Economics and Philosophy, **22** (2006) 55–78
doi:10.1017/S0266267105000702

KNOWLEDGE, PLANNING, AND MARKETS: A MISSING CHAPTER IN THE SOCIALIST CALCULATION DEBATES

JOHN O'NEILL*
Lancaster University

This paper examines the epistemological arguments about markets and planning that emerged in a series of unpublished exchanges between Hayek and Neurath. The exchanges reveal problems for standard accounts of both the socialist calculation debates and logical empiricism. They also raise questions concerning the sources of ignorance and uncertainty in modern economies, and the role of market and non-market organisations in the distribution and coordination of limited knowledge, which remain relevant to contemporary debates in economics. Hayek had argued that Neurath's work exemplified the errors of rationalism that underpinned the socialist project. In response Neurath highlighted assumptions about the limits of reason and predictability that the two theorists shared and attempted to turn those assumptions back against Hayek in a defence of the possibility of socialist planning. The paper critically compares Neurath's and Hayek's criticisms of rationalism and considers how far Neurath is successful in his attempt to employ Hayek's assumptions against Hayek himself.

My aim in this paper is to examine the epistemological arguments about planning and markets that emerge in an exchange between Hayek and Neurath. The exchange forms one of the missing chapters in the socialist calculation debates, which is of significance not just for the light it throws on the problems in the standard accounts of both the calculation debates in economics and positivism in philosophy, but also in virtue of the

* I would like to thank the staff at the Vienna Circle Institute for their assistance in consulting their copy of the Neurath Nachlass. I owe a debt of gratitude to Thomas Uebel and David Archard for their comments on earlier versions of this paper. I would like to acknowledge the support of the Arts and Humanities Research Board and a Manchester University Hallsworth Fellowship in writing this paper.

continuing importance of the epistemological themes it touches upon. It dealt with questions concerning the sources of ignorance and uncertainly in modern economies, the role of market and non-market organisations in the distribution and coordination of the limited knowledge of different actors, and the limits of rational models of economic choice, all of which retain their relevance to contemporary debates in economics.

The debate between Hayek and Neurath took place in an unpublished exchange in the early 1940s. Neurath had been a central target of Hayek's papers 'The Counter-Revolution of Science' and 'Scientism and the Study of Society' which had appeared in *Economica* between 1941 and 1944 (Hayek 1941; 1942–44).[1] In those papers Hayek's epistemological objections to socialism are developed through criticism of the various forms of scientism and 'objectivism' in the social sciences, in particular that variant represented by the 'physicalism' of Neurath and other logical positivists. These forms of scientism are taken to illustrate the errors of rationalism that lie at the basis of the socialist project. 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 between them (Neurath 1945a, 1945b). The public exchange never happened. Neurath died in late 1945 and Hayek's letters reveal little enthusiasm for the prospect.

Neurath's response to Hayek focused on a series of assumptions about the limits of reason and predictability that the two theorists share. As such it reveals some of the major misunderstandings of logical positivism and the Vienna Circle to which Hayek's own account partially contributed and which has recently been subject to welcome revision (Cartwright *et al*. 1996). It also highlights the problems in the standard story of the socialist calculation debates which I have criticised elsewhere (O'Neill 1996, 1999). The socialist calculation debate is normally presented primarily as a conflict between Mises (1920, 1922) and Hayek (1935b, 1937, 1945) on the one hand, and Lange (1936–37) and Taylor (1928) on the other, different sides being accorded the laurels of victory (Buchanan 1985: ch. 4; Lavoie 1985; Shapiro 1989; Blackburn 1991; Steele 1992). However, that presentation misses the nature and extent of the discontinuities between the early and later phases of the debates, discontinuities which are illustrated by Neurath's role in the debates.

Neurath had been directly involved not just in the theory of socialisation, but also in its attempted practice, as director of socialisation in both the republican and soviet phases of the Bavarian revolution that followed the first world war. His work on socialisation formed one of

[1] Popper (1944–45), which also includes criticisms of Neurath, was read to a seminar of Hayek in the same period and appeared in *Economica* in 1944–45. For a discussion see Uebel (2000).

the main objects of criticism in Mises' opening paper in the debate, as it had done to Weber's contribution to the debate (Weber 1978: sections 12–14). Mises' arguments against socialism turned on assumptions about rationality and commensurability which were rejected by Neurath, but taken for granted by Taylor and Lange. Hayek's arguments against socialism turned on epistemological assumptions about the nature of knowledge and rationality which are inconsistent with the assumptions shared by Mises, Taylor, and Lange, and which are much closer to those of Neurath than Hayek realised. Hayek's criticisms of rationalism echo Neurath's earlier criticisms of 'pseudorationalism'. Those similarities in the premises of many of their arguments are the central theme in Neurath's response to Hayek. Neurath attempts to turn Hayek's own assumptions back against Hayek in defence of the possibility of socialist planning. In this paper I will examine the commonalities and differences between Neurath's and Hayek's criticisms of rationalism, and will consider how successful is Neurath's attempt to turn those assumptions back against Hayek.

1. HAYEK AGAINST NEURATH

> What dissuaded me [of positivism] is that the social scientists, the science specialists in the tradition of Otto Neurath, just were so extreme and so naïve on economics; it was actually through them that I became aware that positivism was just misleading in the social sciences. I owe it to Neurath's extreme position that I recognised it wouldn't do. (Hayek 1994: 50)

A central claim of Hayek's 'Scientism and the Study of Society' is that scientism in the social sciences exemplifies an illusion about the scope of human reason that underpins the socialist project. This scientism is exhibited in the doctrine of 'objectivism', of which Neurath's 'physicalism' is taken to be a typical expression. The terms 'objectivism' and 'subjectivism' are used in a variety of logically independent senses in the Austrian economic tradition (O'Neill 1998a: ch. 3). In Hayek's scientism essay, the terms are being used in the following senses. Objectivism is the view that social science requires the elimination of all terms that cannot be given a characterisation in physical terms, in particular the elimination of all mental terms. That eliminativist programme is taken to be typified by Neurath's physicalist programme (Hayek 1942–44: 78). Subjectivism in contrast, is the view that the objects of the social sciences cannot be thus characterised. They are objects 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' (Hayek 1942–44: 53). The doctrines of objectivism and physicalism underpin a belief in the possibility of '*in natura*' calculations in economics – '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' (Hayek 1942–44:170). The phrase '*in natura* calculation' is one that Hayek takes from Neurath. As understood by Hayek, it refers to the possibility of public economic choices that proceed not through market prices but by direct reference to physical attributes of objects. In rejecting objectivism, Hayek aims to show that such *in natura* calculations are not possible. There are no physical units that can be used as a basis for planning economic production.[2] Neurath becomes a primary target of criticism since in his work objectivism, socialism and *in natura* calculation appear together: 'The most persistent advocate of . . . *in natura* calculation is, significantly, Dr. Otto Neurath, the protagonist of modern "physicalism" and "objectivism"' (Hayek 1942–44: 170).

