

Three Pioneers of Ecological Economics – On (Post) Keynesian Influences and the Intellectual Roots of Boulding, Georgescu-Roegen and Schumacher

The history of ecological economics as an established and recognized research field is still a young one. Therefore, a lot of intellectual history of the field has yet to be written. Just as Juan Martinez-Alier wrote in 1987, the year of the establishment of the International Society for Ecological Economics (ISEE): “As in all newly founded branches of science, so it will happen in ecological economics: historiographic reviews of its own disciplinary tradition will now begin to appear...” (Martinez-Alier and Schlüpmann, 1987, p. ix). Although research on the history of ecological economic thought is still scarce, he was correct. Martinez-Alier himself started the investigations with his 1987 book *Ecological Economics, Energy, Environment and Society* where he shows that the intellectual history of ecological economics, focussing on the analysis of energy flows, dates as far back as the formulation of thermodynamic theory in the late 19th century. Spash (1999) followed with research on the development of environmental thought in economics with a special focus on the late 20th century. A main aim of the contribution was to emphasise the distinction between orthodox environmental economics and ecological economics. While there may be a shared concern about environmental issues, methodological and theoretical approaches differ significantly. Røpke (2004) followed with an investigation into the “early history of modern ecological economics”. Here she concentrated on the (re)emerging awareness for socio-ecological issues in the 1960s and 70s and the long gestation period before the eventual institutionalisation in 1987. Part of that “modern” history is an earlier contribution, which predates the institutionalisation, from one of the main protagonists and later founding fathers of the ISEE, Herman Daly. In 1973, he published the famous anthology *Toward a Steady-State Economy* identifying seminal texts for the slowly emerging field. In 2005, he repeated his understanding of who exactly the pioneers of ecological economics are: “The modern-day approach stems from work in the 1960s and 1970s by Kenneth Boulding, Ernst Schumacher and Nicholas Georgescu-Roegen”. Interestingly, all contributions to the intellectual history of the field refer to these pioneers of the 60s and 70s as path pavers, but do *not* explore their intellectual roots. This paper gives insights into their early careers and intellectual influences.

Another important issue increasingly discussed in recent years is that of the compatibility of Post Keynesian thought and ecological economics. While many ecological economists used to

be sceptical of (Post) Keynesianism¹ due to its focus on effective demand and therefore positive stance on economic growth, recent contributions focused on potentially fruitful theoretical and methodological overlaps (Gowdy, 1991; Holt et al., 2009; Kronenberg, 2010; Spash and Ryan, 2012; Fontana and Sawyer, 2016). It is believed that Post Keynesians due to their negligence of environmental issues² could benefit from ecological insights, while ecological economics would find use in Post Keynesian macroeconomics. Contributing authors see potential synergy due to an array of shared methodological and theoretical objections to orthodox economics.

This paper argues that some of these theoretical and methodological overlaps are not mere coincidences, but go back to shared academic experiences, mutual influence and, for some, even personal relationships between early ecological economists and Post Keynesians. Despite all the similarities, the paper also shows how the early contributions to ecological economics are just as diverse as its modern literature.

The contribution of this paper is thus twofold. Firstly, it contributes to the growing literature on the history of ecological economics by exploring the academic life of some of its prominent pioneers. Secondly, it contributes to the discussion of potential synergy between the two schools by especially focussing on (Post) Keynesian influences on those early pioneers of ecological economics. While it becomes obvious that all three authors are very different in personality and approach, all had some interaction with (Post) Keynesian thought that may have shaped their own economics. Georgescu-Roegen for example sees himself as a Schumpeterian, but strongly acknowledges the (Post) Keynesian critique of formalism and production theory; while Boulding could not be more vocal about his Keynesian roots and Schumacher was friends with and continuously worked with important early Post-Keynesians.

¹ For example Daly (2007, p. 26) or Spash and Ryan (2012, p. 8)

² This allegation may not be entirely fair, as we find environmental concern even in early Post-Keynesian writing (see for example the excellent conference paper of Schincariol (2020) on environmental and ecological elements in Joan Robinson's writings). However, it is true that ecological concerns and especially biophysical limits to growth were never a key aspect of Post-Keynesian thought (Kronenberg, 2010, p. 1488).

The paper consists of three parts, each discussing one pioneer. Throughout the discussions, I focus on issues of realism and formalism, mathematisation and uncertainty, as these are the issues shared by all three authors with (Post) Keynesians³.

Ernst Friedrich Schumacher, Keynes and the Cambridge Circus

Schumacher was born in Bonn, Germany in 1911 as the Son of Hermann Schumacher, a famous Professor of Political Economy. When Schumacher first went to University in Germany, undecided on what to study, he signed up for a lecture by Schumpeter, whom he found to be a “terrific fellow” with “lively knowledge” (Wood, 1984, p.14-15). Through some contacts⁴, Schumacher obtained the opportunity to meet Keynes in 1929 when he visited England for the first time. Although his knowledge of economics was still limited at that point, he impressed Keynes enough to be invited to his secret seminars, which in turn impressed Schumacher’s father (Wood, 1984 p.20). From that day on, he was deeply interested in Keynesian economics. He read and admired Keynes to a point where he was confused that the students at his first lecturing job at the School of Banking at Columbia University did not grasp the ideas of Keynes, which were so clear to him (Wood, 1984, p. 50). In a letter to Lord Astor in 1941, he said that he “considers Keynes to be easily the greatest living economist” and in 1940 in a letter to Keynes himself he wrote: “I should like to tell you that there are very few books which have given me as much joy as yours and if this were not...immodest, I should like to say that a certain familiarity with your thought is among the greatest gains I can show for the last ten years” (Wood, 1984, pp. 127-128).

