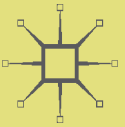
PAPERS AND CORRESPONDENCE OF WILLIAM STANLEY JEVONS

VOLUME VII

EDITED BY

R. D. COLLISON BLACK



PAPERS AND CORRESPONDENCE OF WILLIAM STANLEY JEVONS

Volume VII

PAPERS ON POLITICAL ECONOMY

ECONOMIC PAPERS HITHERTO UNCOLLECTED
EXTRACTS FROM THE PERSONAL DIARIES, 1856–60
LIST OF ADDITIONAL WRITINGS
JEVONS AS EXAMINEE AND EXAMINER
REVIEWS OF *THE THEORY OF POLITICAL ECONOMY*

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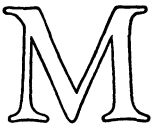

Palgrave Macmillan

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CONTENTS

PREFACE

Apart from the 1875–6 lecture notes contained in Volume VI, the Jevons Papers include only one other previously unpublished piece of economic work – this is the draft article entitled 'The Solar Influence on Commerce' printed as Chapter XI of the first part of this volume. In 1881 Jevons had formed the idea of collecting into two volumes some of the fifty and more papers on economic subjects which he had written since 1857.[1] The preparation of fourteen articles on monetary questions for incorporation into *Investigations in Currency and Finance* was almost complete before his death and was finished by H. S. Foxwell in 1884.

Jevons had presumably himself made the decision not to include his uncompleted paper on 'The Solar Influence on Commerce', evidently written in 1879, and Foxwell did not alter this, although he did include another unfinished item entitled 'Sir Isaac Newton and Bimetallism' as well as various fragments on the latter topic. However, it seems right that the whole of Jevons's writings on his sunspot theory should be accessible, rather than just the four items which were included in *Investigations*. So this unfinished and hitherto unpublished item is included here, as well as a brief paper from *Nature*, 1882 (Chapter XIV below), which, as suggested there, may only have been published after Jevons had decided on the form which *Investigations* was to take.

The second volume of papers which Jevons proposed to collect comprised those which he had written on social questions; these were edited by his wife after his death and published in 1883 under the title of *Methods of Social Reform*. The remaining papers on economic subjects, which have never previously been republished, are now collected in the present volume. Inevitably they form a miscellaneous collection, lacking the unity of theme which characterised *Investigations* and *Methods*; on the other hand they have the merit of allowing the reader to see Jevons at every stage of his intellectual development and displaying almost every facet of his wide-ranging interests in economic questions.

The very first pieces which Jevons wrote on economic questions, when he was a young settler, are included here. Following these are a group of papers connected with *The Coal Question*, the book which first gave Jevons

[1] See H. S. Foxwell's Introduction to the First Edition of *Investigations*, p. xx.

a national reputation as an economist and which he himself thought to have influenced his election as Cobden Professor in 1866.[2]

On his appointment to that Chair Jevons found himself obliged to present political economy in a fairly popular form to primary school teachers and others. Examples of his teaching at this level, which did not win him much popularity with the representatives of the working class to whom it was primarily directed, are incorporated as Chapters VI and VII.

In sharp contrast to these is the paper on 'The Progress of the Mathematical Theory of Political Economy' (Chapter IX), which shows Jevons as an internationally recognised authority on economic theory using the Manchester and London Statistical Societies to propagate the mathematical approach to his subject which he found so much more readily accepted abroad than at home.

For the rest, the collection includes another paper, that on international currency, which might well have found a place in *Investigations* but somehow did not, and some short pieces which exemplify that 'many-sidedness' which Keynes praised in Jevons. One shows Jevons the practical statistician explaining prophetically to the Statistical Society of London the value of a simple calculating machine in connection with the method of least squares, while others display his wide knowledge of the literature of economics, both English and European.

In the Preface to Volume I, I pointed out that 'the works of Jevons, published during and after his lifetime, display the finished products of his mind. The papers published here enable the reader, for the first time, to see the workshop in which they were produced.'[3] This is particularly true of the papers which make up the latter part of this volume. The diary entries with which it opens are quite distinct from the Journal which formed the main text of Volume I but of similar interest in the understanding of Jevons's intellectual development.

