Because Hayek mischaracterized Neurath's physicalism, much in Neurath's account of *in natura* calculation is untouched by many of Hayek's criticisms. The doctrine that Hayek criticized is that there are some purely physical units, like units of energy, which are independent of human use or belief and which could be employed for planning. But not only did Neurath not defend physicalism in this sense, he similarly rejected the doctrine that there are purely physical units that could be employed for socialist planning and with it the technocratic idea that there is any optimum solution to social problems.

Neurath opposed 'what is called the "technocratic movement"', which assumes there exists:

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concept of physicalism to clarification of its role in the debate with Hayek about the nature and possibility of *in natura* calculation.

one best solution with its ‘optimum happiness’, with its ‘optimum population’, with its ‘optimum health’, with its ‘optimum working week’, with its ‘optimum productivity’ or something else of this kind [and which] asks for a particular authority which should be exercised by technicians and other experts in selecting ‘big plans’.  
(1942/1973: 426–7)

A number of points about the elements of *in natura* calculation deserve notice here. First, they are plural. Second, they are not purely ‘physical’ in the sense that Hayek assumes. The material preconditions of human activity do feature in Neurath’s account of in-kind calculations. But so also do the social dimensions of life. The inventory of the conditions of life includes ‘everything about work load, morbidity, mortality, food, clothing, housing, educational possibilities, amusement, leisure time etc.’ (1925/2004: 421). It includes ‘the environment in its broadest sense’ (1937/2004: 524). In discussing real wealth, Neurath was not abstracting from human relations and human conditions. Correspondingly, institutional arrangements matter: self-government and freedom and other human relations belong to the ‘happiness conditions’ of human beings (1942/1973: 427). Neurath’s account of *in natura* decision making is consistent with the institutionalist character of his approach to economics and social science in general.

Neurath’s rejection of the forms of technocratic reason that Hayek ascribes to him forms the basis of much of his response to Hayek. For Neurath, the belief in some kind of technical optimum discoverable through science is a mark of pseudorationalism. Indeed Neurath’s remarks about the limits of reason – ‘Rationalism sees its chief triumph in the clear recognition of the limits of actual insight’ (1913/1981: 8) – find a remarkable parallel in Hayek’s later objections to ‘superrationalism’, as Neurath himself noted. ‘I am the arch-enemy of the “illusion of complete knowledge” and from this point of view I think Professor

von Hayek should praise me and appreciate my never ceasing efforts to destroy such illusions.’ (Neurath, 1945).

In his correspondence with Hayek, Neurath linked the rejection of pseudorationalism with his logical empiricism. Thus he invokes a series of claims about science that he was in part responsible for placing at the centre of the philosophy and sociology of science. Scientific theory is underdetermined by empirical evidence. Evidence itself is uncertain and provisional – observation or protocol statements are open to revision. Theories are a mass of statements that are logically interconnected and confront the world as a whole, not individually. In the metaphor he uses in a variety of different places, we are like sailors who have to patch up their boat at sea. There are no methods or rules of science that can be employed to definitively confirm or falsify theories.

A sign of pseudorationalism is the failure to acknowledge the underdetermination of theory by evidence and uncertainty in prediction. Neither can such uncertainty and ignorance be resolved by treating them as if they could be translated into quantifiable probability statements (1941: 147–8). This general scepticism about predictability is taken by Neurath to have particular relevance when it comes to social decision making. The unpredictability in science in general underpins his rejection of the technocratic ideal of the discovery of an optimal solution to social decisions we noted earlier:

If science enables us to make more than one sound prediction, how may we use science as a means of action? We can never avoid a ‘decision’, because no account would be able to show us one action as ‘the best’, no computation would present us with any ‘optimum’, whatever actions have to be discussed. (Neurath, 1946/2004: 552)

Neurath also appealed to the very features of the unpredictability of human knowledge that were central to Popper’s case against historicism and Hayek’s view of the

market as a discovery procedure. It is a feature of human knowledge and invention that we cannot predict what will be novel, and since social change depends in part on theoretical and practical invention, we cannot predict social change (1943/2004: 527). This point was also central to the final sections of his *Foundations of the Social Sciences* where its implications are stressed in the closing remark which returns to his analogy for the development of knowledge, that scientists are like sailors at sea who cannot put into dock but must modify the ship with materials at hand: ‘A new ship grows out of the old one, step by step – and while they are still building, the sailors may already be thinking of a new structure, and they will not always agree with one another. *The whole business will go in a way we cannot even anticipate today.* That is our fate.’ (1944: 47, emphasis added)<sup>9</sup>