Indeed his appreciation and familiarity with Keynes’s thought shows in the similarity of Schumacher’s and Keynes’s plan for the organisation of post-war trade. Schumacher was convinced that “the principle of `Balance` is the only one which is compatible with international economic peace, and...any nation which achieves a surplus...is endangering the economic security of some other nation or nations...” (Wood 1984, p. 125). In the interest of contributing to world peace, he went on to devise his plan for multilateral clearing, which was an attempt to provide a system for international trade, which would alleviate the pressure

³ Other topics like the longing for a “good life” that is apparent in Keynes and Schumacher have been discussed in Chick (2013).

⁴ Leonard (2018) speculates that it might have been Schumacher’s father, who wrote a letter of recommendation for his son, as Professor Schumacher at that point already published an article in Keynes’s *Economic Journal*.

from regionalism and bilateral trade tensions through cooperation. He developed those ideas at the beginning of the war and, again through contacts, was able to commence a discussion about it with Keynes. Keynes, who was immensely involved in government work during the war, worked on a similar proposal and showed great interest in Schumacher's ideas. However, from the outset they were not exactly on the same page, as Schumacher thought Keynes to be thinking to bilaterally, while Keynes believed his technical aspects to be more developed and his plan going "rather further" than Schumacher's (Wood 1984, pp. 129-130). After Keynes caused irritation by not disclosing his own ideas and asking Schumacher to postpone his publication, Schumacher eventually published his multilateral clearing article in *Economica* in 1943 while the "Keynes Plan" was brought forward in 1943 as a government white paper. In typical Post-Keynesian fashion Schumacher and his colleagues Michal Kalecki and Thomas Balogh at the Oxford institute argued *against* the plan on the ground of Keynesian concepts, suggesting further going ideas themselves⁵. They criticised the plan from a radical perspective of full employment. They were not so much, as Keynes, interested in establishing an international currency (the bancor) but in ensuring full employment for all countries in the long run (Faudot, 2021). This approach of using Keynesian economics to arrive at full-employment policies was not only typical for the work of the *Oxford University Institute of Statistics* but also for Schumacher himself. In his article in the Institute's investigation into *Economics of Full Employment* (Schumacher, 1944) he applies Keynesian principles to Public Finance and contrasts them with the classical approach. The importance Schumacher at that time attaches to Keynesian thought is evident in the multiple usage of the word revolution(ary) in the opening passages of the article: "His book, *The General Theory of Employment, Interest and Money*, produced – or rather brought to a head – a revolution of economic thought. It is the purpose of this paper to apply the results of this 'revolution' to another field- the field of Public Finance." Moreover, on the same page: "...if the results [of Keynesian Public Finance] occasional appears paradoxical or provocative, this is due to the fact that the Keynesian analysis itself had produced results which-measured against the classical doctrine-represent a revolutionary departure." (Schumacher, 1944, p. 85).

⁵ This is a characteristic of all the early Post-Keynesians and famously encapsulated in the story of the Cambridge Circus desperately trying to make Keynes realise the revolutionary aspects of his newly developing ideas that eventually lead to the General Theory. For some Post-Keynesians Keynes did not go far enough and never completely freed himself from his Pre-Keynesian shackles (Robinson 1973, p. 3).

At the same time, Schumacher was involved in another study on full employment. Sir William Beveridge, who already published a famous report on the Social Services, set himself the task of contributing a similarly impactful work on full employment policy. Schumacher got involved through his lifelong friend David Astor who suggested Schumacher to Beveridge's secretary Frank Pakenham over lunch (Wood 1984, p. 161). Without further consultation, Pakenham employed Schumacher who swiftly put together a lengthy draft. Two other members of the "technical committee" that Beveridge privately employed were Joan Robinson and Nicholas Kaldor. Beveridge's biographer José Harris asserts that all the members of the committee were politically "left" to Beveridge. However, with respect to economics they convinced Beveridge that a Keynesian approach of state regulation of demand to achieve full employment was preferable to one of state-ownership (Harris, 1977, p. 435). Through the work with the committee, and especially the advocating of Schumacher and the Post-Keynesians Robinson and Kaldor, Beveridge for the first time considered Keynesianism a real alternative to collectivism.

Harris provides an interesting insight into the discussions of the committee with respect to inflation fears stemming from full employment. A glimpse into early Post-Keynesian argumentation: Beveridge suggested "that the best antidote to inflation was price control, combined with compulsory arbitration in trade disputes". Kaldor and Schumacher believed that "removal of the disciplinary effects of unemployment could be compensated for by a greater degree of workers' control". Joan Robinson wrote in a letter to Beveridge that "everything depends on the moral atmosphere". Workers wage demands would either be opportunistic in an *every man for himself capitalistic world* or workers would be cooperative if they feel "genuine progress towards social justice is being made" (Harris, 1977, p. 437).