Objectivism and *in natura* calculation are taken by Hayek to be particular expressions of an illusion about the scope of knowledge and reason which underpins the whole project of socialist planning. The illusion is one that is typified by the social engineer. 'The engineer's ideal which he feels the "irrational" economic forces prevent him from achieving, based on his study of the objective properties of the things, is usually some purely technical optimum of universal validity' (Hayek 1942–44: 170) The belief in the possibility of a technical optimum is premised on the assumption that the engineer could gather in one person or committee complete knowledge of society. As such 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. (Hayek 1942–44: 173)

Socialist planning is founded upon a mistaken belief in the omnipotence of reason. The belief 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' (Hayek 1942–44: 162). What are the sources of human ignorance to which this argument appeals? The first is 'the division of knowledge' in society, that is, the dispersal of knowledge and skills throughout different individuals in

[2] This argument is aimed not just against socialist theorists but also against precursors of ecological economics such as Ballod–Atlanticus, Popper–Lynkeus Ostwald, Soddy and Solvay who claimed that energy units might serve as a basis of economic choice. (Hayek 1942–44: 90–91). I discuss this dimension of the argument in more detail in O'Neill (2004).

society (Hayek 1937, 1945). However, while Hayek frames the argument in terms of the division of knowledge in society, the central assumption in his argument is the nature of knowledge so dispersed and its unavailability to a central planner. Practical knowledge embodied in skills and know-how, and knowledge of particulars local to time and place cannot be articulated or vocalised in a general propositional form that could be passed on to a central planning body. Consequently, any particular individual or planning body will be ignorant of knowledge dispersed throughout society that is relevant to its decisions. In contrast to central planning, the market solves this epistemic problem. The price mechanism imparts to actors that information that is required for the coordination of their activities without requiring the centralisation of dispersed knowledge.

> Though every party in [markets] will know only a small sector of all possible sources of supply, or of the uses of a commodity, yet directly or indirectly, the parties are so interconnected that the prices register the net results of all changes in demand or supply. It is as such an instrument for communicating to all those interested in a particular commodity the relevant information . . . that markets and prices must be seen. (Hayek 1942–44: 176–77, cf. 1937, 1945)

A central agent in this process of market coordination is the entrepreneur who is alert to new opportunities in the market place. However, that entrepreneur has to confront another source of ignorance, the unpredictability of the future at the point of decision. One reason for that unpredictability lies in the fact that an individual's needs and wants themselves often cannot be articulated. However, the unpredictability of future wants also has a basis in the unpredictability of the future development of knowledge and invention. Wants change with the invention and production of new objects for consumption. If the progress of human knowledge is in principle unpredictable – if we could predict the content of future knowledge, we would already have it – then it follows that since human invention relies on the progress of knowledge, and wants are created by human invention, future human wants are also in principle unpredictable (Hayek 1942–44: s157–58; 1960: 40–41; cf. Popper 1944–45). Hence at any point in time, in making a decision an entrepreneur is ignorant about the full range of future human wants. However the market also solves this problem, since it acts as a discovery procedure in which different hypotheses about the future are embodied in entrepreneurial acts and tested in the market place (Hayek 1978: 179–90, cf. Kirzner 1985). Given Hayek's account of the price system, to replace prices as basis of decisions in favour of *in natura* calculation in kind is to give up a solution to the problem of human ignorance in favour of a socialist illusion of complete knowledge that fails to acknowledge its existence.

2. NEURATH AGAINST HAYEK

> 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 1945a)

In many ways it is unsurprising that Hayek takes Neurath's views on planning as a central object of criticism. Neurath's writings on socialisation certainly contain a number of passages that appear to bear out Hayek's characterisation of his opponent. Thus Neurath's writings of the 1920s and the early 1930s do contain some claims typical of the planning literature of the time, for example of the possibility of 'an economic order in which central institutions survey the entire economy' (Neurath 1920a: 381) and of viewing national or even world economies as 'one enormous factory' (Neurath 1931a: 487). The now ill-sounding metaphor of the social scientist as a social engineer is one that Neurath employed throughout his work. Moreover, as Neurath himself notes at the outset of his reply to Hayek, there is no dispute about whether he defends either physicalism or *in natura* calculation. What Neurath disputes is whether Hayek properly characterises his use of such concepts and phrases and whether, once clarified, they are open to Hayek's objections. Neurath's position is more complex than his use of these phrases or planning slogans suggests.

Much of Neurath's own clarification in his response to Hayek concerns the concepts of physicalism and *in natura* calculation. Neurath did not use the term 'physicalism' in the sense Hayek defines it. It was not an attempt to reduce 'social' or 'mental' vocabulary to that of physics. Rather he meant by physicalism the doctrine that all statements in the sciences, social sciences and everyday life should be capable of translation into the terms that refer to spatio-temporal particulars, to terms that answer to the questions 'where?', 'when?' and 'how?'. He did not subscribe to a form of physicalist eliminativism which insists on the elimination of all 'mental' vocabulary or the reduction of mental vocabulary to physical terms.[3] He was not committed to the elimination of all 'intentional' vocabulary or mental terms from the social sciences or to the absence of interpretative activity on the part of the social scientist. Neurath's social theory is institutionalist. It is a form of social behaviourism which takes public institutions and social orders as the starting point for analysis (O'Neill 2004: 435–38).

Because Hayek mischaracterises Neurath's physicalism, much of Neurath's account of *in natura* calculation is untouched by many of

[3] 'I never tried to "explain mental processes by physical ones" because I do not have the means in my language to distinguish between "mental" and "physical" – all my terms are when, where how terms therefore what Professor von Hayek and others call "mental" appear manifestly in my language as "speech behaviour" or "arguing" etc. i.e. a good where, when, how item.' (Neurath 1945a) For a discussion of Neurath's physicalism see Uebel (2003).

Hayek's criticisms. The doctrine that Hayek criticises is that which claims that there are some purely physical units, like units of energy, that are independent of human use or belief that could be employed for planning, and it is this doctrine he takes to have a basis in physicalism understood as the view that one could eliminate all 'mental' or intentional terms from the social sciences. Not only does Neurath not defend physicalism in this sense, he similarly rejects 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 (O'Neill 2004: 438–42). This is most clearly evident in his 'International Planning for Freedom' in which Neurath opposes 'what is called the "technocratic' movement" which assumes there exists '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"' (Neurath 1942: 426–27). There is no scientific unit that will do the job here, including physical energy units (Neurath 1942; 427). Similarly, Neurath's socialisation plans both theoretical and practical, while they retained an important role for central coordination, contained a large associational component which took decision-making away from any single centre (O'Neill 2003a). These suspicions of centralised technocratic planning had roots in epistemological arguments against Cartesian rationalism that have significant parallels to those of Hayek.