Neurath’s response to Hayek offers an important defence of the central two claims of the tradition of ecological economics which Hayek criticizes. He allows that the economy is physically embedded without falling for the kinds of physicalist reductionism that Hayek properly criticizes, for example of treating all decisions through energy units. Hayek clearly overstated his case. That one cannot give a physicalist reduction of economic categories does not entail that there is not a perfectly good role for physical descriptions and indicators in economic analysis. Correspondingly, Neurath pointed out that monetary measures of productivity and growth have to be kept distinct from measures of physical and institutional changes that are relevant to human welfare, and that what in more recent terms would be called material flow analysis of economies and physical indicators of sustainability have a role in economic theory and policy analysis.<sup>10</sup> He properly noted that monetary measures fail to adequately capture changes in human welfare. What Neurath called in-kind decision making is close in conception to what would now be called multi-criteria decision analysis and shares the

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<sup>9</sup>For an account of the uses and contexts of the simile of the sailors throughout Neurath’s work see Cartwright et al. (1996: 89–166).

<sup>10</sup>For further discussion see Martínez-Alier et al. (2001).

advantages of that approach against attempts to reduce choices to single monetary units through a cost–benefit analysis.<sup>11</sup>

Finally, note that, for Neurath, ignorance and unpredictability are universal features of social choice:

Professor von Hayek thinks people think too much of the society as a factory, as if we were able to predict so much better in a factory. I want to stress the point that in the factory we are not able to predict as comprehensively as Professor von Hayek thinks. I have to over-Hayek Professor Hayek: [there] we are not in a position of comprehensive prediction either. (Neurath, 1945)

The problem of decision making in conditions of uncertainty is a general feature of social life. As he had put it years earlier, all action is ‘an anticipation of unpredictable events’ (Neurath, 1921/1973: 159).<sup>12</sup>

3. The left Vienna Circle and the Frankfurt School: competing traditions of political ecology<sup>13</sup>

Neurath’s criticisms of pseudorationalism and technocratic decision making are central to a debate which retains continuing importance to ecological economics. His debate with the Frankfurt School left a lasting legacy in political ecology. It defined two distinct approaches to political ecology, which remain in troubling tension with each other. On the one side there is a body of work in political ecology which is concerned with the physical and biophysical conditions for human well-being. The approach is typically concerned with the ways in which different economic activities, practices and structures are limited by environmental conditions

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<sup>11</sup>For further discussion see Martínez-Alier et al. (1998) and (1999).

<sup>12</sup>For a discussion of the implications of the outcome of this debate generally and for science policy, see O’Neill (2004) and (2012).

<sup>13</sup>This section draws on O’Neill and Uebel (2005).

required for resource provision, waste assimilation, climate regulation and so on. In making claims about the physical conditions for economic and social provisioning, the approach draws on both the natural sciences and social sciences. The historical origins of this approach in the work of Neurath and the left Vienna Circle, and later in Kapp, we have noted above. On the other side is a body of work in political ecology which takes environmental problems to have a cultural origin in a crisis of 'Western reason'. This approach is sceptical of science in that scientific reason itself is taken to be a form of ideology responsible for the domination of both nature and of human beings. At the same time, scientism, and in particular the identification of practical rationality with instrumental rationality, precludes critical reflection on the sources of domination. In doing so it fosters an unreflective technocratic politics of experts. This second approach has its origins in the Frankfurt School, in particular in the work of Horkheimer, Adorno and Marcuse.

The role of the Institut für Sozialforschung (Institute for Social Research), the Frankfurt School, is an interesting one. On the one hand it gave financial support to both Neurath for development of his work on the standard of living and to Kapp for his work on planning. The support of both belonged to a tradition of empirical social research and work on planning in particular that is to be found in the early Frankfurt School. On the other hand the central trajectory of the work of the Frankfurt School moved from the late 1930s onwards in an entirely different direction, towards the view that science itself was necessarily committed to the domination of nature. In developing this view, it converged on an account of the Vienna Circle that we have already seen expressed in the work of Hayek as involving a form of scientism that was committed to a technocratic politics. These two very differently motivated Hayekian and Frankfurt criticisms are largely responsible for the now standard but mistaken association of logical positivism with technocratic politics and for the use of 'positivism' as a term of academic abuse.