The overarching theme of promoting full employment not only for the stabilisation of effective demand but also for reasons of social justice is prominent in all of Schumacher's work. The 3 months stay as economic advisor to the Burmese government in 1955 and several trips to India in the 60s lead Schumacher to come up with more unorthodox theoretical constructs. Especially in India, he witnessed the misery that mass unemployment caused. At the *Cambridge Conference on the Role of Industrialisation in Development* in 1964, he had the opportunity to present his concept of "intermediate technology" to other economists for the first time. He starts off by describing the "process of mutual poisoning". The competition

arising from the establishment of modern industry in some Indian cities leads to massive unemployment in rural areas, which in turn leads to mass migration towards the metropolitan areas, “causing them to grow to a totally unmanageable size” (Schumacher, 1965, p.91). The purely quantitative concept of “Economic growth”, Schumacher argues, hides this type of miserable development. Experience shows that there are types of economic growth which spell increasing misery for ever more people and destroy all social cohesion” (ibid. p. 91). He further attacks “the experts that rarely refer to the twin evils of mass unemployment”, who, just as Keynes’s academic opponents believe that unemployment is transitional and cannot persist in the long run. A reoccurring theme, which is also prominent in the Post-Keynesian writing of the time⁶, is the reference to the *real world* for the refutation of orthodox theories. Schumacher writes: “In case after case unemployment is greater at the end of a Five-Year-Plan than it had been at the beginning. India is a case in point and so is Turkey” (ibid. p. 92). To aid those labour abundant countries he suggests the use of intermediate technology. Western technology is, in Schumacher’s eyes, not appropriate, as it underutilises the abundant factor. This technology would be more productive than traditional and slowly disappearing modes of production and, even if less efficient, would be cheaper than advanced technology. Combined with a form of economic organisation in “districts”, that aim to decentralise the creation of workplaces and use local resources could provide a bridge or possibly an alternative to modern industrial organisation. This proposal, while enthusiastically received by many at the conference, let “sparks fly of” between the old wartime friends Kaldor and Schumacher (Robinson R., 1965, p. 3). John E. King (2009, pp. 117-118) describes Kaldor’s reasoning for his rejection of the intermediate technology “myth”. He advocated for the efficient use of the little capital available. He criticised the scepticism of urbanisation and the attempt at industrialising the countryside by referring to the catastrophic results of the Chinese “Great Leap” and the fact that modern technology is dependent on the availability of skilled labour. However, Kaldor also did not believe that the latest technology is always the best. These theoretical quarrels between likeminded heterodox academics curiously parallels the fickle modern relationship of these two schools.

Schumacher’s focus on the achievement of full employment, which through his life was further deepened by religious considerations and the concepts of Buddhist economics, is

⁶ Only consider Kaldor’s famous „stylised view of the facts” (Kaldor, 1957).

especially prominent in his bestselling book *Small is Beautiful: A Study of Economics As If People Mattered* (part of Daly's famous anthology which made it a classic for ecological economists). Here he talks admiringly of what he calls "Buddhist economics": "The very start of Buddhist economic planning would be a planning for full employment" (Schumacher 1973, p. 51). In his mind from the ethical point of view there can be no argument made for any type of unemployment, even if one thought it contributes to total output and can be compensated for, as work itself is part of a good life. It can give a man a chance to utilise and develop his faculties and to overcome his egocentredness. Earlier in the book, he bitterly attacks Keynes for his essay "Economic Possibilities for our Grandchildren" (Keynes, 1930) in which he describes the future to be rich and plentiful due to the eventual abundance of capital, which would come about through accumulation within a capitalistic system that puts economic over ethical values. Schumacher asserts the "Keynesian message is clear enough: Beware! Ethical considerations are not merely irrelevant, they are an actual hindrance, 'for foul is useful and fair is not' " (Schumacher, 1973, p. 20). Trying to paint Keynes as an advocate for an unethical economic science seems, especially considering their personal acquaintance, oddly mislead. Contradictingly, a few pages later Schumacher quotes the end of the same essay that lead to the heavy critique, which shows that Keynes "admonished us not to 'overestimate the importance of the economic problem, or sacrifice to its supposed necessities other matters of greater and more permanent significance'". "Such voices", he says, "however, are but seldom heard today" (Schumacher, 1973, p. 37).

Other passages in the book suggest that Schumacher's problem lay with orthodox economics of the time and less with Keynes. I believe he could have made good use of Joan Robinson's neologism "Bastard Keynesians".

For many aspects of his work, like his exploration into uncertainty, seem clearly influenced by Keynes, who in 1937 wrote.