Jevons used his journal as an occasional record of his thoughts and of events of special significance. He was never a regular diarist, but between 1856 and 1860 he used a series of Letts' diaries to jot down records of his work and reading, which serve now to throw valuable light on the early growth of his interest in social and economic studies and the sources from which he derived some of his knowledge and ideas. All the entries which seem significant in this regard are reproduced here; such a selection seemed preferable to publishing the whole text of the diaries, which include many trivia such as jottings of daily or weekly expenditures.

While the diaries contain much information on Jevons's early reading, information about his writings, beyond what has previously been known,

[2] Cf. Letter 253, Vol. III, p. 101.
[3] See Vol. I, p. xii.

proved to be contained in a plain black-covered exercise book in which he kept a record of all his activities as an author. This not merely supplements the incomplete lists of Jevons's writings given by Mrs Jevons in *Letters and Journal* and by H. S. Jevons as an appendix to the fourth edition of *The Theory of Political Economy*, but also enables a number of pieces published anonymously by Jevons to be identified.

Finally, the opportunity has been taken to bring together some related items published elsewhere. Reference has already been made to the well-known story of the 'sad reverse' which Jevons felt he had suffered in the political economy examination at University College London in the summer of 1860. In view of this, special interest attaches to the examination paper set on that occasion by Jacob Waley,[4] and it is therefore reproduced here.

Fourteen years later, his reputation as an economist firmly established, Jevons was invited to act as one of the examiners for the Moral Sciences Tripos at Cambridge in 1874 and 1875. Three papers on political economy were then part of the Moral Sciences Tripos and special interest also attaches to these, not only because of Jevons's part in setting them, but also because among the candidates were, in 1874, Mary Paley (afterwards Mrs Alfred Marshall), and in 1875 John Neville Keynes.

The circumstances of the 1874 Tripos examination have again been classically related by John Maynard Keynes in *Essays in Biography*. Of the four examiners two placed Mary Paley in the first class and two in the second, leading Dr Kennedy (of Latin Grammar fame) to compose the verses which ended—

> Were they at sixes and at sevens?—
> O Foxwell, Gardiner, Pearson, Jevons![5]

Keynes's *Essays in Biography* also contains some well-known references to the reception of *The Theory of Political Economy* and particularly to Marshall's 'tepid and grudging' review of the book. This review is reproduced here along with that of Cairnes, as the last representative of the classical school, that of Cliffe Leslie, representing the historical school, and the anonymous critique of the *Saturday Review*, which Edgeworth regarded as sufficiently able to merit special comment in his *Mathematical Psychics*.[6]

The index to Volumes I–VII, which appears at the end of this volume, has been prepared by Mrs Barbara Lowe of Cambridge. I should like to record my thanks to her for the great skill and meticulous accuracy with which she has carried out the very large amount of work involved.

[4] See Letter 256, n. 5, Vol. III, p. 106.
[5] *Collected Writings of J. M. Keynes*, vol. x, *Essays in Biography*, p. 237.
[6] pp. 83–6.

In conclusion, I should like to return to two points which I made at the end of the Preface to Volume I – first, to stress again that for any errors and imperfections in editing which remain in these volumes, the responsibility is mine alone; and last, but most certainly not least, to put on record my continuing gratitude to my wife and family for the support and encouragement they have given me during the years that this project has been under way.

Queen's University, Belfast
12 November 1975

R. D. COLLISON BLACK

LIST OF ABBREVIATIONS

used throughout the volumes

Relating to Jevons material

LJ	*Letters and Journal of W. Stanley Jevons*, edited by his wife (1886).
LJN	Previously published in LJ; manuscript not now in Jevons Papers, or other known location.
LJP	Previously published in LJ, but only in part; fuller text now given from the original manuscript in the Jevons Papers or other indicated location.
WM	From a manuscript made available by Dr Wolfe Mays, University of Manchester.
Investigations	*Investigations in Currency and Finance*, by W. Stanley Jevons. Edited, with an Introduction, by H. S. Foxwell (1884). All page references to first edition.
Methods	*Methods of Social Reform and other papers*, by W. Stanley Jevons (1883).
T.P.E.	*The Theory of Political Economy* by W. Stanley Jevons (1st ed. 1871, 4th ed. 1911). All page references to fourth edition, unless otherwise stated.