Neurath's objections to the idea of Cartesian rationalism had already been evident in his earlier debates with Mises, specifically his objections to Mises' claim that monetary units provide a single unit of comparison through which rational choices could be made. That position assumed an algorithmic conception of practical reason, according to which rational decision-making requires the application of mechanical procedures of calculation which will arrive at a determinate optimal answer to a question. For Neurath that view of reason is a form of what he calls 'pseudorationalism'.

The concept of 'pseudorationalism', central throughout Neurath's work, first appears in his 1913 paper 'The Lost Wanderers of Descartes and the Auxiliary Motive'. A rationalist who believes in reason must recognise the boundaries to the power of reason in arriving at decisions: 'Rationalism sees its chief triumph in the clear recognition of the limits of actual insight' (Neurath 1913: 8). It is a mark of the pseudorationalist to believe that there do exist rules of insight which determine answers to all decisions. Pseudorationalism exists in the domains both of action and of thought. In the sphere of theory, it is exhibited in the belief that there exist rules of scientific method which if followed eliminate falsehood and lead to

ever-nearer approximations to the truth. What marks the philosophy of Descartes is a realisation of the limits of rules of reason in action, but a failure to recognise similar limits in the rules for the direction of the mind. Just as in action, so in theoretical matters, reason underdetermines our theories.

Clearly Neurath's remarks about the limits of reason, and indeed his specific attack on Cartesian rationalism, are echoed in Hayek's later remarks in the scientism essay against Cartesian rationalism – that 'it may . . . prove to be far the most difficult and not the least important task for human reason rationally to comprehend its own limitations' (Hayek 1942–44: 162). The parallels between their views are taken up by Neurath in his notes and correspondence with Hayek. The point is made thus in his notes:

> [I] should think that even [though] disagree[ing] with many of von Hayek's remarks and his historical outlook, I should describe him as a research worker, who together with us physicalists, fights the pseudorationalism of our period, which tries to use science as a kind of idol, and scientists and quasi-scientists regarded as a kind of born leaders, who may direct our life according to so-called "tests". Who tests the testers? (Neurath 1945a)

Hence Neurath's complaint that the views Hayek ascribes to Neurath and other logical empiricists views are completely at odds with what they have written, failing to acknowledge their shared rejection of pseudorationalism. He puts it thus in one of his letters:

> Of course there are people – I call them pseudo-rationalists – who try to present ONE and ONLY ONE best solution as a scientific one and I agree with you that this pseudorationalism is dangerous and may sometimes support totalitarianism. But I think that you should at least mention that there is a scientific attitude, represented by Logical Empiricism, which is PLURALIST through and through . . . (Neurath to Hayek 11.1.45, Neurath 1945b)

The rejection of pseudorationalism is taken by Neurath to follow from his logical empiricism. Pseudorationalism as Neurath uses the term in his later works involves two logically distinct claims applied to both theory and action.

1. There are rules of reason, methods which unequivocally determine the correctness or incorrectness of a decision or the truth or falsity of a theory.
2. There is a single correct or optimal decision or true theory to be discovered.

The rejection of both is related to Neurath's empiricism and indeed can be traced back to the early influence of Mach and Duhem on Neurath's

work. His arguments are most fully developed in the realm of theory, the case in the practical realm being to some extent parasitic on those arguments. Against the first claim Neurath invokes a series of claims that he in part had been instrumental in making central to the philosophy of science. Scientific theory is underdetermined by evidence. Empirical evidence itself is uncertain and provisional – observation or protocol statements are open to revision. Theories consist of a body of statements which are logically interconnected and confront the world as a world as a whole not individually. In the metaphor he uses at 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 definitively confirm or falsify theories. Hence his preference for a language of theories being 'shaken' or 'corroborated' rather than being 'verified' or 'refuted' (Neurath 1941: 147). Against the second claim Neurath calls upon an empiricist case against realism. The aim of science is not to converge at a single best description of the underlying nature of the world. Its aim is to organise our empirical statements and predictions. There is no reason to assume convergence: 'there are often several systems of hypotheses for the explanation of the same complex of facts' (Neurath 1916: 29). Different boats can sail in the same sea of empirical evidence: 'we always have to discuss sets of "worlds" or better sets of comprehensive structures of statements' (Neurath 1945a).

In developing this criticism of pseudorationalism Neurath focuses on two main targets. The first, as is evident in the passage above, is Popper. Indeed, Neurath takes Hayek to task for mixing in bad company:

> You see Logical Empiricism (I am avoiding the term Logical Positivism because Comte and his 'family' promoted a very absolutist doctrine, also politically, therefore I think it more educational to cut the strings between them and us) is essentially 'pluralist' whereas Karl Popper is essentially 'absolutist' – remember he thinks that there is *one* world picture 'the best' etc. He thinks we can isolate instances of a negative character and destroy a hypothesis definitively by that etc. Did you read my article on his book . . . . I am wondering how you the fighter for freedom and toleration feel yourself in full agreement with scholars who are absolutists and not in full agreement with scholars, who like me, destroy the totalitarian outlook with the roots. (Neurath to Hayek 26.7.45 in Neurath 1945b)

The article to which Neurath refers is his 1935 paper 'Pseudorationalism of falsification'. Popper's falsificationism exhibits pseudorationalism in the domain of thought: it is driven by the belief that valid scientific argument is fully capturable in a set of deductive rules that unequivocally eliminate candidates for the truth. Against that view Neurath notes the now much repeated observation that the historical development of the sciences required that we hold onto theories despite the mass of falsifying

evidence.[4] Against both 'the absolutism of falsificationism . . . and the absolutism of verificationism' (Neurath 1935a: 131) Neurath defends a principle of methodological pluralism and tolerance (Neurath 1935a: 122–23). He also points out that 'older successful theories are not always approximations to later ones' (Neurath 1935a: 130). Neurath's critique of Popper anticipates much in more recent post-Kuhnian philosophies of science.[5]

A second target of Neurath's attack on pseudorationalism is the Laplacean belief in the existence a system of equations from which all events could be predicted (Neurath 1930: 43). The rejection of any kind of Laplacean picture of science is associated with scepticism about the possibility of determinate and certain predictions in science.

> *'The' system is a great scientific lie*. Not even as an anticipated goal is it a useful guiding thought as it takes us close to Laplace's spirit which, it is thought, with knowledge of all the equations of the sciences, constantly makes correct predictions: an assumption that cannot be verified in any way; metaphysical formulations, useless for the purposes of science . . . *Multiplicity* and *uncertainty* are essential. From the data at our disposal we can, in more than one way, deduce predictions that are in harmony with science; the multiplicity of predicting cannot be excluded by any method; no degree of systematic procedure can alter this. (Neurath 1935b: 116)

Thus a sign of pseudorationalism is its failure to acknowledge the underdetermination of theory by evidence and uncertainty in prediction.