A useful starting point to understanding the bifurcation in the traditions of ecological thought is the first issue of volume 6 of the Frankfurt School's journal, *Zeitschrift für Sozialforschung* (*Journal for Social Research*), published in 1937, which contains two papers which make for unusual companions.<sup>14</sup> The first of these papers was Horkheimer's 'The latest attack on metaphysics' (1937a), a critique of logical positivism. According to standard history, this paper, along with 'Traditional and critical theory' (1937b), marked the beginning of the transition from the programme for interdisciplinary empirical research that characterized the early work of the Institute to the central themes of Critical Theory, which promised a hitherto unavailable philosophical comprehension of social totality, that defined its second. The paper also marked an important turning point in the history of the reception of the work of the Vienna Circle, providing the starting point for the now familiar picture of the logical empiricists, especially in left circles, as committed to a technocratic and instrumentalist view of politics, unable to sustain any critical standpoint on existing society. The second paper was by Neurath, one of the main targets of Horkheimer's paper, and was titled 'Inventory of the standard of living' (1937). This paper reformulated some of the central themes in Neurath's long-standing attack on the attempt to capture changes in welfare in purely monetary terms.

The co-presence of Horkheimer's paper with that of a leading logical empiricist may appear surprising until the wider context is appreciated. For all their early philosophical differences, which were substantial, there existed many actual and potential points of contact between the early interdisciplinary materialism of the Frankfurt School and the radical physicalist sociology of writers like Neurath. Indeed, that journal issue was preceded by a number of meetings and some partial cooperation. However, this is not to say there were no surprises in the co-presence of the two papers. For Neurath himself, the strength,

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<sup>14</sup>For a detailed discussion of this episode see O'Neill and Uebel (2005).

uncharitableness and polemical nature of Horkheimer's critique did come as an unwelcome surprise: he had no idea that such a confrontation was planned but had hoped for a further narrowing of their differences. In reply he wrote a deliberately understated and remarkably unpolemical response for publication in the journal. This response Horkheimer refused to publish. Not surprisingly, further contact between the Frankfurt School and members of the former Vienna Circle was minimal.

Horkheimer's criticisms of Neurath and logical positivism in 'The latest attack' also needs to be placed within the complex context of the development of Horkheimer's thought, from the early programme of interdisciplinary materialism, through the second phase of the articulation of Critical Theory initiated in the 1937 papers, to the third phase beginning around 1940 during which his criticism of instrumental reason was developed in close cooperation with Adorno.<sup>15</sup> The second and third phases saw the development of the central claims of the Frankfurt School that have been influential in the development of political ecology.

The materialism of Horkheimer's earlier work has some affinities to the form of empiricism defended by Neurath, just as Neurath's Marxism had meant that his account of physicalism was much more sympathetic to materialism than others in the Vienna Circle. Both Neurath's and the early Horkheimer's work were concerned with developing a programme that might be characterized as materialism without metaphysics. For both, while it did not entail any ethical position, their materialist attitude was associated with a particular set of political and ethical concerns reflecting their shared Marxist assumptions. Both held that a rejection of metaphysics had ethical implications in so far as it ruled out any appeal to abstractions that were separate from the particular lives of particular human beings. While for Neurath it involved a commitment to a politics on 'the earthly plane' (1928/1973: 295), for

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<sup>15</sup>This now canonical periodization was developed by Dubiel (1978).

Horkheimer materialism 'opposes every attempt to play down the importance of insight into the earthly order of things by turning man's attention to a supposedly more essential order' (1933/1972: 26). Horkheimer granted a partial overlap with positivism in their common opposition to the use of metaphysics to reconcile individuals to their fate in existing social orders (ibid.: 6).

The papers of 1937 saw a shift in Horkheimer's views towards the more influential critique of scientific reason and with it a marked alteration in the conception of the role of philosophy. Philosophy becomes a resource that has to be distanced from science, since it is not just the social context in which science operates that is now taken as the central critical concern, but the nature and telos of science itself. Virtually inverting the view which animated the early materialist work, philosophy wholly separate from the sciences becomes the central source of Critical Theory. This shift becomes still more pronounced in the third phase of the Frankfurt School's work in which the earlier interdisciplinary programme is altogether abandoned.