Relating to other material

BM	British Museum, London (now British Library).
FW	Fonds Walras, Bibliothèque Cantonale de Lausanne.
HLRS	Herschel Letters, Royal Society, London.
JRSS	*Journal of the London* (later *Royal*) *Statistical Society*.
KCP	Palgrave Papers in the Library of King's College, Cambridge.
LSE	London School of Economics, British Library of Political and Economic Science.
MA	Archives of Macmillan & Co. Ltd.
NYPL	New York Public Library.
RDF	From a manuscript made available by Mr R. D. Freeman.
TLJM	Isabel Mills, *From Tinder Box to the 'Larger Light'. Threads from the Life of John Mills, Banker* (Manchester, 1899).
Walras Correspondence	*Correspondence of Léon Walras and Related Papers* edited by William Jaffé (3 vols, Amsterdam, 1965).

Figures following any of these abbreviations denote page numbers.

I CONTRIBUTIONS TO THE SYDNEY *EMPIRE*

On 17 June 1857 Jevons wrote to his sister Henrietta: 'the subject I have been most of all concerned in for the last six months is political economy'.[1] Three short pieces in the Sydney *Empire* are the first published results of that interest. As might be expected, they are examples of vigorous criticism rather than profound original thinking. Jevons had not at this time developed his own system of economic ideas, nor had he perhaps a very extensive acquaintance with those of other economists. Thus he showed no acquaintance with the theory of systematic colonisation of Edward Gibbon Wakefield,[2] on which the policy of an 'upset price' for public lands in Australia was founded, and his whole approach was empirical rather than analytical.

The background to, and bibliography of, these pieces has been set out by Professor J. A. La Nauze in his *Political Economy in Australia* (Melbourne, 1949). As Professor La Nauze states, the Sydney *Empire* was a daily newspaper, edited at this time by Henry Parkes: from September 1856 until it ceased publication in August 1858 the *Empire* included a weekly Meteorological Report written by Jevons. Not long before his death, Jevons wrote to Parkes 'I have always felt indebted to you for the kindness with which you used to publish my first efforts in science and political economy' (Jevons to Parkes, 18 June 1882, Parkes Collection, Mitchell Library, Sydney: quoted in La Nauze, op. cit., p. 39).

The first of these contributions, a comparison of the land and rail policy of New South Wales, which appeared on 8 April 1857, is reproduced in Volume II as Letter 103, pp. 282–7. The other two, dealing respectively with the public lands of New South Wales and with railway economy, in June and December of the same year, are reproduced below.

W. S. JEVONS TO THE EDITOR OF THE *EMPIRE*[3]

[From a Correspondent.]

THE LAND LAWS AS THEY ARE.

1. At present the waste lands of this colony are treated as a vast estate or fund, portions of which are to be economically sold or expended from

[1] See Vol. II, Letter 105, p. 292.

[2] See R. C. Mills, *The Colonization of Australia* (1915); D. N. Winch, *Classical Political Economy and the Colonies* (1965).

[3] Published on 24 June 1857: cf. Vol. II, Letter 107, n. 9, p. 297.

year to year, to afford a revenue for the general purposes of the community.

2. To ensure economy a minimum price of one pound per acre is imposed upon all land, which, together with any additional sum obtained by open competition, is to be paid down before occupation.

3. The extent or supply of waste lands being altogether boundless in comparison with the demand under this regulation, the upset price of land is not the *natural exchange value* of the land but a monopoly price.

4. As this monopoly price of nearly £1 per acre is paid to Government, it is properly denominated a *tax on the act of occupying and cultivating lands* otherwise useless (or very nearly so) to all. In short *price* is not the proper name, and tends to mislead persons.

5. The tax on the act of occupation though not large in comparison with the value of the produce which may be easily raised from the land, has the great fault of withdrawing capital at the very moment when it is most required for effectively commencing cultivation.

6. It is thus not an uncommon case in the country to find men who have purchased small but rich farms and expended almost their whole capital in paying the Government price or tax, obliged in consequence to defer cultivation, and in the meantime to raise a little money and support themselves by working at their former trades, even under great disadvantages. When it also happens, as I have myself known it, that these would-be farmers are living upon imported American or Chilian flour, the effects of the land-laws reach a climax of absurdity.