This general scepticism about predictability is taken to have particular relevance when it comes to social decision-making. The unpredictability in science in general entails that the technocratic ideal of the discovery of an optimal solution to social decisions is untenable. There is no algorithm for arriving at an optimal decision of the kind a theorist like Mises or those in the 'technocratic' movement' assume. The development of his argument is summarised in one Neurath's last published papers:

> Even before the first world war I realized that acknowledging a kind of primary 'pluralism' in our scientific approach has also its consequences for our daily life. 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

[4] '[A] great many observation statements that seem to contradict the theory of elementary quantum are not regarded as essential 'shakings' because one just deems the 'confirmations' of the theory of elementary quantum to be very significant. Popper, however, wishes to see forceful decisions forcefully founded. That is a basic tendency of many pseudorationalist endeavours' (Neurath 1935a: 127).

[5] The point is noted by Feyerabend (1995: 91). See also Hempel's comments in Hempel (2000: 300–04).

> to be discussed. Therefore 'decision' plays its part in any kind of scientific research as well as in our daily life. That is the reason why I stressed the 'unpredictability' as an essential element of empiricism thus repudiating all attempts to use unequivocal historical predictions as the basis of social actions. (Neurath 1946b: 80)

It is this scepticism about predictability and its implications for social choices that Neurath underlines in his response to Hayek:

> I myself, who as a physicalist fights against people who think that general prediction is in principle within our range should appreciate Professor von Hayek's attitude, if he did not think he is fighting physicalism, when reducing the arrogance of some half-popular scholars who like to tell of the extraordinary powers of science, comparable only with the faculty of a seer. I have always stressed this point, together with Philipp Frank, Richard von Mises and others. Laplace's spirit was a metaphysical figure and all these historicising, as it were Laplaces are not better. (Neurath 1945a)

Neurath's case against complete predictability in social life does not just appeal to the pluralist scepticism that comes with his particular version of empiricism. It also appeals to special features of the unpredictability of human knowledge that were central to Popper's case against historicism and to Hayek's view of the market as a discovery procedure. It is a feature of human knowledge and invention that we cannot predict the content of that which will be novel. 'He who wants to predict a new invention in social life or in engineering has to anticipate this invention . . . . Therefore we have to admit that as empiricists we cannot predict changes in our social structure as we might predict changes in the astronomical constellation . . . ' (Neurath 1943: 148). In his reply to Hayek, Neurath points out that this rejection of social prediction is central to the final sections of the *Foundations of the Social Sciences* in which the unpredictability of the future of knowledge and its implications is stressed in the closing remark of the book. His much used analogy of the development of knowledge, that scientists are like sailors at sea who cannot put into dock but must modify with materials at hand to shore up the vessel, is here used precisely to deny the possibility of anticipating the future of knowledge:

> 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. (Neurath 1944a: 47, my emphasis)

The claim that we cannot predict the content of future knowledge or inventions is shared with Hayek and Popper. However it is put to different effect. It underlies the apparently odd combination of science and utopia in Neurath's work: to predict the future is like the sailors at sea trying to bring that future into existence. It is an attempt at social invention not an external

Laplacean deduction from given knowledge. Neurath's idea of the social engineer formed part of his rejection of predictability. Social engineering expressed not, as Hayek assumes, the idea of running a whole society like a machine, but rather a form of scientific utopianism. The role of the social scientist is not to predict the future, but rather, like the engineer, to present possibilities.[6]

In concurring with Hayek about the limits of knowledge and predictability in social life, Neurath also accepts the argument that actions can and should be guided by rules of conduct which are not fully justifiable by rational argument: 'I fully accept with Professor von Hayek that therefore the community life will be based on COMMON ACCEPTANCE OF CERTAIN RULES the results of which we cannot PROVE in a strict way' (Neurath 1945a), although in doing so Neurath stresses that this does not rule out the possibility of change of such rules.[7] This is not a conclusion that Hayek would have rejected. While sharing the conservative's assumption about the nature of practical knowledge, Hayek had rejected any conservative conclusions that might be thought to follow (Hayek 1960: postscript). Where Neurath and Hayek differ in rejecting conservatism is the degree to which such change is open to conscious direction in the pursuit of some goal. Neurath's model of the social engineer does inherit a utopian image of the possibilities of conscious social change. Hayek on the other hand defends the rather extreme view that 'progress is movement for movement's sake' on the grounds that the very notion of a condition being better or worse simply does not arise 'since our wishes and aims are also subject to change in the course of the process' (Hayek 1960: 41).[8] Neither position is entirely satisfactory.

[6] 'Similarly, any collection of historically given material would be advantageous, if we were discussing the future of social structures; but, the conception of new ways of life would be of some importance – a kind of creative "social engineering" or "scientific utopianism" . . . We may invent new possibilities, but we shall not be able to invent all of them, because even invention is correlated to certain other social elements, which do not form part of our environment today. Unpredictability plays its part. As we are interested in the discussion of practical questions concerning a future world community, we should stick to this point and avoid dissertations on so called "historical necessity" or "historical forces which determine the fate of mankind" and similar phrases which indicate that some of our interlocutors pretend to a knowledge of a "film" which is as yet in the making. This "unpredictability" and "making decisions concerning our future way of life' are closely connected' (Neurath 1944b: 29).

[7] 'The common action, the community life and all our private life has to be based on rules we have in common the "results" of which cannot be assayed through and through – nevertheless we are altering our behaviour and our rules and later at some "results" we think are sufficiently apperceivable and we are "influenced" by that . . . ' (Neurath 1945a).

[8] I criticise this view in O'Neill (1998a ch. 6). From the conservative side see Oakeshott's comment: 'A plan to resist all planning may be better than its opposite, but it belongs to the same style of politics' (Oakeshott 1991: 26).

Neurath's empiricism entails a general claim about unpredictability in social life. Neurath presses the ubiquity of the problems of unpredictability and the absence of complete knowledge against Hayek. Unpredictability and the absence of complete knowledge are general facts of social existence which in existing societies permeate non-market as well as market spheres. Thus in response to Hayek's claim Neurath notes that the same problems of knowledge arise within the factory:

> 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: we are not in a position of comprehensive prediction there either. (Neurath 1945a)

The problem of knowledge that Hayek raises is one that arises at every level of the economy. Hence, the market cannot in itself be the only solution to the problems of decision making in conditions of uncertainty and unpredictability, since these are general features of social life that exist and are overcome in non-market as well as market spheres.

3. HAYEK AGAINST HAYEK?

> What would Professor Hayek answer if the tables were turned on him? (Neurath 1945c: 121)

Neurath's response to Hayek can be understood as an attempt to map common ground with the purpose of 'over-Hayeking' Hayek, of redeploying Hayek's own assumptions against Hayek's conclusions. How far is Neurath right that they do employ common assumptions? And how powerful is Neurath's response to Hayek's position given those assumptions?