During the second phase Horkheimer's philosophical reflection increasingly focused on the role of science in the productive processes of industrial capitalist societies and on the ideological role of philosophies of science. Science was viewed as a form of knowledge that was constituted by an interest in the manipulation of its object for productive ends.

What scientists in various fields regard as the essences of theory thus corresponds, in fact, to the immediate tasks they set for themselves. The manipulation of physical nature and of specific economic and social mechanisms demand alike the amassing of a body of knowledge such as is supplied by an ordered set of hypotheses. The technological advances of the bourgeois period are inseparably linked to this function of the pursuit of science. (1937b/1972: 194)

One of the marks of 'traditional' as opposed to 'critical' theory was taken to be the lack of self-consciousness of this fact. Thus traditional theory takes the particular form of scientific knowledge as given: 'the real social function of science is not made manifest' (ibid.: 197). Unconsciously, the scientist renders invisible his or her own role in reproducing existing society, thereby ensuring 'the conservation and continuous renewal of the existing state of affairs' (ibid.: 196). One particular scientific conception of theory is treated in an unhistorical way and in doing so becomes 'a reified, ideological character' (ibid.: 194). Logical positivism on this account is but a particular expression of a conservative ideology. This, and the claim that science is committed by its very nature to a purely instrumental understanding of its object, became central not only to the later work of the Frankfurt School but also became the basis of a central component of one important strand of political ecology.

The central question that Neurath raised regarding Horkheimer's position in its shift from an empirically grounded reflection on the social context of the sciences which is central to the early work, concerns the criterion for determining the acceptability or rejection of competing claims about science and about the social world in which science develops. As Horkheimer noted in his reply to Neurath, 'The weakest point of my piece was pointed out by you, naturally, on page 13 of your reply. "Horkheimer nowhere indicates by means of which control one can determine when a point of view is 'correct' and when it is 'incorrect'.'"'<sup>16</sup> Horkheimer responded by questioning the vagueness of the criteria of empirical control that the logical empiricists offered, but this left unanswered Neurath's central objection to his position. It is unclear on what basis he took himself to be developing his non-naturalistic account of a philosophy that is autonomous from the sciences. To what criteria of reason could it appeal?

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<sup>16</sup>Horkheimer to Neurath 29 December 1937, in Horkheimer (1995: 348).

The problem became increasingly apparent as Horkheimer's criticisms of the concept of reason that informed the Enlightenment project became more radical. Thus in *Eclipse of Reason*, reason as such is taken to be based in an interest in the domination of nature: 'The disease of reason is that reason was born from man's urge to dominate nature, and the "recovery" depends on insight into the nature of the original idea, not on a cure of the latest symptoms.' (1947/1974: 176). However, in developing his critique of reason, Horkheimer does not want to reject the norms of reason as such. The critique is a 'self-critique': 'in such self-critique, reason will at the same time remain faithful to itself' (ibid.: 177). But how can such a radical self-critique of reason be sustained without undermining the grounds of the critique? As Habermas later put it, 'the radical critique of reason proceeds self-referentially; critique cannot simultaneously be radical and leave its own criteria untouched' (1986/1993: 57). Horkheimer rejected any turn to irrationalism and held on to the critical role of reason – but without offering a defensible account of how it survives its own self-criticism.

The radical critique of reason left a problematic legacy for the Frankfurt School just where it is most influential in political ecology – in their critique of science. Part of the problem in the identification of science with instrumental reason lies in the lack of clarity in what overcoming instrumental reason is taken to involve. The problems are clearly apparent, for example, in Marcuse's influential account of science as ideology. Marcuse repeats the strong claim about the relation of science and the domination of nature: 'science, by virtue of its own method and concepts, has projected and promoted a universe in which the domination of nature has remained linked to the domination of man' (1968: 135). But Marcuse, unlike Horkheimer and Adorno, did not give up on the idea of radical social change. Thus he found himself forced to claim that the end of domination requires a new science grounded in a different interest, and with a different view of nature, not as an object to be manipulated but as 'a totality of life to be protected and cultivated' (1972: 61). This change in the interests of

science would carry with it changes in its content: 'Its hypotheses, without losing their rational character, would develop in an essentially different experimental context (that of a pacified world); consequently, science would arrive at essentially different concepts of nature and establish essentially different facts.' (1968: 136). Marcuse's idea is implausible. What the 'rational character' of the new science would look like, what its criteria of theory choice would be, what would characterize the new types of concepts, are all left opaque.

