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The Prying Eyes of the Natural Scientist

William Stanley Jevons (1835–1882) is unquestionably one of the great minds in the history of economics. Today, he is remembered as one of the "fathers" of the so-called marginalist revolution in economics. With his *Theory of Political Economy* (1871), decisions of economic agents came to be analysed by means of the calculus, in terms of deliberations over marginal increments of utility. In this "mechanics of utility and self-interest" (*TPE2* 90), economic agents – whether in their role of consumers, workmen, or other – came to be seen as maximising utility functions. The marginalist revolution was a definitive break with the labour theory of value – value came to be identified with exchange value, and this was identified with marginal utilities, not with the costs of production. Jevons is also remembered for his innovative contributions to the empirical, statistical study of the economy. He ardently propagated the use of graphs to picture and analyse statistical data. He introduced index numbers to make causal inferences about economic phenomena. In short, there is no particle of economic science, theoretical or empirical, to which Jevons did not make important contributions that are, today, considered revolutionary. Jevons is one of the fathers of modern economics, indeed.

This summary evaluation of the importance of Jevons's contributions to economics contrasts starkly with the image we gain from a superficial glance at his contemporaries. In his lifetime, Jevons was well valued as an able statistician, but many of the leading contemporary political economists considered his pursuits in mathematical economics as obscuring the subject. It was only the younger generation of scientists and economists – like George Darwin and Francis Ysidro Edgeworth – who appreciated the novelty and

fruitfulness of his ideas.[1] It is worth quoting from John Stuart Mill's famous letter to Cairnes on Jevons's *Theory* to illustrate his reservations (*Mill* 17:1862–3):[2]

> I have not seen Mr. Jevons's book, but as far as I can judge from such notices of it as have reached me, I do not expect that I shall think favourably of it. He is a man of some ability, but he seems to have a mania for encumbering questions with useless complications, and with a notation implying the existence of greater precision in the data than the questions admit of.

Mill (1806–1873) was not alone in his judgement. Reviews of the book – from, amongst others, Alfred Marshall (1842–1924) and John Elliot Cairnes (1823–1875) – were quite sceptical.[3] Henry Sidgwick (1838–1900), the great utilitarian philosopher, downplayed the importance of Jevons's use of the calculus while acknowledging the importance of his new utility theory of value.[4] In the 1875 re-edition of John Elliot Cairnes's influential *Lectures on the Character and Logical Method of Political Economy*, Cairnes even wrote that the work of his "able friend" did not give him any reason to alter the views on method he had expressed as early as 1857. Reservations to the *Theory* were made not only by those whom Jevons explicitly attacked – the classical economists – but also by political economists of the historical school, such as Cliffe Leslie (1825–1882) and John Kells Ingram (1823–1907), who favoured detailed historical explanations over theory abstracted from historical detail, whether expressed verbally or mathematically.

These conflicting appraisals from past and present leave us with an enigma of how to evaluate Jevons's place in the history of economics. Using Roy Weintraub's recent distinction between the body and the image of a science

[1] See also Schabas (1990), Chapter 7.
[2] Mill, Letter 1698, 5 December 1871, to Cairnes.
[3] In later years, Marshall admitted that he was angry about the book for two reasons. Firstly, he had been thinking along the lines of Jevons; secondly, being an ardent admirer of Ricardo and the Classical School, he felt that injustice had been done to them in the *Theory*. See Schabas (1989). A more general account of the reception of the *Theory* is to be found in Schabas (1990). Inoue's recent collection of reviews of Jevons's work corrects the impression that the *general* response to the *Theory* was negative. This was far from the full picture. See Inoue (2002, 2:187–297).
[4] Sidgwick fully acknowledged the additional challenge Jevons's theory of utility posed to classical political economy that had come under severe pressure with William Thornton's *On Labour* and John Stuart Mill's subsequent "recantation" of the wage fund theory. For Thornton's influence on economic theory, see, for example, Chaigneau (1997), Donoghue (1998), Ekelund and Thornton (2001), Vint (1994), and White (1994b).