The sense in which I am using this term [uncertain] is that in which the prospect of a European war is uncertain [...]. About these matters there is no scientific basis on which to form any calculable probability whatever. We simply do not know. Nevertheless, the necessity for action and for decision compels us as practical men to do our best to overlook this awkward fact[...] (Keynes, 1937,p.214)

Schumacher, correspondingly writes with respect to his „exploratory calculations“:

Exploratory calculations, of course, do not prove anything. A *proof* about the future is in any case impossible, and it has been sagely remarked that all predictions are unreliable, particularly those about the future. What is required is judgement, and exploratory calculations can at least help to inform our judgement (Schumacher, 1973 p. 24).

The similarities between Schumacher's approach and the “fundamentally Keynesian” approach to economics is further evident in his recapitulation of the Cambridge Conference and the discussion with his friend Kaldor in 1964 (when the conference took place). He questions how realistic the arguments against his “intermediate technology” are when he writes: “one sometimes wonders how many ‘development economists’ have any real comprehension of the condition of the poor”. He accuses his critics, who argue that the most productive capital should be used even if labour is saved, that their arguments “are evidently static in character and fail to take account of the dynamics of development” (ibid. p. 169). Schumacher specifies that entrepreneurial ability or the quantities of inputs are not fixed in an underdeveloped economy and, based on his industrial experience questions the existence of any “law” (which he pejoratively puts in quotation marks) of fixed capital/output ratios. In his eyes, proponents do not realise that “the most sophisticated equipment, transplanted into an unsophisticated environment” is not always used at full capacity (ibid. p.170). His ambition to be realistic is even more salient when he proclaims that “to do justice to the real situation it is necessary to consider the reactions and capabilities of people, and not confine oneself to machinery or abstract concepts” (ibid. pp.169-170).

This is the type of realistic approach to dynamic theory, with contempt for extremely abstract formalism, that made Joan Robinson praise his contributions at the end of the war. In her review of the Oxford Institutes investigation into unemployment, she writes:

In general the essays seem somewhat unnecessarily technical and severe in style. This does not apply to Mr. Schumacher's contribution, which provides an interlude in pleasant pastures between the rocky uplands of Mr. Kalecki's austere exposition and the dense forest of Dr. Balogh's close packed argument (Robinson, 1945, p.77).

Unsurprisingly, Robinson's foreword to *After Keynes*, a collection of the papers of a conference⁷, which Robinson organised, emphasises Schumacher's contribution. His paper, "Does Economics Help? An Exploration of Meta-economics" in Robinson's words "attacks the model-builders who have tried to reduce economics once more to a mechanical system" (Robinson 1973, foreword). He asks economists to study "meta-economics", to understand that humans do not behave like atoms and that it is necessary to make essential distinctions to be able to say something about economic phenomena from a pluralistic perspective that includes all the sciences and allows for "the study of man in his wholeness" (Schumacher 1973, pp. 33-36). To him, any blind attempt to aggregate and analyse goods in a market based on the assumption of homogeneity fails to be insightful. Robinson comments on the reaction Schumacher got for his paper:

laymen in the audience were immediately on the speaker's side but some of the professional economists were shocked and reacted with indignation. As the argument went on, more and more points were conceded to Schumacher, except by the hard core of professionals who were still shouting at each other when the meeting broke up (Robinson 1973, foreword).

Although he may have had critical words for Keynes at some stages of his life, it seems like Schumacher had mainly given up on modern professional economics and lazily related the orthodoxy of his times to Keynes. On the other hand, he contributed to a conference themed *After Keynes* without repeating his personal criticism. In any case, the strong influence Keynes had on Schumacher is obvious. We see that he intensely worked with Post-Keynesians such as Kalecki, Robinson and Kaldor, the latter two becoming lifelong friends, and that in the same vein all his economic writing strongly emphasises the importance of full employment, realism, the understanding of dynamics, uncertainty and shows contempt for unnecessary formalism – all key aspects of Post-Keynesianism.

However, it would still be speculation if Schumacher completely agreed with Robinson's closing sentence from the 1973 foreword that "economics is some use, but it would have been a great deal more if the Keynesian revolution had really succeeded."

⁷ The 1972 Annual Meeting of the *British Association for the Advancement of Science*.

Kenneth Ewart Boulding – Keynes, Robinson and the Coming Spaceship Earth

Kenneth E. Boulding (1910-1993) was born into a working class, Methodist family in Liverpool. After attending Liverpool Collegiate School on a scholarship, he went to Oxford on another scholarship to study Chemistry. He soon switched subjects to economics. In his biographical note he recalls that “in 1929 [...] I was horrified by the unemployment problem, which I had seen first hand not only in Liverpool but in South Wales. As an earnest young man wanting to save the world, I was pretty sure chemistry wouldn’t do it. At that time the great problems of the human race seemed to be economic” (Boulding, 1989a, p. 369).