7. The result is shown from a statistical point of view in the following table.

Country	*Year of Estimate*	*Population*	*Estimate of Acres in Crop*	*Proportion of Acres to each Person*
New South Wales	1856	266,189	180,000	68
England and Wales	1846	16,920,879	13,300,000	·78
Canada	1848	723,332	1,281,504	1·77
Prussia	1849	16,285,013	29,782,444	1·83
France	1834	33,152,234	63,099,110	1·90

N.B. – The "acres in crop" for New South Wales are roughly estimated by adding about 10,000 to the returns for 1855, as given in the Census Report.

The other estimates are from M'Culloch, except where it was necessary to calculate the population from the nearest census.

From the above few examples it will appear probable that New South Wales is less advanced in agriculture than almost any other country in the world.

8. By the operation of the land laws is probably explained, also, the extraordinary fact, disclosed by the late census, that the rural and pastoral population only form 55 per cent. of the whole.

Population of Sydney	69,173
Ditto ditto country towns	51,391
Ditto rural and pastoral	145,625
Total of New South Wales	266,189

The number returned as engaged in agricultural occupations was only 16,728, or 6·3 per cent of the whole.

Even in England, the greatest of manufacturing countries, the rural population was just equal in 1851 to the town population, each being therefore 50 per cent. of the whole.

9. The only real benefit of the upset price is, that the sale of Crown lands yields at present about £184,000 per annum, or about one-sixth part of the revenue. The amount is, however, uncertain and fluctuating, and yields a false support, since to expend this for the ordinary purposes of government, is like a man living on his capital instead of the interest of it.

10. The chief additional argument urged in favour of the upset price is, that it prevents *land-jobbing*, and is really no impediment to those who have sufficient capital to commence farming properly. In short, that it rather ensures than obstructs the distribution of land to those who will make the best use of it.

In answer it may be said that, even supposing persons of moderate or considerable fortune are not much inconvenienced by the payment of the tax, there must always be numbers of persons of just such an amount of means that the payment or not of the tax will decide whether they can or cannot become farmers. And in the case of those who are not altogether prevented from occupying land, the effect of the tax or increased price of land is not the less injurious in proportion, as we have before instanced.

As to land speculation—

First – An upset price or tax cannot prevent speculation, but only impedes it in proportion as it impedes all sales or transactions with land from the greater sums of money involved in them.

Secondly, if it be allowed, as surely it must be, that the interests of the State lie in the distribution and cultivation of the lands, the business of the

speculator is really identical with that of the Government, merely with the difference that the work will be performed a hundred times as efficiently by the former, who himself receives a portion of the profits, as by a Government Department. That much money might be made by land-jobbing is perhaps undeniable, but this implies increased gain and value in some direction, and necessarily increased cultivation; and better so than that the land should remain untouched and in every way useless. It is certain that land would now be more accessible to all classes if no upset price had ever been imposed, and that the prosperity and the revenue too of the country would be much larger than it is.

THE LAND LAWS AS THEY SHOULD BE

11. The waste lands are useless to the community, excepting the comparatively small profits which they yield as squatting runs, whereas every acre cultivated yields produce, and supports increased population, which may be taxed in a more or less direct manner for the increase of the revenue.

12. It being one of the chief duties of Government to raise the revenue in the least injurious and inconvenient way possible, the upset price or tax on the occupation of land should be entirely abolished.

13. Large quantities of land, however, having been purchased for many years past on the understanding that this price would always be maintained, it would be a breach of faith to throw a practically inexhaustible supply of new lands into the market at their natural or almost nominal value, unless either compensation be offered to all previous purchasers, which is clearly impossible, or the value of all such purchased land be by some means artificially raised by the same amount.

14. This may be most easily accomplished by imposing a perpetual yearly tax of one shilling per annum per acre, in place of the present upset price, which is equivalent to demanding the interest at 5 per cent., instead of the capital.

15. Every facility to be offered to persons to acquire any piece of waste land they may desire in the colony, but to prevent unfair dealing as well as to ascertain the real value of the land, all sales or rather leasings had better be still made by open auction. The charges on land would therefore be as follows:—

I. Cost of survey, &c., to be paid down.
II. Fixed rent of 1s. per annum per acre.
III. Premium bid at auction.

If the third sum were required to be paid down, it would either act injuriously in withdrawing capital, or lead poor persons to select bad land

purposely. It should be, therefore, turned into a yearly rent on the same terms, or the land should be leased to the person bidding the highest rent.