A related difficulty is also apparent, albeit in a very different way, in the work of Habermas. Habermas, while accepting the claim that scientific knowledge is constituted by an interest in technical control, rejects the idea that this limitation can be overcome: 'The idea of a New Science will not stand up to logical scrutiny...' (1968/1970: 88). Habermas restates the problem as one of the colonization of the life-world by instrumental reason. Scientific reason has its proper place in the sphere of instrumental action: the problems arise when it leaves its proper domain. Habermas also offers, through his account of communicative rationality, what Horkheimer never managed to offer: an account of what the criteria of rationality are outside the sphere of the natural sciences. Habermas' account of communicative rationality (see his 1981) has its roots in Kant's defence of the public use of reason as a condition of enlightenment: dialogue is rational to the extent that it is free from the exercise of power and strategic action and participants are equal in their communicative capacities to state and evaluate arguments, such that the judgements of participants converge only under the authority of the good argument. However, while the Habermasian project avoids some of the internal difficulties of Horkheimer's position, it has its own problems in offering an account of the role of science and scientific expertise in public deliberation. Indeed those problems are visible in the influence that Habermas's theory has had in public policy.

In Habermas's account, what remains of the Frankfurt critique of science and instrumental reason is a claim about their extension beyond their proper domain. Technocratic politics, the scientization of politics and public opinion, involves the elimination of the practical sphere of public debate about norms. It involves the reduction of political issues to matters of technical reason.<sup>17</sup> Now while there may be considerable power to this claim, it leaves problems about scepticism and trust in the claims of scientific expertise itself untouched. Habermas's position fails to properly formulate one of the central democratic problems of science in modern public policy. This is the problem that, at one and the same time, citizens have to rely on scientific knowledge and yet have good reasons for maintaining some scepticism about its claims. In particular, the assumptions of epistemic equality that are built into Habermas's account of communicative rationality render it ill-equipped to address the problems of ineliminable epistemic inequality in public life and the problems that this raises for democratic politics.<sup>18</sup>

Public decisions in the modern world rely on claims by experts, the grounds for which are opaque to direct inspection by the citizen and indeed by other scientists. Nor is this opacity eliminable. The capacity to make and evaluate particular claims in the special sciences relies on a background of training within particular scientific practices. It relies on particular competences and know-how, not all of which is open to explicit articulation. Both citizen and scientist in most matters rely on the competences of others which they lack. Habermas's assumption of equality of competence that is built into the model of communicative rationality fails to acknowledge the existence of epistemic inequality even in the ideal conditions of his non-coercive speech community. While the assumption of epistemic equality may have power in the moral domain, it is implausible in that of the sciences. As a result Habermas's account is forced to gloss over some of the real difficulties

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<sup>17</sup>This is a constant in Habermas' work ever since his 1963 book.

<sup>18</sup>For a discussion of this claim see O'Neill (2002).

about the role of science in modern public life, in particular that of simultaneous reliance on expertise coupled with proper scepticism about its claims. Yet it is just in this context that the official opponent of the Frankfurt School, Neurath, speaks most clearly.

Evidence of Neurath's scepticism about the technocratic movement can also be found in both of the key papers in Neurath's engagement with the Frankfurt School, in 'Inventory' and in his unpublished reply to Horkheimer. In the first, Neurath develops a theme that was central to his contributions to the socialist calculation debate, the rejection of any single measure, monetary or non-monetary, through which one could arrive at a technically optimal social outcome. Alongside this specific argument from the incommensurability of different options, Neurath's rejection of technocratic accounts of social choice is also founded on a more general set of arguments against the view of theoretical and practical reason involved. Those arguments have their basis in the kind of sceptical naturalistic reflection on science that Neurath reiterated in his response to Horkheimer: the underdetermination of theory by empirical evidence; theories as bodies of logically interconnected statements which confront the world as a whole, not individually; the uncertainty and provisionality even of observation statements. This fallibilism itself has to be understood naturalistically in terms of the history and sociology of science. It was reflections about the nature of scientific knowledge that founded Neurath's scepticism about excessive claims for the role of science and technical expertise in offering unique determinate answers to problems and his rejection of assumptions about knowledge that underpins the 'technocratic movement' with its various claims about optimal social decision making.