(2002, 1–2) – that is, between its substance and its perceived methods and history – this book traces these conflicting appraisals of Jevons back to the contrasting images of political economy that were defended by Jevons himself and his contemporaries. From an evaluation of these contrasting images, it may be understood why and to what extent Jevons can be seen as one of the fathers of modern economics. Hence, my focus is on the changing methods of political economy, not on the changes in its theoretical content. Before going into any detail, it will be useful to briefly review existing appraisals of Jevons's work.

Jevons's Place in the History of Economics

Much has been written about Jevons's place in the history of economics. Starting with Keynes's and Robbins's centenary appraisals of Jevons, these studies have considerably deepened our knowledge and understanding of Jevons's work and the context in which it was produced. In his beautiful and dense essay on Jevons, Keynes paid equally high tribute to the *Theory* and to Jevons's statistical studies. At home as well in abstract theory as in the "black arts of inductive economics", Jevons was, according to Keynes, "the first theoretical economist to survey his material with the prying eyes and fertile, controlled imagination of the natural scientist" (Keynes [1936] 1988, 66). Robbins even went to the extreme when he noted that the "sheer genius" of Jevons's "capacity in handling facts", more than the *Theory*, was perhaps his "most conspicuous claim to fame" (Robbins [1936] 1988, 101).

Keynes's portrayal of Jevons – as scrutinising the data, spending "hours arranging his charts, plotting them, sifting them, tinting them neatly with delicate pale colours like the slides of the anatomist, and all the time poring over them and brooding over them to discover their secret" ([1936] 1988, 66) – rightly describes him as pursuing an anatomy, or physiology, of society, although Keynes's account is more imaginative than informative. Scientists use instruments and experiments to let the data speak, and this might be only vaguely inferred from Keynes's description. Moreover, Keynes seems to have meant this description only for Jevons's empirical studies, whereas it was generally considered that his most important innovation was the introduction of a specific instrument – the calculus – into economics.

Collison Black delivered his centennial commemoration of Jevons's first airing of his marginalist ideas in his "Notice of a Mathematical Theory of

Political Economy" (read in 1862 to section F of the British Association for the Advancement of Science (BAAS)). In 1962, Black had just recently discovered a wealth of material in the possession of Jevons's granddaughter, Mrs Könekamp, which provided new insight into Jevons's life and work. Contrary to what might perhaps be expected from Black's modesty with regard to his eminent predecessors, his and Könekamp's edition of these papers, from 1972 through to 1981, have greatly contributed to a renewed interest in Jevons's work. Various detailed studies appeared regarding exactly what Jevons's contribution was to the so-called marginalist revolution (see, especially, Black et al. 1973). His contribution to the development of statistics and econometrics is discussed in detail in several highly valuable studies (e.g., Stigler 1982; Aldrich 1987, 1992; Morgan 1990). His relation to his predecessors and successors has also been extensively examined (e.g., Bostaph and Shieh 1986; Schabas 1989, 1990; Kim 1995; Peart 1993, 1995a, 1996; White 1989, 1991b, 1994a, 1994b, 2004b). From these in-depth studies, a much richer image emerges of Jevons as one of the founders of "modern economics" – as in the title of Black's contribution to the Bellagio conference on the marginalist revolution in economics (Black et al. 1973). The term echoes Robbins's depiction of marginalist economic theory as the unifying core of modern economics (White 2004).

The Bellagio conference on the marginalist revolution deserves some special attention. Obviously, not only was Jevons's work addressed, but also the more general issue of whether there was any unifying core at all in the work of the three founding fathers of the "marginalist revolution", as was once claimed by Schumpeter. Was it sheer coincidence that Jevons, Menger, and Walras all published their tracts in the first half of the 1870s, or were these different authors, unknowledgeable about each other's work, nevertheless working on the same project: the introduction of a marginalist theory of choice in which actors maximised their utility in light of given means? It is certainly not my purpose to repeat this discussion; I will summarise it briefly.