16. The continual leasing of lands in this manner would yield a steady and perpetually increasing revenue of a perfectly unexceptionable character. It would be of the nature of the *tax on the increase of rent,* proposed and recommended by Mill, the great modern authority in political economy, and as the average value of all lands gradually increased from the growing numbers of the population, the land-tax might be now and then increased, say one penny per acre at a time, the increase being laid of course on all appropriated land whatever. Those portions, however, purchased previously to the change of laws would still enjoy the exemption of one shilling, which is equivalent to a repayment of the upset price.

17. A land office should be established in which all sales and conveyances of lands would be registered, and their respective rents recorded; any purchaser of land will therefore be liable for the rent or tax, until a transfer is made in this office and accepted by the new owner.

18. The tenure of the land to be perfectly secure and complete, and no reservations whatever to be made, but for roads and similar public purposes. The rent or more properly the tax to be only recoverable as any ordinary tax or other debt.

19. Every facility will be offered by the Land Office for the transfer and division of land in any manner that may be desired by the owner, provided that no transfer be allowed for a less quantity than 10 acres in one piece. This is to prevent too minute a subdivision of agricultural lands, which is known to be injurious to productiveness.

20. Land rent to be remitted on any piece of land not exceeding one acre, upon which a house or other erection of the least value of £100 shall be built, the area of land exempted to increase in some proportion if the house be of greater value than £100.

21. Land may thus be freed from the Land Office regulations and divided in any manner for building purposes, but will be registered and assessed in a separate department of the Government, charged with collecting a moderate house tax.

22. The sudden failure of one-sixth part of the revenue ensuing from such a change of laws, would, of course, be inconvenient for the first one or two years. Such large quantities of land would, however, be almost immediately taken on lease, as soon to remedy this. In the meantime the occasion would be a legitimate one for resorting to further loans, as the perpetual interest on the money borrowed by 5 per cent. debentures, would only be equal to the perpetual rents of the average quantity of land at present purchased every year. But much larger quantities would certainly be taken up, and instead of running in debt, the revenue would

be really gaining just as much as if the whole were paid for at the upset price.

23. Great precautions should be taken in making the change of regulations gradually, for instance, by limiting for a few years the total quantities of land allowed to be leased, lest over excitement or a crisis should be occasioned.

24. If laws were carried out on the above roughly sketched principles, it might be confidently said that New South Wales had laid the foundations of the most unexceptionable system of direct taxation in the world. The spontaneous increase of the rent or value of land, and the expenditure of each family as measured by the condition of their dwelling-house, being proved by Mill to be most desirable sources of revenue. With the assistance of duties on spirits and tobacco they might in time provide the whole.

25. And if the lands were thus thrown open to the use of all who have just enough capital to use them, the total produce would be immensely increased, and numbers would find employment in agricultural pursuits who now crowd the towns and depress wages and business in many trades (thus putting a stop to all further clamour about protection).

It is needless to enter into the benefits to the colony and all concerned in it, from the stream of emigration which would spontaneously turn hither from England, as well as from the neighbouring colonies. New South Wales would assume a new importance and a fresh position in the world.

Sydney, June 23, 1857.

W. S. JEVONS TO THE EDITOR OF THE *EMPIRE*

[29 December 1857]

[From a Correspondent.]

A short time since I wasted some trouble in trying to prove that considerations of economy may be desirable even in accepting such a magical gift of science and skill as a locomotive railway. Indirect benefits, and specious appearances of progress and improvement, seemed to me a very shadowy recompense for a most direct and tangible pecuniary loss. And not only do they seem so, but logical arguments from the most indisputable truths of Political Economy lead to the same irresistible conclusion. This was clearly and completely shewn in Professor Pell's paper, read to the Philosophical Society, and lately published in the *Sydney Magazine* for November.

But opinions which will not be accepted for mere words and arguments are now beginning to be impressed upon the public mind by a variety of slight untoward signs. Debentures, secured upon the whole consolidated revenue of New South Wales, are falling in price, or even unsaleable. The stream of capital is, in fact, dried up, indicating a want of confidence in commercial men, which is indeed well accounted for by the actual results of the speculation, viz., 38½ miles of railway in working condition for £1,049,194, with working expenses amounting to 66 per cent. of the total receipts, and leaving £38,439 as an "annual charge on revenue to defray interest." It is almost useless now to re-open the whole question of Government extension of railways, to which we are already more or less committed. The experiment is in progress, and I shall, therefore, only avail myself of opportunities as they occur, to show what the results are, and to prove by a *reductio ad absurdum* that the first principles of common sense, as well as of economical science, have been violated from the commencement. On the present occasion I shall only notice a statement on the subject which, as proceeding direct from head-quarters, perhaps requires all the more a little close criticism.