The most striking area in which there is congruence between Hayek and Neurath is in their common rejection of Cartesian rationalism and the technocratic conception of planning that they both take to stem from it. Hayek's account of Neurath as an advocate of such rationalism in his scientism essay is simply in error. Moreover, there are important overlaps in their arguments against the possibility of complete predictability in the social sciences. For example, both appeal to the argument that complete prediction of the future direction of society is impossible, since social change is dependent on developments in the content of knowledge and those developments are in principle unpredictable. However, while there are overlaps, there are also significant differences in the nature of their arguments.

Neurath's arguments against pseudorationalism are premised on a particular view of scientific knowledge: the underdetermination of theory by evidence, the uncertain and provisional nature of the empirical basis

of science, the fact that theories are a mass of statements that confront empirical statements not individually but as a whole, the absence of rules of method that unequivocally confirm or falsify theories, and a rejection of the very idea of convergence on truth in science. Hayek's arguments proceed rather from assumptions about the practical nature of much knowledge and the dispersal of such knowledge throughout society. No single planning agency could integrate such knowledge. The market can.

The two sets of arguments against Cartesian rationalism which Neurath and Hayek offer are not inconsistent with each other. One could hold both. However, the actual debate points to real tensions in the development of their arguments. In this final section I will examine three themes in their discussions that have continuing significance for arguments about the role of knowledge in political economy and political philosophy: the basis of and response to pluralism in the modern world; practical knowledge and the division of knowledge; and the role of propositional knowledge and discursive institutions in economic and social coordination.

Consider Neurath's rejection of pseudorationalism. As I noted above, there are two logically independent claims that Neurath takes to characterise pseudorationalism:

1. There are rules of reason, methods which unequivocally determine the correctness or incorrectness of a decision or the truth or falsity of a theory.
2. There is a single correct or optimal decision or true theory to be discovered.

Should we accept Neurath's arguments against these claims? Consider the case of Hayek's bad companion Popper. Popper is committed to both claims as far as the development of science is concerned. Whether both claims should be rejected is another matter. As I noted above, there are real strengths to Neurath's criticisms of the first claim and specifically his case against Popper's falsificationism. More generally, the real power in Neurath's criticism of pseudorationalism lies in his rejection of an algorithmic view of reason in both theoretical and practical affairs. However, his case against the second claim raises more problems. Here the practical and theoretical components need to be taken apart. There is a case for scepticism about the very notion of optimality in the sphere of decision-making. The claim that there is an optimal solution to be found to social and economic problems may be a rationalistic conceit. However, the arguments against the idea there is a truth, singular, to be discovered, the realist component of Popper's position, and his related accusation of 'absolutism' against Popper are less clearly defensible.

The problems come to the fore in an exchange on Popper and pluralism that Neurath had with Carnap in 1943 and 1944. In it Neurath repeats his accusation against Popper as 'essentially . . . non-pluralist' since he holds that there is in principle a single best description, and contrasts this with the pluralism of empiricism which allows for divergence and revisability in the empirical basis of science and for 'MORE than one theory possible, when we see one acceptable, MORE than one "history of the world" possible within any given empiricist frame' (Neurath to Carnap 25.09.1943 in Neurath 1943–45). Neurath here extends the criticism of a non-pluralist attitude beyond Popper to include also Tarski's semantic conception of truth. The Tarskian conception of truth, which had been endorsed by Carnap, is presented by Neurath as itself involving a commitment to 'Aristotelian metaphysics on the "true" [which] is connected with the anti-pluralist view point' (Neurath to Carnap 25.09.1943 in Neurath 1943–45). Talk of the 'truth' and 'falsity' of theories is best replaced with talk of their 'acceptance' or 'rejection'. Carnap in response denies that the Tarskian schema is either metaphysical or anti-pluralist, and affirms the often made point that one cannot define 'true' as 'accepted' since it fails the redundancy or disquotational test on adequate account of truth '"p" is true iff p'.[9] Neurath in his responses doesn't deny this is the case. His proposal isn't to define 'truth' in terms of 'accepted', but to reject the term 'truth' altogether from careful talk in science.[10] We can make do with the concept of 'acceptability'.[11]

The failure of redundancy for 'accepted' or 'rationally accepted' highlights the way Neurath's eliminativism about truth is in principle more pluralistic than that which takes the aim of science to be truth. Given a body of sometimes properly disputed evidence and background assumptions,

[9] 'That the semantical concept of truth is not metaphysical can very easily be shown by the following translation: "The sentence 'This tree is green' is true" means not more and not less than "This tree is green" . . . .This translation shows that the concept of truth is not metaphysical but scientific. Furthermore the translation makes it clear that the term 'true' is not at all meant in the sense of "absolutely certain", "indubitable" or anything else like that as you sometimes seem to believe. And the translation also shows that "true" has nothing to do with "accepted" . . . ' (Carnap to Neurath 4.2.1944 in Neurath 1943–45). Compare the same point made in more recent discussion by Fine (1996:243) and Alston (1996: ch. 7).

[10] '[I]n the republic of science we had better abstain altogether from using the terms 'true' and 'false' and their substitutes or weakened at all levels of discussion, as long as we discuss empiricist problems of cosmic history and unified science' (Neurath1944a:13). The one concession he makes for the use of the 'true-false phraseology' is in the semantics of formal systems (Neurath 1944a:12–13 and 48 fn. 19).

[11] 'I avoid in cautious discussions, the terms 'true' and 'false' because they have an absolute character; we cannot say, according to our traditional grammar: "The statement S is true for X today, but was false yesterday". I propose to speak of 'accepting' or 'rejecting' a statement, because we can say according to out traditional grammar: "The statement S is acceptable today for X, but was not acceptable yesterday"' (Neurath 1941: 147).

it is quite possible for two or more rival theories about some matter to be rationally acceptable. Scientific communities can reasonably disagree. So long as we are humans with cognitive limitations, it is possible that they might continue to disagree even in some 'ideal' context we are supposed to reach in the long run. However, if theories are inconsistent one with another then it is not possible for them all to be true. Truth is singular, error is many. Commitment to truth in that sense is by definition non-pluralistic. However, as Carnap notes, as long as one does not believe that some statements are not only true but 'absolutely certain' or 'indubitable', the singularity of truth is quite consistent with a fallibilism and pluralism in the practice of science. To hold that one theory is true is not to deny that there are not reasonable grounds for holding competing theories. Reasonable disagreement is still disagreement and it is so because not all claims can be true. The concept of truth, just because it is singular, has a critical role in the development of knowledge. The term 'truth' has a good normative role in scientific and non-scientific argument. Neurath's eliminativism is no more defensible here than it is with a number of other concepts that appeared on Neurath's index of prohibited terms.[12] Moreover, again as Carnap notes, unless one confuses 'true' with 'indubitable, neither is such eliminativism required to defend the political and social pluralism that Neurath aims to defend. The elimination of the concept of truth is neither defensible in itself, nor is it required to defend pluralism. A defence of pluralism is possible from the less radical components of Neurath's case against pseudorationalism.