Though to a considerable extent Jevons and Walras were in agreement with their approach to economic theory, this was certainly not the case for Menger.[5] It was argued that most of Jevons's theoretical innovations – such

[5] Jaffé's 1976 de-homogenisation of the "fathers" of the marginalist revolution has been recently discussed in a special issue of the *American Journal of Economics and Sociology*. See Comim (1998), Fontaine (1998), Hébert (1998), and Peart (1998).

as marginal utility, maximising behaviour, and emphasis on consumption theory – were present in the work of other economists long before Jevons, though not in the Ricardian mainstream. Upon closer inspection, Jevons proved more tied to the classical cost of production theory than was suggested by his vehement rejection of the "wrong-headed" doctrines of Ricardo and Mill. The only thing that most authors agreed upon as being Jevons's genuine contribution to modern economics was his insistence on the use of mathematics, especially the calculus, in framing economic theory. This is despite the fact that it was evident – as indeed Jevons himself had pointed out in the second edition of the *Theory* (1879) – that Jevons had many precursors, especially in France, some of whom had shown considerably more skill in handling the calculus than Jevons (see Ekelund and Hébert 1999). Instead of placing the emphasis on a continuity or discontinuity with his predecessors in terms of theoretical content, the attention shifted to Jevons's methodological contribution. His use of the calculus seemed to concur with the unity in method he defended with regard to all of the sciences – the natural and the social – including economics.[6]

From very different perspectives, Mirowski's highly influential *More Heat than Light* (1989) and Schabas's 1990 monograph on Jevons investigated this thesis more closely. Schabas explicitly addressed Jevons's use of the calculus in light of his philosophy of science as set out in *The Principles of Science* (1874). The *Principles* is a book which, until then, had hardly been noticed outside the realm of the natural sciences – a fact which was explained by the philosopher of science Ernst Nagel in his introduction to the 1958 Dover edition as being due to its lack of discussion of the distinct methods of the natural and the social sciences. Schabas forged this alleged defect of the book into its very strength. From her discussion, it transpired that there are good grounds for defending the thesis that Jevons foreshadowed the so-called hypothetical deductive method as the unifying approach to the sciences (which was distinctly one of the reasons for Nagel's enthusiasm for the *Principles*), and she approached Jevons's *Theory of Political Economy* from this perspective.

[6] As had been argued as early as 1962 by the logician Wolfe Mays, "there is a close relationship between Jevons's philosophy of the natural sciences and his methodology of the social sciences" (Mays [1962] 1988, 212).

Granted that this is the case, it unfortunately does not explain why the calculus can be of use in economics, nor why a subjective theory of value should be preferred to a cost of production theory. Even more pressing, such a unified method of inquiry does not entail that the subject matter of political economy be quantitative in nature – Jevons's main argument for treating economics mathematically. As Schabas (1990, 80–1) contends, Jevons's "appeal to the quantitative complexion of economics" was "perhaps the most simplistic of [his] arguments" even though it might have been "to Jevons and his contemporaries . . . perfectly cogent". It enabled the economist to freely "explore analogies to the natural sciences", especially "to mechanics" (80, 84).

As we will see in more detail in this book, Jevons's "appeal" to mechanical analogies was not at all "cogent" to his contemporaries. Far from unequivocally agreeing with Jevons's appeal to the "quantitative complexion of economics", contemporary economists reacted dismissively or with puzzlement to Jevons's use of mathematics in political economy. Even though they would have agreed with the *complexion* of political economy, this did not make the subject fit the use of mathematics to unravel its secrets, nor did this make analogies legitimate with mechanics – quite the contrary. Hence, Mirowski's penetrating and, as it happened, highly provocative thesis that early marginalists like Stanley Jevons modelled their new theories and method on a specific brand of physics that rose to the fore in mid-century Europe, thermodynamics, seemed a much more promising route than that of Schabas to explain the rift between classical economists and the newly emerging marginalist theory. However "totalising" Mirowski's narrative may be (Weintraub 2002, 6), it clearly opened new vistas within the history of economics.

But Mirowski's strong language was not particularly helpful to make his case, depicting early marginalists like Jevons as incompetent engineers who lured economists into the wrong theory because of their lack of understanding of the new physics and the mathematics that went with it. In her own account of Jevons, Schabas (1990, 6) clearly showed herself annoyed with such a "conspiracy thesis", and she was not alone in this. If we look through Mirowski's normative language, however, it remains undeniable that there were moves between physics and economics in nineteenth-century Europe in which thermodynamics played a significant role.