The statement I refer to is from Captain Martindale's report, as follows:—

	£	s.	d.
Annual charge on revenue to defray interest	59,670	13	7
Estimated gain to community by improved communications, per annum	362,907	11	8
Gain to community by the construction of railways after payment of all expenses, per annum . . .	303,236	18	1

The improved communications referred to in the above being "the entire of the railways existing, in progress, or at present proposed (to be constructed)."

Now, if Captain Martindale were to favour us with the full details of the calculations by which he has arrived at the above satisfactory conclusion, we should probably be smothered with such a complexity of statements as to sections and estimates, gradients, fish-jointed rails, cross sleepers, rolling stock, traffic, &c., &c., as none but the mind of a Royal engineer can fairly grapple with. I will not, therefore, prefer such a hazardous request, but proceed to treat the point after my own method. I regard the above statement as reducible at once to the following three-horned dilemma:— 1st. A fallacy in all Captain Martindale's estimates

and calculations. 2nd. Absurd mismanagement in the regulation of the railway tolls. Or, 3rd. An absurd infatuation on the part of the public employing or that might employ the railway.

Having just stated this, I need scarcely explain it further. We are required to believe that a certain portion of the public, possessing, we may fairly suppose, an average share of common sense, may be expected to travel upon and employ the railways which are proposed to be immediately constructed, and we are informed that they will derive therefrom an annual benefit, pecuniarily estimated at £362,907; yet such railways will be insolvent to the extent of nearly £60,000 per annum. The public using the railway, or receiving benefit from it, coolly pocket £362,907, and are shameless enough to refuse even £60,000, or 20 per cent. of it, to pay the fair expenses, leaving this as a charge upon the remainder of the public whom the railways may positively injure by unequal competition. The alternative is evident. Raise the tolls to the extent of about 25 per cent., and maintain them by the force of legislative authority, and as sure as human nature is governed by the law of self-interest, the most of those who formerly used the railway, will disgorge a small proportion of their former profits rather than obstinately relinquish the whole. Captain Martindale may rely upon the public performing their part of the negotiation with discrimination and common sense, and the third alternative is, in short, utterly inconceivable. I will not attempt to decide between the other two alternatives.

But I shall probably be answered, "Oh, you are under a mistake. This prosperous (but inconceivable) state of affairs is what *is to be* when the extensions already proposed are completed." Well, this I must acknowledge alters the case entirely; there is such a very striking and essential difference between what *is to be* and what eventually *comes to pass,* as cannot better be illustrated than by the difference between the present financial condition of our railways and what Captain Martindale might anticipate according to his own statement if he ventured to raise the tolls. And the same difference might be still better illustrated if we could trace back the first origin and rise of the railway mania in New South Wales, which resulted in that financial phenomenon – the Parramatta railway. I have often wondered, for it does not come within my colonial experience, who they could be that first proposed that undertaking, or by what enticing statements and calculations, on a par with Captain Martindale's "gain to the community," they allured the shareholders who were only saved from loss by the unfortunate adoption of the present Government railway policy.

In the condition of things anticipated by Captain Martindale, a proper regulation of the tolls might undoubtedly render the railways solvent and even pecuniarily profitable, like the Post Office in England. I ask, could

the same result be in any degree expected from raising or regulating the tolls on the present railways? If so, it is the height of folly not to do so immediately. Supposing the receipts of the railways were once rendered sufficient to pay working expenses and interest, can we doubt that capital would immediately be offered at a fair rate from every quarter, where the speculation is profitable, and an additional national security is included. Or again, taking Captain Martindale's "annual charge" at £60,000 and annual "gain to community" at £300,000, is it conceivable that capitalists should now show any signs of distrust, or that, on the contrary, capitalists, contractors, or whole organised railway companies would not rush in to secure such a useful and profitable field for speculation. The only conclusion I can draw is that Captain Martindale's statement is fallacious and even inconceivable, which cannot but throw a shadow of uncertainty over his other conclusions and recommendations so far as connected with finance and economy.