He first interacted with Keynes in his last year as an undergraduate when he wrote an article on displacement cost which he send to *The Economic Journal* where Keynes was editor. After extensive comments from Keynes, it was accepted. Boulding felt like that was an “extraordinary piece of courtesy towards an unknown Oxford undergraduate”. The same year saw the publication of Keynes’s *Treatise on Money*, which Boulding “read with great excitement” and special focus on the historical chapters at the end. He was once asked on the impact Keynes had on him as a young man, to which he replied with “Wordsworth’s famous line on the French Revolution, ‘Bliss was it in that dawn to be alive, but to be young was very heaven” (ibid. p.370). He recalled the quote again in a note on Joan Robinson, this time referring to another great book coming out of Cambridge (UK) at the time. Joan Robinson’s *The Economics of Imperfect Competition* (1933), which made a great impact on him as “a budding young economist in the mid-1930s.” He identifies two revolutions of the time, the one of Keynes and the imperfect competition revolution of Robinson and Chamberlin. Essentially, “Joan had a good deal to do with both of them” (Boulding, 1989b, p. 854) and Boulding goes on to praise Keynes and Robinson for their commitment to discuss real economic issues; “what looked like a catastrophic failure of the market economy in the Great Depression” (ibid. p. 853). Discussing the Cambridge capital controversy, which he found to be “one of the most trivial controversies in the history of economic thought”, he commends Robinson’s literary elegance⁸ and clarity in identifying issues with the neoclassical production theory. Although he may not have been interested in the Cambridge capital controversy he does agree on a very fundamental basis, going even a bit further than questioning the

⁸ This is an interesting parallel if we consider Boulding’s own poetic writing and general interest in literature. The admiration for Robinson’s literary skills is also expressed in Boulding’s review (1963) of Robinson’s *Economic Philosophy* (1962).

aggregation of capital. He is overall critical of the “operational value of the traditional triad labor, land and capital for they are ‘hopelessly heterogeneous aggregates’” (Harcourt 1983, p. 153). One key aspect of his general scepticism towards simplifying aggregation and commitment to reality is the appreciation of complexity in economic issues. Boulding saw Robinson’s “wonderful intuitive feeling of the appalling complexity of the economic system and of the enormous amount of information that was lost in trying to reduce complexity to a single number” (Boulding, 1989b, p. 856). In the same vein, he applauds Joan Robinson for not falling into the trap of excessive econometrics and “ritual mathematization” (ibid.). This is an interesting parallel between Boulding and the *Cantabrigians*⁹, who were, completely in the tradition of Marshall and Keynes, highly critical of the ongoing mathematisation and the attempt to make precise what is imprecise in nature. The common denominator, as with Schumacher and Georgescu-Roegen, is the desire to relate to the real world and to tackle real life problems, like the biophysical limits of our ecosystems or the “totally unacceptable level of unemployment” (ibid., p. 854). The uneasiness regarding aggregation of heterogeneous elements is a result of that desire.

Boulding (1948) expands on these issues very early on in a review of Samuelson’s *Foundations of Economic Analysis* (1947), where he takes the opportunity to discuss the role of mathematics in economics. Here, while freely acknowledging the strength that abstraction and mathematics applied to economics can bring to the table, he heavily criticises the idea that economics is a mathematical science. The weakness of mathematical treatment being the distraction from “the actual complexity of the internal structure of the variables concerned” (Boulding, 1948, p. 189). He gives an example of that weakness by discussing Samuelson’s failed forecasting attempts, where he used his strongly formalised version of Keynesian Macroeconomics. While not criticising him for getting it wrong (as he would have agreed with the forecast on non-formal grounds), he argues that the assignment of variables to aggregate concepts like *interest rate* or *income* ignores their internal structure. Any following analysis in the realm of variables is doomed to carry on the loss of information resulting from that abstraction, the “fatal defect of their heterogeneity” (ibid.). Pondering on how to judge “*what* variables are significant, [...] what basic assumptions are reasonable about the nature of assumed functional relationships” he comes back to the power of literary analysis: “[...] these

⁹ For a short summary of the standing of mathematical economics at Cambridge before World War II see Turner (1989, p. 237).

involve the exercise of a faculty of mind which is more akin to literary criticism than to mathematical analysis" (ibid.).

Samuelson identifies two pillars of his *Foundations*. The first being the concept of maximisation, which Boulding confines to marginal analysis. He believes Samuelson's treatment of the matter to be complete and questions if any further research will be fruitful. The problem with marginal analysis lies in the assumption of continuity, which to Boulding is unrealistic. Assuming discontinuity greatly decreases the meaningfulness of marginal extreme values as multiple equilibria result. Further, many other approaches seem to give better results (in labour economics, for example, trade unions do not seem to maximise anything) (ibid. pp. 193-195). Boulding attacks the second pillar, the theory of difference equations, on similar grounds. Certainly, formally speaking, difference equations are "the very stuff and substance of dynamic economics", but they rely on stability in their relationships. That stability is very hard to come by in the complex world of social phenomena. Even worse, given the endogenous nature of social sciences, if one would find such a stable "law" the very fact of discovery might act destabilizing. Interestingly, just as the Post-Keynesians do in accordance with Keynes, Boulding relates economics to an art and sees economics as embedded in pluralism (ibid. p. 197)¹⁰. His final verdict is clear: "Mathematics is only part of the foundations of economic analysis; its other foundations lie in philosophy, in the other social sciences, and even in art and literature where that essential but nonmathematical quality of critical judgement is developed". Boulding ends with assuring that "no economist who studies it [*Foundations*] can fail to profit from it". Nevertheless, he "cannot help feeling a certain sense of rapidly diminishing marginal productivity in the application of mathematics to economics" (ibid. p. 199).