A central component of Neurath's response to Hayek is the common commitment to pluralism that he takes to share with his 'co-worker', However, they differ on the basis of this pluralism. They differ also on the nature of the economic and social institutions required to sustain pluralism in the modern world. Hayek's response to the plurality of both beliefs and values in the modern world is non-discursive. The virtue of the market economy is that it allows individuals with different substantive doctrines, ends and beliefs about the good, to cooperate with each other without the need for dialogue or conversation about those ends. It enables

[12] The point is made forcibly by Carnap in his response: 'I am inclined . . . to think that if a procedure or concept is accepted by a majority of good scientists, then it may still be that it needs modification; but it is highly improbable that it is entirely wrong. Therefore I am astonished to see how many procedures or concepts used by the overwhelming majority of good scientists are rejected by you without your offering arguments as weighty as this situation would demand. I regard the following items as examples for this: the concept of existence (Russell), asymmetry of negative and positive cases, the simple semantical concepts e.g. 'true', 'designation', 'analytical', 'consequence', 'contradiction' . . . .' (Carnap to Neurath 4.2.1944, in Neurath 1943–45)

'each individual to gain from the skill and knowledge of others whom he need not even know and whose aims could be wholly different from his own' (Hayek 1976: 109). The problem with the planned economy is that it requires agreement on the relative ordering of different ends. It involves the substitution of a household economy for the catallactic order of the market which allows for coordination without such agreement. Neurath in contrast takes the market economy itself to be incompatible with a plurality of different forms of economic and social relations. Already in his early work, against what he calls 'the intolerance of the market economy', he defends a form of planning in which 'it is possible for forms of economy of various kinds to co-exist without being forced into competition' (Neurath 1920a: 397). In his later works, the view is developed further in terms of an account of 'planning for freedom', which involve a variety of coordinated overlapping associations. I return to these below. Against Hayek, this response retains a strong discursive component. The existence of a plurality of different comprehensive doctrines of the good life requires the existence of a neutral 'social *lingua franca*' which will allow 'possibility of discussing actions in a common language' (Neurath 1944b: 30). A central contrast between the approaches of Neurath and Hayek here turns on the role of language and practical knowledge in economic activity and social organisation more generally.

While both Hayek and Neurath criticise Cartesian rationalism, they proceed from different assumptions. Neurath's arguments against pseudorationalism appeal to his particular form of sceptical empiricism. Hayek's case against Cartesian rationalism in contrast appeals to the division of knowledge, specifically the dispersal of particular practical knowledge throughout a population. How far does Neurath provide an adequate response to those arguments against the possibility of planning? Consider first Hayek's assumptions concerning the practical nature of knowledge. Neurath grants Hayek's point that 'community life' will be based on rules that cannot be vindicated through rational reflection. This is consistent with his earlier claim that 'instinct, tradition and auxiliary motive are in common opposition to pseudorationalism' (Neurath 1913: 10). Correspondingly Neurath's early socialisation plans held onto a role for the habitual and customary that was atypical of social democracy of the period.[13] However, the parallels with the auxiliary motive in his earlier work might suggest significant differences with Hayek. Traditions and unreflective rules appear in Neurath's 1913 paper 'The Lost Wanderers of Descartes and the Auxiliary Motive' primarily as non-rational aids to decision that come into play when argument fails. Appeals to tradition

[13] See in particular his discussion of Gemeinschaft in Neurath (1920b).

are preferable to the unfounded belief in the scope of rational insight that is characteristic of the pseudorationalist. But the modern rationalist who knows the limits of reason will prefer choice by lot to tradition and habitual behaviour (Neurath 1913: 10–11). The argument does not turn on the claim that tradition and habit embody practical knowledge. However, the notion of practical knowledge does form a part of the Machian legacy of Neurath's work, and Neurath in other writings does allow that habitual behaviour can embody forms of such knowledge. Consider, for example, the distinction he draws between 'habits with technical grounding' and 'habits which have no technical basis, which spring only from tradition' (Neurath 1931b: 374). In conceding Hayek's point about practical knowledge, Neurath is calling upon claims that are independently developed in his own work. What might be granted is that his account of practical knowledge is not as fully developed as it might be.

A similar point can be made about practical judgement. When Neurath appeals to the need to make 'decisions' where argument and reason give out, others who similarly criticise rationalism would employ the Aristotelian notion of practical judgement. The concepts are clearly distinct. Judgement is a skill or capacity. A person can have better or worse judgement. Her judgement can be improved with its exercise. A decision is not a skill but an act, which can be an outcome of judgement, habit or simply the result of lot. Now there are clearly contexts in which, in talking of appealing to decisions where reason gives out, Neurath is assuming that judgement is employed. However, Neurath doesn't always distinguish explicitly between these cases and those in which a decision is the outcome of lot. The result again is that his account of practical knowledge in economic life is not as rich as it might be.

What of Hayek's appeal to the concept of the division of knowledge? In Neurath's responses to Hayek's criticisms in the scientism essay, there is very little on the division of knowledge. However, the problem that Hayek addresses was one that was central to Neurath's work. While Neurath does not address that argument directly, his project of a unified science was aimed in part at showing that the divisions of knowledge could be overcome for the purposes of rational socialist planning.

The project for the unification of science has been itself a much misinterpreted project of the Vienna Circle. There are at least four forms the project can take:

(i) a reductionist project in which all the sciences would be logically derivable via bridge-laws from physics;
(ii) a programme for a unified method which would be followed by all sciences;
(iii) a project for a unified language of science;

(iv) and a project for the orchestration of the sciences which would integrate the different sciences for the purposes of action on some specific problem.

Neurath rejects the first reductionist project completely: 'would it not be preferable to treat all statements and all sciences as coordinated and to abandon for good the traditional hierarchy: physical sciences, biological sciences, social sciences and similar types of "scientific pyramidism"?' (1944a: 8). Opposition to pyramidism runs through Neurath's later work on unified science. Neurath also rejected the second doctrine, the possibility of a unified method for the sciences. On method Neurath was a pluralist. In defending the programme for a unified science, Neurath was concerned only to defend the third and fourth projects, that of unifying the language of science and that of the coordination of the sciences. Like Carnap, he held that the fourth project required the third, that coordination requires a common language. The language of physicalism, the everyday language that refers to objects and events with a spatio-temporal location, was to provide that coordinating language. His solution to the problem of coordination given the division of knowledge is again discursive.