At the same time, I gladly allow that wherever Captain Martindale's technical engineering knowledge and skill are alone concerned, the report seems to be the most sensible and impartial paper on the subject, of which we have the benefit. If there is one glimpse of hope for the substantial yet judicious and economical improvement of our internal communications, it is in the proposal first made, I think, in this report, to introduce here the plank-road of the United States. A party of common fencers, one would imagine, could lay down such a line upon the existing roads, almost as rapidly and easily as they would fence them in. Surely the suggestion of plank-roads should not be lost sight of.

AN EXACT THINKER.

II MR GLADSTONE'S NEW FINANCIAL POLICY

Macmillan's Magazine, Vol. 14 (June 1866) 130–4

This article was written at the time when the public interest aroused by *The Coal Question* was at its height. The background to it is given by the entries in Jevons's Journal for 5 and 11 March and 20 April 1866 (Vol. I, pp. 202–3 and 205) and by his correspondence with Alexander Macmillan and Gladstone (Letters 233, 238, 241–3, 245 and 257, Vol. III, pp. 84–120). In his Budget statement on 3 May 1866 Gladstone referred to Jevons's arguments on future coal supplies as a reason for redeeming debt rather than reducing taxation; this is the 'new financial policy' to which this article refers.

Of the three subsequent papers, the first two largely restate the

essential arguments of *The Coal Question* in a more condensed and more popular form. The third, of which only a brief abstract was published, was written almost ten years after that book had appeared. In it Jevons sought to show that his predictions had been vindicated by the movements of coal production during the intervening years.

The *Standard* newspaper remarks that Mr. Gladstone, having worked out one vein of financial expedients – the remission of taxes – is about to pursue another line of *sensational finance*, by attacking the National Debt. It would be hard to express in fewer words so high an eulogy of both the party and their leader to whom the *Standard* is opposed.

The *Saturday Review* points out how cleverly Mr. Gladstone marked this turning-point in his financial career. "After preparing the minds of his hearers by an exordium of more than Gladstonian mystery, he kept curiosity in suspense for more than an hour while he dilated on the national importance of untaxed pepper and the reduction of the omnibus duty to $\frac{1}{4}d.$ per mile." The petty character of these and other minute fiscal modifications "had, however, a special rhetorical meaning, and served to point the great thesis of the speech, that the period of fiscal revision which we have passed through with such brilliant results is drawing to a close, and that we have now entered upon a new age, in which our chief duty is, and our leading policy should be, to see to the reduction of our National Debt."

Like a musician in composing a symphony, Mr. Gladstone announces the termination of one movement by prolonged cadences, which raise expectation while they defer a new and striking movement. And the new key-note was doubtless struck with consummate skill and with effect. "In the part of his speech," says the *Spectator*, "relative to the exhaustion of coal, when he explained that the misfortune to be apprehended must fall chiefly on landowners – since labour, if wages fall, may emigrate; capital, if profits fall, will emigrate; but land cannot emigrate, and rents must fall if population and capital depart – the country gentlemen looked not only 'rather blue and dejected,' but a little indignant, as if under cover of science the Chancellor of the Exchequer had wantonly invented some new and refined species of torture for them, which they did not know how either to escape or revenge."

Now as regards this proposal to commence a new and vigorous effort for the liquidation of our debt, the *Saturday Review* remarks:—"What Mr. Gladstone says upon this subject is little more than an effective reproduction of Mr. Mill's speech on the Malt Duties."

The *Times*, again, makes it appear that Mr. Gladstone has undergone

a sudden conversion. "The fervour with which he enforced, on Thursday last, the duty of paying off our obligations was new, and men are apt to distrust these sudden conversions. If all that Mr. Gladstone said was true, how came it, they ask, that he now impresses it upon us for the first time? Great financiers have before now been misled."

"It is not necessary," the *Times* continues, "to stake the adoption of Mr. Gladstone's plan for the conversion of permanent into terminable obligations upon the perfect trustworthiness of his speculations on coal. It is tolerably certain that he has exaggerated the rate at which the exhaustion of our coal-fields is proceeding by assuming, with Mr. Jevons, that the consumption will continue to increase in its present rate of geometrical progression; but, on the other hand, it is quite conceivable that some readier means of getting at the heat-power of coal may be discovered, entirely destroying our local advantages as a manufacturing nation. The true point to be considered, is whether the plan of conversion of the Chancellor of the Exchequer is good in itself."