He repeated both his discontent with the dominance of mathematical economics and his appreciation of Keynes's more realistic approach, this time also regarding his cultural awareness, in an article "Toward the Development of a Cultural Economics" (1972): "His sense of the real world, at least of the speculators and financiers, which he knew so well [...] gives his work something of the richness of cultural detail that one feels in Adam Smith, even though in a more limited range of culture" (Boulding, 1972, p. 268). In the following discussion, he

¹⁰ For Keynes's stance on plurality in economics one only needs to read his obituary to Marshall: "...the master economist must possess a rare *combination* of gifts [...] he must be mathematician, historian, statesman, philosopher- in some degree" (Keynes, 1924, p. 322).

again praises the appreciation of complexity and structure. Perhaps the most profound insight to come out of economics is Keynes's result that "the actual quantities of product produced, consumed, invested and so on were not the result of the decision of individual households, businesses, or even governments, but were the result of the interaction of the decisions of all parties to the system" (Boulding, 1972, p. 282).

Boulding himself tried to establish economic concepts that carefully take into account the internal structure of economic quantities. Shortly after the review of Samuelson's book, Boulding published his *A Reconstruction of Economics* (1950) in which he explores the implications of thinking economics anew from a balance sheet perspective. In the foreword he proclaims that "the influence of J.M. Keynes is almost too obvious to mention" and how he "should certainly accept the title of a Keynesian" who "with all other modern economists owe[s] an enormous debt to Keynes's brilliance of insight and imaginative sweep" (Boulding, 1950, p.ix). However, in Post-Keynesian manner, he believes that his book can address "a number of weaknesses [in Keynes's system] which have not been corrected by his followers" (ibid.). The first contribution that follows in the book is the important distinction between the circulation of assets and the creation, accumulation and destruction of assets. The result is a strong critique of neoclassical economics and a microeconomic theory of the firm based on reorganisations of the balance sheet with respect to liquidity preference and uncertainty. Fundamental uncertainty can only be addressed if the firm recognises the need for appropriate buffer stocks (liquidity preference) to realise windfall gains or to attenuate windfall losses (uncertainty). The second contribution is the provision of a "macroeconomic" theory of distribution in step with the theory of employment. It is therefore unsurprising that the book, which Boulding believes no one in Cambridge ever read¹¹, earned modern Post-Keynesian appraisal (Wray, 1997; McFarling, 2002). It therefore seems appropriate that Boulding relates himself to (Post)-Keynesians when he calls the distribution theory that's described in the book as one of the "K-Theories", "because it is to be found in some form in the writings of Keynes, Kalecki, Kaldor, and, if I may say so, Kenneth Boulding" (Boulding, 1989b, p. 856). He credits Keynes with the first recognition of the concept in his *widow's cruse* doctrine in *A Treatise on Money* (1930). The cornerstone of those theories is elegantly encapsulated in the by now famous quote from Kalecki that "the workers spend what they get

¹¹ "Why, indeed, should anybody at the center of the world read anything that came out of Iowa?" (Boulding, 1989, p. 857)

and the capitalists get what they spend". The idea is that in a growing economy the addition to businesses net worth can only arise from capitalist activity like investment. The payment of wages however does not change the businesses' net worth, it simply shifts "assets out from a liquid form into the product of the work with the same value. Profit can therefore only arise if the product is revalued above cost at the moment of sale, which, of course, gives you good old 'surplus value'" (Boulding, 1989, pp. 856-857). The value of the total product exceeds the wage payment. Relating to "good old surplus value" is, especially given the fact that Boulding did not think much of Marxism, interestingly in step with Robinson's and Sraffa's revival of classical economic theory.

All these topics show up in some form or another in Boulding's contribution to the development of ecological economics - his famous essay "The Economics of the Coming Spaceship Earth" (1966)¹². The essay is a plea for sustainability and stresses the biophysical limits of the earth. He contrasts the "Cowboy Economies", we currently all live in, with the desired "spaceman Economy". The former glorifies consumption and production and measures its success by the amount of throughput (which often implies pollution) generated from (often nonrenewable) resources, which are extracted from the ecosystem (Boulding, 1966, pp. 8-9). The latter, in accordance with the above-discussed principles, tries to minimise throughput and is "primarily concerned" with "stock maintenance". The measure of success would be "the nature, extent, quality and complexity of the total capital stock", as well as the overall human condition (ibid. p. 8-9).

For the welfare of the whole society, the same flow and stock questions arise as with the asset structure of the firm. For Boulding the critical part is the stock. We prefer being well fed to eating. We prefer being clothed to buying clothes. With this perspective, consumption becomes something to be minimised with regard to the maintenance of the state.

This frugal aspect is not necessarily one that can be found in Post Keynesian thought, however the influence of Keynes and Robinson is clear. Boulding appreciates the acknowledgement of society's complexity, the literary skill and anti-formalism, and emphasises the same concepts like uncertainty, realism and heterogeneity.

¹² Also part of Daly's important anthology *Towards a Steady-State Economy* (1973).