In relation to Jevons, these exchanges have recently been detailed by Michael White (2004b). White argues that Jevons's summary statement of the fundamental "problem of economics"[7] and his reworking of his original outline in between its presentation to the BAAS in 1862 and the *Theory* in 1871 are to be understood in relation to his engagement with the debates over the conservation of energy in the 1860s. Jevons's *Coal Question* (1865), which was somewhat of a hit in his own day, serves as a major source in this regard. But even without such a detailed analysis, it might seem obvious that Jevons's energy came from energy physics. In the preface to the *Theory* we read:[8]

> The nature of wealth and value is explained by the consideration of an indefinitely small amount of pleasure and pain, just as the theory of statics is made to rest upon the equality of indefinitely small amounts of energy. (*TPE2* 44)

This obvious relation between Jevons's program in economics and energy physics produces a serious problem. White's investigations into the context of the alterations Jevons's program underwent in the 1860s and onwards reveal that its initial impetus lay not in his engagements with debates over the conservation of energy, but elsewhere. After all, Jevons's first airing of his new mathematical theory to the BAAS in 1862, published in 1866 as the *Brief Account*, certainly did not rely on notions of energy. Jevons used mechanical metaphors well before he recasted some (not all) of them in terms of energy. More importantly, as White notes, Jevons's references to the "energy framework . . . left no mark on the formal mathematics (i.e. calculus and geometry) of TPE" (2004b, 242). Referring to his 1862 paper, Jevons wrote in the introduction to the *Theory*: "All the chief points of the theory were sketched out ten years ago" (*TPE2* 77). Neither Schabas's recourse to Jevons's *Principles* nor Mirowski's narrative about the transfer of energy physics to economics is thus sufficient to explain the rift in method between Jevons and the classical economists.

[7] Jevons stated this problem in the concluding remarks of the *Theory*. It reads: "Given, a certain population, with various needs and powers of production, in possession of certain lands and other sources of material: required, the mode of employing their labour which will maximize the utility of the produce" (*TPE2* 254).

[8] The phrasing is an allusion to White (1991d).

Perhaps because of these difficulties, Sandra Peart, in her monograph on Jevons (1996), approached the differences between the classical economists and Jevons from a more pragmatic perspective. While emphasising theoretical continuity between Mill and Jevons, she aimed to locate their differences in perspective in their widely diverging approaches to empirical research. Turning to the methodological writings of classical economists like Mill and Cairnes, it is easily seen that differences in their opinions on the fitness of political economy to mathematics did not reside in an agreement or disagreement about the similarity between political economy and the natural sciences per se. Whatever may have been the differences between the methodological views of these classical economists and Jevons – and there were many – there was no dispute about the laws of political economy appealing to the same status as the laws obtained in the natural sciences, though this status as such met with radically different appraisal by Mill and Cairnes on the one hand and Jevons on the other. Indeed, one of the main purposes of John Stuart Mill's famous 1836 essay on the proper definition and method of political economy had been to secure for the laws of economics the same status as natural laws.

Peart argues that what economists like Mill and Cairnes on the one hand and Jevons on the other did not agree on was how to assess these laws. Jevons's distinction between the mathematical character of political economy and its exactness is relevant here. Peart scrutinised this distinction even more incisively in her article on Mill and Jevons (1995a). She pinpoints the disagreements between Mill and Jevons in their different attitudes towards the problem of multiple causation, a serious conundrum in those days. According to Mill, the "abstract truths" of political economy could not be perceived empirically due to the interference of disturbing causes. Jevons, in contrast, treated these disturbing causes as "noxious errors" which would average out on the whole. As a consequence, Mill resisted the introduction of statistical tools and techniques that in Jevons's perception formed the alpha and omega of the toolbox of the social scientist.

Peart reinterprets Jevons's *Principles of Science* in this light. Jevons's extensive discussions in the *Principles* of methods for correcting measurement errors naturally concur with his statistical innovations. Peart's account of Jevons enforces the image one forms from the detailed studies on his empirical work mentioned earlier, in which Jevons is depicted as a forerunner of the probabilistic revolution (Aldrich 1992), or at least one of

those paving the way for the rise of econometrics in the thirties (Morgan 1990).