The problems of choice in conditions of necessarily uncertain and incomplete knowledge are not new. However, they are becoming increasingly to the fore in ecological problems. So also is the recognition of the problem that our decision making needs at the same time to both rely on scientific expertise and be open to proper scepticism about its

limits: ‘Our life is connected more and more with experts, but on the other hand, we are less prepared to accept other people’s judgements, when making decisions’ (Neurath, 1996: 251). There is no permanent solution to such conflicts – while institutional conditions for social trust are important, scepticism of expertise is not something to be eliminated. Democracy is ‘the continual struggle between the expert... and the common man’ (ibid.). Democratic deliberative processes are in part about ways of living with that conflict and guarding against the recurrent dangers of technocratic pseudorationalism.<sup>19</sup> The naturalistic scepticism which informs Neurath’s criticism of a technocratic politics speaks more closely to the problems of the place of science in public life than does either the radical criticism of instrumental reason of the first generation of the Frankfurt School or the account of instrumental and communicative reason offered by Habermas in the second. As we noted above, applications of the Habermasian model of deliberative institutions cannot avoid addressing the Neurathian problem of the simultaneous reliance on and proper scepticism about science in public life. So while there is nothing in Neurath’s work that approaches a detailed account of public deliberation, the theory of deliberative democracy that arises out of the work of Habermas could do with a reconciliation with the forgotten heritage of his precursors’ ‘positivist’ opponents. At the level of public science policy, the two traditions of political ecology have much to say to each other.<sup>20</sup> Here too, we believe, political ecology can only gain from continuing to build on the input of the analytical philosopher who helped shape its foundations.

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<sup>19</sup>On the wider contemporary relevance of Neurath’s mature writings on social organization, see O’Neill (1998: Postscript), (2003a) and (2003b).

<sup>20</sup>There remain, of course, deep conflicts between the social Epicurianism of Neurath, which was deeply anti-Kantian and the reformulation of a Kantian ethic by Habermas – although a similar conflict exists within the Frankfurt tradition between discourse ethics and the early materialism of Horkheimer.

## Bibliography

(Note that while texts are referred to by date of original publication, only recent editions or translations are listed here.)

Berger, S. 2008. 'K. William Kapp's Theory of Costs and Environmental Policy: Towards Political Ecological Economics'. *Ecological Economics* 67, 244–52.

Cartwright, N., J. Cat, L. Fleck and T. Uebel. 1996. *Otto Neurath: Philosophy Between Science and Politics*. Cambridge: Cambridge University Press.

Dubiel, H. 1978. *Theory and Politics. Studies in the Development of Critical Theory*. Cambridge, MA: MIT Press, 1985.

Habermas, J. 1963. *Theory and Practice*. London: Heinemann, 1974.

Habermas, J. 1968. 'Technology and Science as Ideology'. In Habermas, *Towards a Rational Society*, Boston, MA: Beacon Press, 1970, 81–122.

Habermas, J. 1981. *The Theory of Communicative Action*. Boston, MA: Beacon, 1986.

Habermas, J. 1986. 'Remarks on the Development of Horkheimer's Work'. In S. Benhabib, W. Bonss and J. McCole (eds), *On Max Horkheimer*. Cambridge, MA: MIT Press, 1993, 49–63.

Hayek, F. 1937. 'Economics and Knowledge'. In Hayek 1948, 33–56.

Hayek, F. 1941. 'The Counter-Revolution of Science'. In Hayek 1979, 185–290.

Hayek, F. 1942–4. 'Scientism and the Study of Society'. In Hayek 1979, 19–184.

Hayek, F. 1945. 'The Uses of Knowledge in Society'. In Hayek 1948, 77–91.

Hayek, F.A. 1948. *Individualism and Economic Order*. London: Routledge and Kegan Paul.