Nicholas Georgescu-Roegen, Kaldor and mathematisation

Georgescu-Roegen was born in Romania in 1906. Already as a child, he excelled in mathematics, which he went on to study at the University of Bucharest, where he would also find an interest in applying mathematics and statistics to economic problems. He went on to study in Paris and London where the Rockefeller Foundation eventually approached him. Interested in the time series application of the *Harvard Economic Barometer* he went to Harvard in 1934 only to find out upon arrival that the organisation was shut down - they failed to predict the Wallstreet crash of 1929 (Georgescu-Roegen, 1989, p. 21). Here he met Joseph Schumpeter to whose evolutionary approach to economics he subscribed ever since. He even went as far as to say that "Schumpeter turned me into an economist [...] My only degree is from *Universitas Schumpeteriana*" (Szenberg, 1992). However, he did come into contact with (Post-)Keynesian thought and protagonists. Although he was well versed in mathematics, he was as critical of the ongoing mathematisation in economics as Schumacher, Boulding, Robinson and Keynes. A first glimpse of his later scepticism can be seen in his recollection of his Harvard days. When he came to Harvard in 1934, he encountered the group of Rockefeller Fellows from Europe. They discussed mathematical economics for hours and Schumpeter, who presided over the group, would often invite them for dinner in an upstairs room of the Harvard Club. "Those memorable dinners lasted so late in the night that we were the last to lock up the club" (Georgescu-Roegen, 1988, p. 22-23). The group consisted of Oskar Lange¹³, Fritz Machlup, Gerhard Tintner and Nicholas Kaldor, who arrived a year later. Georgescu-Roegen admiringly speaks of Kaldor in his recollection: "Kaldor was a special figure in the group". Kaldor was not thrilled when he first learned that the group mainly discussed mathematical economics. He said that he didn't understand economics. After attending once out of curiosity, he became a regular. Georgescu-Roegen was impressed with his ability to "better by a verbal argument a mathematical point". He recalls another story of an academic exchange with Kaldor that further shows Georgescu-Roegen's appreciation of Kaldor's talent and his contempt for senseless formalism. In 1935, Georgescu-Roegen wrote an article in *The Review of Economic Studies*, trying to attack "a new problem, the pricing of limitational factors". He starts with praising the insight from Pareto's general model, but emphasises a methodological weakness. The generalisation leads to complexity, which does not allow for

¹³ Who had spent some time at Cambridge and was a close friend to Joan Robinson (Turner, 1989, p. 236).

economic interpretation, and relating to the importance of the internal structure of quantities, it ignores the role of the individual factors of production. In his exposition, towards the end, he shortly discusses a more complex extension of his model, which he deems useless by questioning its “economic meaning”. He ends on the question: “does economics need so many purely formal mathematical generalisations?” (Georgescu-Roegen, 1935, p. 49). Kaldor, “as if bent on confirming [...] [Georgescu-Roegen’s] opinion about his talent”, politely pointed out a mistake that Georgescu-Roegen made and which later on in 1948 would help him work out another concept (Georgescu-Roegen, 1989, p. 26).

It is of course unclear if Kaldor’s approach to economics had any influence on Georgescu-Roegen, and even Kaldor’s discussion style at the time is a matter of speculation. In any case, even if it was literary in nature, it was still in the tradition of “deductive analytical method” (Kaldor, 1986, p. 6). However, he already was a Keynesian in the making when he came to Harvard. Kaldor asserts that long discussions, which the Great Depression generated at L.S.E. in the early 1930s, lead him to the insights of the Swedish economists, particularly Myrdal. They made him “realize the shortcomings of the ‘monetarist’ approach of the Austrian School of von Mises and von Hayek and made me such an easy convert to Keynes after the appearance of the *General Theory* three years later” (Kaldor, 1986, p. 7). While that would be a year after meeting Georgescu-Roegen, in a footnote of his recollections, he mentions how his later years at L.S.E. in the early 1930s were “not altogether happy ones”. He felt isolated and while L.S.E. in general was regarded as “left-wing”, advocates of orthodoxy dominated the economics department, “an ideology [...] [he] abandoned well before the appearance of Keynes’ *General Theory*” (Kaldor, 1986, p. 16). Kaldor eventually went back to England, but the Keynesian Revolution swiftly arrived at Harvard, which was still under the spell of Schumpeter, who had a rather competitive relationship with Keynes¹⁴. Galbraith claims that although, “the old economics was taught by day [...] in the evening and almost every evening from 1936 on, almost everyone in the Harvard community discussed Keynes” (Galbraith, 1971, p. 49). It is therefore highly likely that Georgescu-Roegen was familiar with Keynes and talked heterodoxy with Kaldor, but it seems like he was always devoted to Schumpeter, whom he referenced frequently. The focus on growth economics and dynamics, which Keynes did not expand much on, might explain his indifference towards Keynes. Another reason could be his

¹⁴ Samuelson recalls that Schumpeter was „jealous of Keynes and he was very jealous of the fact that all his best students went tearing after this fellow” (Pantinkin and Leith, 1977,p. 87)

reluctance to engage in monetary theory, where he was not “able to feel at home”. He saw the field as diluted by endless controversies between Keynesians and monetarists, and within the camps. He believes “monetary theory has no leading thread” and does not relate to the real world: “Bankers and financiers are generally successful only because they ignore the economists”. Stemming from his experience with extreme inflation in Romania, he was especially sceptical of “Keynesian” policies. In his mind, it was a blank cheque for demagogues who abused deficit spending without sound taxation plans (Georgescu-Roegen, 1989, pp. 29-30). As with Schumacher, this seems to address more the neoclassical synthesis than “fundamentally Keynesian” thought though.