On Peart's reading, what had been considered *the* distinguishing feature of Jevons's work at the Bellagio conference – the introduction of the calculus – typically enough turns out to be of far less importance than is commonly thought. In her view, the distinguishing contribution of Jevons to economics did not reside in treating political economy mathematically, but where it was located by Keynes and Robbins: in his scrutinising an avalanche of numerical data to unravel their hidden secrets. On Peart's reading, research on Jevons seems to be thrown back to Robbins's statement at the very beginning of his 1936 essay on Jevons's place in the history of economics: "It is not easy . . . to define the exact nature of his achievement. . . . He formed no school. He created no system". His summary statement seems to be the most that can be said of Jevons: "The totality of his achievement, the wide range of his activities, the fertility of his imagination, the marvellous lucidity and attack of his expository style, rather than the perfection of any one of his constructions . . . gives him his place in history" ([1936] 1988, 94).

THE DISTINCTION BETWEEN MIND AND MATTER IN VICTORIAN BRITAIN

Maybe we should acquiesce, like Robbins, in appraising Jevons's lively and fertile imagination as his main claim to fame. Unity is not always found. In Jevons's case, however, there is a firm reason to dig deeper. Why else would he have proclaimed in the *Theory* that there is but one method for all of the sciences and threw up his hands in dismay at those who thought otherwise:

> There exists much prejudice against attempts to introduce the methods and language of mathematics into any branch of the moral sciences. Most persons appear to hold that the physical sciences form the proper sphere of mathematical method, and that the moral sciences demand some other method, I know not what.
>
> (*TPE1* 3)

The most notable distinction in this quotation is that between the "natural" and the "moral" sciences. The question that may be raised is why Jevons denied a distinction between different fields of the sciences that apparently was so obvious to "most persons"? Neil De Marchi's 1972 short, but

still extremely complete, survey of the differences and agreements between Jevons and his predecessors is very helpful in searching for an answer.

Mathematics, De Marchi (1972, 350) notes, "was not essential to the concept of marginal utility nor to the principle of diminishing (marginal) utility". De Marchi argues that for someone like Mill or Cairnes, an explanation of diminishing marginal utility would have to be given in terms of the association psychology, and this type of psychology ran counter to "a clear conception of marginal satisfaction" (1972, 352). According to De Marchi, adherence to this type of psychology might explain why political economists such as Mill, Cairnes, and Cliffe Leslie were "blinded . . . to the clarity of expression which Jevons' mathematics imparted to the notion of the margin".

De Marchi modifies his statement on the relationship between the association psychology and mathematics when he writes that the association psychology did not constitute an "absolute barrier" to "a clear conception of marginal satisfaction", and he refers to Richard Jennings's *Natural Elements of Political Economy* (1855) as a case in point. But was it really only a matter of clarity of conception? Without exploring the theme any further, De Marchi implicitly locates the distinction between Jevons and his adversaries – Mill, Cairnes, and Cliffe Leslie – in developments in psychology that came to blur a distinction that provoked vehement debates in Victorian England: the distinction between the phenomena of mind and matter.

White's incisive essay on the relation of Jennings to Jevons (White 1994a) serves as a hallmark on this issue. White makes it sufficiently clear that the gist of Jennings's arguments were not derived from the association psychology, but from so-called psychophysiological theories, such as those of William Carpenter and Thomas Laycock in which man's actions are seen as the offspring of his neurophysiological constitution. With regard to this type of argument, Cairnes remarked that, if "Political Economy is to be treated in this way, it is evident it will soon become a wholly different study from that which the world has hitherto known it" (1857, 181).

And that is just what happened. Developments within psychophysiology in Victorian Britain tended to blur the notorious distinction between mind and matter. When this distinction lost its relevance in the course of the nineteenth century, it became increasingly unclear wherein the difference between the physical and the moral sciences resided. As is argued at length in this book, it is these very different attitudes towards the distinction between mind and matter that help to explain the different views on the method of