- Hayek, F.A. 1960. *The Constitution of Liberty*. London: Routledge and Kegan Paul.
- Hayek, F.A. 1978. 'Competition as a Discovery Procedure'. In Hayek, *New Studies in Philosophy, Politics, Economics and the History of Ideas*. Chicago: The University of Chicago Press, 179–90.
- Hayek, F.A. 1979. *The Counter-Revolution of Science*. Indianapolis: Liberty.
- Horkheimer, M. 1933. 'Materialism and Metaphysics'. In Horkheimer 1972, 10–46.
- Horkheimer, M. 1937a. 'The Latest Attack on Metaphysics'. In Horkheimer 1972, 132–87.
- Horkheimer, M. 1937b. 'Traditional and Critical Theory'. In Horkheimer 1972, 188–243.
- Horkheimer, M. 1947. *The Eclipse of Reason*. New York: Seabury Press, 1974.
- Horkheimer, M. 1972. *Critical Theory. Selected Essays*. New York: Seabury Press.
- Horkheimer, M. 1995. *Gesammelte Schriften. Band 16. Briefwechsel 1937–40* (ed. by G. Schmid-Noerr), Frankfurt: Suhrkamp.
- Kapp, K.W. 1936. *Planwirtschaft und Aussenhandel*. Geneva: Georg & Cie.
- Kapp, K.W. 1955. 'Review: *Einführung in die Theorie der Zentralverwaltungswirtschaft* by K. Paul Hensel'. *American Economic Review* 45, 682–5.
- Kapp, K.W. 1963. *The Social Cost of Business Enterprise* (2nd edn of *Social Cost of Private Enterprise*, 1950). Nottingham: Spokesman, 1977.
- Kapp, K.W. 1965. 'Economic Development in a New Perspective: Existential Minima and Substantive Rationality'. *Kyklos* 18, 49–79.
- Kapp, K.W. 1970. 'Environmental Disruption and Social Costs: A Challenge to Economics'. *Kyklos* 23, 833–48.

- Kapp, K.W. 1974. *Environmental Policies and Development Planning in Contemporary China and Other Essays*. The Hague: Mouton.
- Kapp, K.W. 1988. *The Humanisation of the Social Sciences*. Lanham, MD: University Press of America.
- Kirzner, I. 1985. *Discovery and the Capitalist Process*. Chicago: University of Chicago Press.
- Marcuse, H. 1968. *One-Dimensional Man*. New York: Abacus.
- Marcuse, H. 1972. *Counter-Revolution and Revolt*. London: Allen Lane.
- Martínez-Alier, J. 1987. *Ecological Economics*. Oxford: Blackwell.
- Martínez-Alier, J. 1991a. 'Environmental Policy and Distributional Conflicts'. In R. Constanza (ed.), *Ecological Economics: The Science of Management and Sustainability*. New York: Columbia University Press, 118–36.
- Martínez-Alier, J. 1991b. 'Ecological Perception and Distributional Conflicts: A Historical View'. In F.J. Dietz, J. Van der Straaten and F. Van der Ploeg (eds), *Environmental Policy and the Economy*, Amsterdam: Elsevier, 117–38.
- Martínez-Alier, J. 2002. *The Environmentalism of the Poor: A Study of Ecological Conflicts and Valuation*. Cheltenham, UK and Northampton, MA, USA: Edward Elgar Publishing.
- Martínez-Alier, J., G. Munda and J. O'Neill. 1998. 'Weak Comparability of Values as a Foundation for Ecological Economics'. *Ecological Economics* 26, 277–68.
- Martínez-Alier, J., G. Munda and J. O'Neill. 1999. 'Commensurability and Compensability in Ecological Economics'. In C. Spash and M. O'Connor (eds), *Valuation and Environment: Principles and Practices*. Cheltenham, UK and Northampton, MA, USA: Edward Elgar Publishing.

Martinez-Alier, J., G. Munda and J. O'Neill. 2001. 'Theories and Methods in Ecological Economics: A Tentative Classification'. In J. Cleveland, D. Stern and R. Constanza (eds), *The Economics of Nature and the Nature of Economics*. Cheltenham, UK and Northampton, MA, USA: Edward Elgar Publishing

Mises, L. Von. 1922. *Socialism: An Economic and Sociological Analysis*. Indianapolis: Liberty Press, 1981.

Neurath, O. 1909. 'Remarks on the Productivity of Money'. In Neurath 2004, 292–6.

Neurath, O. 1912. 'The Problem of the Pleasure Maximum'. In Neurath 1973, 113–22.

Neurath, O. 1913. 'The Lost Wanderers of Descartes and the Auxiliary Motive'. In Neurath 1983, 1–12.

Neurath, O. 1919. 'Character and Course of Socialization'. In Neurath 1973, 135–50.