He would only on occasion refer to Keynes. One occasion is very interesting. In his article “Methods in Economic Science”, he laments the extreme mathematisation of the profession and praises the early awareness of the likes of “Alfred Marshall, Knut Wicksell, and Lord Keynes”, who were well trained in mathematics, but still only regarded it as a tool and not the language of economics (Georgescu-Roegen, 1979, p. 317). He goes on to criticise “empty exercises with symbols”, the act of coming up with equations and variables that are only by definition related to economic processes (ibid. p.318). To him, following from that empty symbolism is a complete misrepresentation of the production process. “First, the standard production function does not distinguish between the agents of production- labor power, capital and land- and the flow elements which form the object of the agents’ activity”. The result being, aided by the use of a Cobb-Douglas function, a complete disregard for the natural fact that physical capital is not freely substitutable with the resources it is derived from (ibid. p. 318-319). Ignoring the time a production processes takes, is another issue of the production function. The standard form cannot account for production that is more intensive. For example by doubling the production time doubles the output. This is often confused with the doubling of workers. In a much later article, pondering on all the methodological issues involved with production functions he eventually approvingly referred to Joan Robinson: “there are therefore plenty of reasons to say with Robinson, that ‘the Wicksteedian production function has been a powerful instrument of miseducation’” (Georgescu-Roegen, 1990).

In his 1979 article, he then goes on to argue against the “mechanistic” *Weltbild* and for the idea that most important issues nowadays are characterised by evolutionary tendencies.

Structural Economic problems can arise from novelties, and true novelties cannot be represented in an analytical model, as such a model can only deal with what is there from the outset. He therefore makes the case for what he calls dialectic reasoning opposed to arithmomorphic models. The former allows to traverse and explore the penumbra, the space between the extremes. Justice for example is not an analytical concept, explainable by math – it requires the “use of *words*, instead of numbers, for truly qualitative changes cannot be represented by an arithmomorphic model” (Georgescu-Roegen, 1979. p. 325).

His desire to be realistic and to let go of formalism for its own sake, lead him to emphasise the entropy law as the ordering concept for economic processes, while simultaneously advocating for an economic science that acknowledges indeterminism and complexity stemming from human factors. All of this can be seen in Georgescu-Roegen’s seminal contribution to ecological economics, his book *The Entropy Law and the Economic Process* (1971)¹⁵. The ultimate realism - seeing production not only as an input-output system, but rather a one-way road from one physical state to the next - from order to disorder and therefore emphasising the irreversibility of human production. Boulding’s review of the book is full of praise for its intellectual breadth and jokingly comments that “the reader who can overcome these blows to his self-image as an educated man will find the style clear and the argument frequently very persuasive” (Boulding, 1972, p. 1099). However, he disliked the economics part of the book, as it seemed too disconnected. Although sympathising with the idea of an entropy theory of value, he believes it to be uninformative in the presented form: “A measure of disorder does not tell us much about the order that is destroyed [...]” (ibid.). And while stating that the chapters on economics are weaker than the rest, he welcomes the “extremely interesting heretical insights”, and is delighted to welcome Georgescu-Roegen “to the heretical set, which regards consumption as a bad thing, welfare being measured by the enjoyment of the stock [...] rather than by throughput [...]. I am delighted, also, to recognize in him an economist of the coming “spaceship earth” (ibid.).

He closes with a more or less prophetic statement: “This is not a book that may appeal to a very wide circle of readers. If, however, the right 500 people were to read it, science perhaps would never be quiet the same again” (ibid. 1100). He was correct insofar as the book became

¹⁵ As Daly was Georgescu-Roegen’s student, this book is of course included in the anthology.

a cornerstone of ecological economics and a starting point for most investigations into the biophysical limits of our world.

Conclusion

All three pioneers of ecological economics had some connection to Keynesian thinking, Keynes or his followers. They all stress the importance of realism over formalism and are concerned with real world issues like unemployment or the exhaustion of resources, and pollution. The degree to which this can be related to their interactions with (Post)Keynesians or Keynes(ian thought), is up for discussion. Surely, the claim can easily be made for Schumacher, who worked so intensely with Keynes and his followers, while Boulding was very vocal about his Keynesian influences. Georgescu-Roegen on the other hand obviously subscribed to Schumpeter's evolutionary economic approach, which exhibits many similarities to Post-Keynesian thought. His work shows signs of influence from Keynes and Kaldor, whom he praised in his recollections. In any case, the paper shows that the theoretical and methodological overlaps between modern ecological economics and Post-Keynesianism go back to the early and mid-20th century and may stem from mutual influence between the pioneers of both traditions of economics.

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