The claim that unity in the practice of science requires unity in language has been subject to influential criticism by Suppes (1984: ch. 6) who points out that the development of modern science has been marked by a growing linguistic specialisation. Scientists increasingly use language and terms that no one outside their immediate disciplinary neighbours is able to understand. The division of knowledge in the scientific endeavour has gone hand in hand with an increasing division of linguistic labour. The coordination of the sciences does not appear to require a physicalist language. Nor would such a unification be desirable (Suppes 1984: 122). Whether Neurath's programme for a unified language of science is open to Suppes' objections is questionable. Neurath's programme for unification is more minimal than Suppes supposes (O'Neill 2003b). For Neurath unification takes place at the point of action and decision (Cartwright *et al*. 1996). Different scientific disciplines may have their own particular vocabularies, but at the point of action they need to speak a common language. Neurath makes the same claim more generally about the coordination of social and economic activities. While in modern conditions of pluralism, different groups and creeds may speak different languages, at the point of action they must have a common language in order to coordinate their activities. However, while Suppes' particular criticisms of Neurath's programme for the unification of the language of science may miss their target, his arguments still have some force. Suppes does raise some proper questions about the degree to which the Neurathian

programme for the orchestration of the sciences and social action more generally focus on language as the means of coordination.

Again Neurath's views here contrast sharply with Hayek's. For Hayek the virtue of the market is that it allows for coordination of activities without the need for conversations. The price mechanism resolves the problem of coordination of action given the dispersal of knowledge that cannot be articulated in propositional form and hence could not be a matter for conversation in a common language. Hayek clearly is not denying a role for language in social life, but he is demarcating the limits of what can be expected from coordination that requires all knowledge to be articulated in propositional form. Neurath's particular version of the unification of science through unification in language fails as a response to these Hayekean arguments. Neurath's focus on the need for a unified language is overplayed in both the case of science and more generally for social coordination. The cooperation of the specialised sciences is not primarily a linguistic achievement, but a social one, the result of institutional conditions in which the increasing division of knowledge and language across the sciences can proceed without undermining a common project. And in part, at least, that is a matter of the social conditions for the trustworthiness of testimony across disciplines within the sciences, and where science informs public policy, trustworthiness between the sciences and citizens (O'Neill 1998b). Neurath clearly recognised this social dimension to the problem and indeed of the role of testimony in science (Uebel forthcoming). Within his account of unified science, however, these issues to be lost in his misplaced focus on the languages of the sciences.

Nevertheless, once the role of linguistic unification is granted that more modest role, Neurath's account of the orchestration of the sciences retains a large critical significance for Hayek's arguments. The project of orchestration as a social project did have relevance for Neurath's account of planning. The relevance is visible in Neurath's final public exchange on the unity of the sciences and pluralism, an exchange with Kallen who had coined the term 'orchestration of the sciences'. In response to Kallen's claim that there was something coercive and monistic about the 'orchestration' project (Kallen 1946), Neurath responds that the project was concerned with ascertaining 'how much unity of action can result, without any kind of authoritative integration' (1946c: 230). Science is integrated without any pyramidic organisation. The model of orchestration of the kind one finds in the sciences is one Neurath takes over into planning, in particular in his later writings which shift to some degree from accounts of central planning found in his earlier writings:

> We may, for example, imagine a future order based not on 'state pyramidism', if this term may be accepted, but on 'overlapping institutions', which do not coincide with any 'hierarchic' world pattern. The area of national education

> need not coincide with the area of railroad administration and this area may overlap a wide area of international fuel-administration. The various world-wide plans may be correlated in various ways and some international committees may provide as much centralized direction as seems desirable. (Neurath 1943: 149)

The model of overlapping institutions forms part of Neurath's associational model of socialism, which he had defended throughout his writings but which came increasingly to the fore in his later works. It appears later in his 1942 essay 'International Planning for Freedom' as a picture of a socialist society as a 'societas societum' – a view in which economic life is not governed by market principles, but in which civil society, in the sense of thriving public associations, exists. He rejects the centralisation of powers and functions in the state in favour of dispersed overlapping planning authorities.

Whether or not Neurath's specific proposals for planning are defensible (I leave that question aside here), his account of the social coordination of the sciences does raise problems with Hayek's positive arguments for markets. The fact that the coordination of the sciences is a social achievement points to a weakness in Hayek's claims about the market in realising coordination. When Hayek wants to illustrate the role of practical knowledge he sometimes turns to claims about the role of 'tacit knowledge' in the development of science (Hayek 1978). He is right to do so. The coordination of scientific knowledge, both tacit and articulated, is one of the institutional achievements of the modern world. However, as support for the necessity of markets and prices to co-ordinate tacit knowledge, the example fails. The public scientific community is one of great examples of a predominantly non-market social order within the modern world. Hence the concerns about the possible effects on the development of the sciences of the introduction of market-based intellectual property rights regimes (O'Neill 1998a: chs. 11–12). More generally, as Neurath notes in his comments on over-Hayeking Hayek, the coordination of knowledge, tacit and articulated, is a ubiquitous problem that exists at all points in the social and economic order. As knowledge has come to the centre of economic life in the modern world, the management of the distribution of unarticulated knowledge throughout organisations of various kinds without its loss has become an increasingly important task. There exist at a variety of levels mechanisms of coordination throughout the economy in different institutional forms, our knowledge of which is itself often practical and unarticulated. The problem of how coordination of activity is to be best realised given the dispersal of knowledge is central to all economic organisation. There is no simple route from the division of knowledge, practical and theoretical, to the defensibility of the market as a necessary means for its coordination.