Neurath, O. 1921. 'Anti-Spengler'. In Neurath 1973, 158–213.

Neurath, O. 1925. 'Economic Plan and Calculation in Kind'. In Neurath 2004, 405–65.

Neurath, O. 1928. 'Personal Life and Class Struggle'. In Neurath 1973, 249–98.

Neurath, O. 1937. 'Inventory of the Standard of Living'. In Neurath 2004, 513–26.

Neurath, O. 1941. 'The Danger of Careless Terminology'. *The New Era* 22, 145–50.

Neurath, O. 1942. 'International Planning for Freedom'. In Neurath 1973, 422–40.

Neurath, O. 1943. 'Planning or Managerial Revolution'. In Neurath 2004, 527–38.

Neurath, O. 1944. *Foundations of the Social Sciences*. Chicago: University of Chicago Press.

Neurath, O. 1945. 'Physicalism, Planning and the Social Sciences: Bricks Prepared for a Discussion v. Hayek' 26 July, 1945 *The Otto Neurath Nachlass in Haarlem* 202 K.56.

Neurath, O. 1946. 'After Six Years'. In Neurath 2004, 549–56.

Neurath, O. 1973. *Empiricism and Sociology* (ed. by M. Neurath and R.S. Cohen). Dordrecht: Reidel.

Neurath, O. 1983. *Philosophical Papers* (ed. by R.S. Cohen and M. Neurath). Dordrecht: Reidel.

Neurath O. 1996. 'Visual Education: Humanisation versus Popularisation'. In E. Nemeth and F. Stadler (eds), *Encyclopedia and Utopia. The Life and Work of Otto Neurath*. Dordrecht: Kluwer, 1996, 245–335.

Neurath, O. 2004. *Economic Writings 1904–1945* (ed. by T. Uebel and R.S. Cohen). Dordrecht: Kluwer.

O'Neill, J. 1993. *Ecology, Policy and Politics: Human Well-Being and the Natural World*. London: Routledge.

O'Neill, J. 1998. *The Market: Ethics, Knowledge and Politics*. London: Routledge.

O'Neill, J. 2002. 'Socialist Calculation and Environmental Valuation: Money, Markets and Ecology'. *Science and Society* 66, 137–51.

O'Neill, J. 2003a. 'Neurath, Associationism and the Markets'. *Economy and Society* 32, 184–206.

O'Neill, J. 2003b. 'Unified Science as Political Philosophy'. *Studies in History and Philosophy of Science* 34, 575–96.

O'Neill, J. 2004. 'Ecological Economics and the Politics of Knowledge. The Debate Between Hayek and Neurath'. *Cambridge Journal of Economics* 28, 431–47.

O'Neill, J. 2012. 'Austrian Economics and the Limits of the Market'. *Cambridge Journal of Economics* 36, 1073–90.

O'Neill, J. and T. Uebel. 2005. 'Horkheimer and Neurath: Restarting a Disrupted Debate'. *The European Journal of Philosophy* 12, 75–105.

Popper, K. 1944–5. 'The Poverty of Historicism'. Reprinted with revisions in *The Poverty of Historicism*, London: Routledge, 1986.

Uebel, T. 2000. 'Some Scientism, Some Historicism, Some Critics: Hayek's and Popper's Critiques Revisited'. In M. Stone and J. Wolff (eds), *The Proper Ambition of Science*. London: Routledge, 151–73.

Uebel, T. 2005. 'Incommensurability, Planning and Ecology. Neurath in the Socialist Calculation Debate'. *History of Political Economy* 37, 309–42.

Uebel, T. 2007a. *Empiricism at the Crossroads. The Vienna Circle's Protocol Sentence Debate*. Chicago: Open Court.

Uebel, T. 2007b. 'Philosophy of Social Science in Early Logical Empiricism: The Case of Radical Physicalism'. In A. Richardson and T. Uebel (eds), *The Cambridge Companion to Logical Empiricism*. Cambridge: Cambridge University Press, 278–304.

Uebel, T. 2008. 'Calculation in Kind and Marketless Socialism: On Neurath's Utopian Economics'. *European Journal for History of Economic Thought* 15, 475–501.

Weber, M. 1921–22/1972. *Wirtschaft und Gesellschaft*. Tübingen: Mohr.

Weber, M. 1921–22/1978. *Economy and Society*. Berkeley: University of California Press.