REFERENCES

Alston, W. 1996. *Realist Conception of Truth*. Cornell University Press
Blackburn, R. 1991. Fin de Siècle: socialism after the crash. *New Left Review* 185:5–67
Buchanan, A. 1985. *Ethics, efficiency and the market*. Clarendon
Cartwright, N., J. Cat, L. Fleck, and T. Uebel 1996. *Otto Neurath: philosophy between science and politics*. Cambridge University Press
Cohen R. S. and M. Neurath (eds.) 1983. *Otto Neurath: philosophical papers*. Reidel
Cohen, R. S. and T. Uebel (eds.) 2004. *Otto Neurath: economic writings 1904–1945*. Kluwer
Dahms, H. J. 1994. *Positivismusstreit: die Auseinandersetzungen der Frankfurter Schule mit dem logischen Positivismus, dem amerikanischen Pragmatismus und dem kritischen Rationalismus*. Suhrkamp
Feyerabend, P. 1995. *Killing Time: the autobiography of Paul Feyerabend*. University of Chicago Press
Fine, A. 1996. Science made up: constructivist sociology of scientific knowledge. In P. Galison and D. Stump (eds.) *The disunity of science: boundaries, contexts and power*. Stanford University Press
Hayek, F. (ed.) 1935a. *Collectivist economic planning*. Routledge and Kegan Paul
Hayek, F. 1935b. The nature and history of the problem. In Hayek 1935a
Hayek, F. A. 1937. Economics and knowledge. In *Individualism and economic order*. Routledge and Kegan Paul
Hayek, F. 1941. The counter-revolution of science. *Economica* 8:9–36, 119–50, 281–320, reprinted with revisions in Hayek 1979
Hayek, F. 1942–44. Scientism and the study of society. *Economica* 9(1942):267–91; 10(1943):34–63; 11(1944):27–29, reprinted with revisions in Hayek 1979
Hayek, F. A. 1944. *The road to serfdom*. Routledge and Sons
Hayek, F. A. 1945. The uses of knowledge in society. In *Individualism and economic order*. Routledge and Kegan Paul
Hayek, F. A. 1949. The socialist calculation debate: the competitive 'solution'. In *Individualism and economic order.* Routledge and Kegan Paul
Hayek, F. A. 1960. *The constitution of liberty*. Routledge and Kegan Paul
Hayek, F. A. 1978. Competition as a discovery procedure. In *New studies in philosophy, politics, economics and the history of ideas*. University of Chicago Press: 179–90
Hayek, F. A. 1979. *The counter-revolution of science*. Liberty Press
Hayek, F. A. 1984. Two pages of fiction: the impossibility of socialist calculation. In C. Nishiyama and K. Leube (eds.) *The essence of Hayek*. Hoover Institution Press
Hayek, F. 1994. *Hayek on Hayek*. Routledge
Hempel, C. 2000. *Selected philosophical essays*. Cambridge University Press
Kallen H. 1946. The meanings of "unity" among the sciences once more. *Philosophy and Phenomenological Research* 6:493–96
Kirzner, I. 1985. *Discovery and the capitalist process*. University of Chicago Press
Lange, O. 1936–37. On the economic theory of socialism. In Lange and Taylor 1956
Lange, O. and F. Taylor 1956. *On the economics of socialism*, ed. B. Lippincott. McGraw Hill
Lavoie, D. 1985. *Rivalry and central planning: the socialist calculation debate reconsidered*. Cambridge University Press
Mises, L. von. 1920. Die Wirtschaftrechung im sozialistischen Gemeinwesen. *Archiv für Sozialwissenschaften* 47, translated as 'Economic calculation in the socialist commonwealth'. In Hayek 1935
Mises L. von. 1922. *Die Gemeinwirtschaft: Untersuchungen über den Sozialismus*. Gustav Fischer, 2nd edn translated as Mises 1981
Mises L. von. 1981. *Socialism: an economic and sociological analysis*. Liberty Press
Neurath, O. 1912. The problem of the pleasure maximum. In Cohen and Neurath (eds.) 1983

Neurath, O. 1913. The lost wanderers of Descartes and the auxiliary motive. In Cohen and Neurath 1983
Neurath 1916. On the classification of systems of hypotheses. In Cohen and Neurath 1983
Neurath, O. 1919. Through war economy to economy in kind. In Neurath 1973
Neurath, O. 1920a. Total socialisation. In Cohen and Uebel 2004
Neurath, O. 1920b. A system of socialisation. In Cohen and Uebel 2004
Neurath, O. 1928. Personal life and class struggle. In Neurath 1973
Neurath, O. 1930. Ways of the scientific world-conception. In Cohen and Neurath 1983
Neurath, O. 1931a. The current growth in global productive capacity. In Cohen and Uebel 2004
Neurath, O. 1931b. Empirical sociology. In Neurath 1973
Neurath, O. 1932. Protocol statements. In Cohen and Neurath 1983
Neurath, O. 1935a. Pseudorationalism of falsification. In Cohen and Neurath 1983
Neurath, O. 1935b. The unity of science as a task. In Cohen and Neurath 1983
Neurath, O. 1940. Argumentation and action. *The Otto Neurath Nachlass in Haarlem* 198 K.41
Neurath, O. 1941. The danger of careless terminology. *The New Era* 22: 145–50
Neurath, O. 1942. International planning for freedom. In Neurath 1973
Neurath, O. 1943. Planning or managerial revolution. (Review of J. Burnham, *The Managerial Revolution*). *The New Commonwealth* 148–54
Neurath, O. 1943–5. Neurath–Carnap correspondence, 1943–1945. *The Otto Neurath Nachlass in Haarlem*, 223
Neurath, O. 1944a. *Foundations of the social sciences*. University of Chicago Press
Neurath, O. 1944b. Ways of life in a world community. *The London Quarterly of World Affairs* 29–32
Neurath, O. 1945a. Physicalism, planning and the social sciences: bricks prepared for a discussion v. Hayek. 26th July 1945. *The Otto Neurath Nachlass in Haarlem* 202 K.56
Neurath, O. 1945b. Neurath–Hayek correspondence, 1945. *The Otto Neurath Nachlass in Haarlem* 243
Neurath, O. 1945c. Alternatives to market competition. (Review of F. Hayek, *The Road to Serfdom*). *The London Quarterly of World Affairs* 121–2
Neurath, O. 1946a. The orchestration of the sciences by the encyclopedism of logical empiricism. In Cohen and. Neurath 1983
Neurath, O. 1946b. After six years. *Synthese* 5:77–82
Neurath O. 1946c. The orchestration of the sciences by the encyclopedism of logical empiricism. In Cohen and. Neurath 1983
Neurath, O. 1973. *Empiricism and sociology*. Reidel
Oakeshott, M. 1991. *Rationalism in politics and other essays*. Liberty Press
O'Neill, J. 1996. Who won the socialist calculation debate? *History of Political Thought* 27:431–42
O'Neill, J. 1998a. *The market: ethics, knowledge and politics*. Routledge
O'Neill, J. 1998b. Rhetoric, science and philosophy. *Philosophy of Social Sciences* 28:205–25
O'Neill, J. 1999. Ecology, socialism and Austrian economics. In E. Nemeth and R. Heinrich (eds.) *Otto Neurath: Rationalität, Planung, Vielfalt*. Weiner Reihe
O'Neill, J. 2003a. Neurath, associationalism and 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
Popper, K. 1944–45. The poverty of historicism. *Economica* 11(1944):86–103 and 119–37; 12(1945):69–89, reprinted with revisions in Popper 1986
Popper, K. 1986. *The poverty of historicism*. Routledge

Schapiro, D. 1989. Reviving the socialist calculation debate: a defense of Hayek against Lange. *Social Philosophy and Policy* 6:112–38

Steele, D. 1992. *From Marx to Mises: post-capitalist society and the challenge of economic calculation*. Open Court

Suppes, P. 1984. *Probabilistic metaphysics*. Blackwell

Taylor, F. 1928. The guidance of production in a socialist state. In Lange and Taylor 1956

Uebel, T. 2000. Some scientism, some historicism, some critics. In M. Stone and J. Wolff (eds.), *The proper ambition of science.* Routledge

Uebel, T. 2003. Twentieth century philosophy of social science in the analytical tradition. In S. P. Turner and P. A. Roth (eds.) *The Blackwell guide to the philosophy of social science*. Blackwell

Uebel, T. forthcoming. Epistemic agency naturalized: the protocol of testimony acceptance. *Proceedings of the Aristotelian Society*

Weber, M. 1978. *Economy and society*. University of California Press