The *Saturday Review* similarly says that "the great coal argument" may be put aside altogether, and that the main point – whether posterity will be better for cancelling the debt – is evaded by Mr. Gladstone and Mr. Mill.

We will accept the suggestion, and put aside "the great coal argument." At the same time it may be remarked that, after the emphatic challenge which Mr. Mill addressed to the House of Commons and the country on the 17th of April, we must wait for a refutation before the question can be shelved. "If Mr. Jevons's conclusions could be shown to be fallacious in any way by an honourable member, it would be most desirable that it should be done; but up to the present time no answer had been given to him which led to more than a comparatively short extension of the time during which a supply of coal may be expected."

But putting the question aside, we hold that it is altogether erroneous to say that Mr. Gladstone has suffered any sudden conversion, or displayed any inconsistency. There is no charge against this great minister more common than that of impulsiveness and inconsistency. In this case, at least, it seems to be wholly unfounded. There are some persons indeed, and even some ministers, who have only one idea, and they are consistent only as long as they pursue that idea.

Mr. Hutton, in his admirable critique on the Chancellor's character, reprinted from the *Pall Mall Gazette,* has beautifully expressed how Mr. Gladstone's mind has something in common with every phase of feeling in the country. He is emphatically a man of many ideas; and when one great idea, that of unimpeded commerce, is confessedly approaching realization, what is more natural and consistent than that the next most important idea should rise into prominence? The consistency of a broad

mind is necessarily different from that of a narrow mind. It is fixed upon foundations which others cannot see.

There is every reason to believe that for years back Mr. Gladstone has looked forward to a reduction of the National Debt as an appropriate sequel to his great Free Trade measures. In his Budget of 1864 he explicitly stated his views. After explaining that the nett sum applied in that year to the liquidation of the debt was 4,146,000*l.*, he added, "The House was pleased last year to give its sanction to more than one measure intended for the purpose of furthering and renewing that policy which aims at the reduction and extinction of debt by the conversion of Perpetual into Terminable Annuities; and I have to acquaint the House that, in consequence of those measures, we have during the last year converted Perpetual into Terminable Annuities, to the extent of 433,000*l.* *The National Debt appears to me to be a very formidable burden, grave and serious even in the midst of our wealth and prosperity, and likely to become even more grave and serious in its pressure if our prosperity turned out to be less permanent and less stable than most of us are disposed to believe.*"

The policy, the measures for carrying it out, and the views which led to its adoption, are identical with those of his last financial statement, only less full and explicit. And there is every reason to suppose that, in this emphatic reference to a "less permanent prosperity" than most of us were disposed to expect, he had his own impressions concerning our coal mines.

Let us remember how strongly Mr. Gladstone's attention must have been drawn to this subject of coal in 1860, when he was carrying the French Treaty of Commerce through Parliament, and debates arose concerning the 11th clause, which prohibits us from laying a tax on the export of coal.

Notions concerning the exhaustion of our coal seams were then freely bandied about, and Mr. Hull was led to undertake his able and successful inquiry as to the total contents of our coal-fields. Most persons, too, must remember the thrill of vague dread which ran through the nation when Sir W. Armstrong, in his address to the British Association in the autumn of 1863, speaking among the scientific and practical men of England assembled at the metropolis of the coal trade, referred to the time when that busy trade must become less busy.

There can be no doubt, too, that Mr. Gladstone's mind has for a considerable time been occupied by independent reflections on the subject of coal. Hawarden Castle lies in the Flintshire coalfield, where exhaustion is proceeding so steadily and palpably that Mr. Hull assigns forty years as the probable duration of the present supply.* It would be

* In this estimate no account is taken, on the one hand, of the increasing demand for coal, nor, on the other hand, of the possible increase of supply by mining under the river Dee.

hardly possible for Mr. Gladstone to shut his eyes to what was going on round his own walls. It happens that his reflections were distinctly stated. On December 30th, 1864, Mr. Beckett, F.G.S. of Wolverhampton, gave a lecture at Mold upon the Flintshire coalfield; and the Chancellor, who was present as an auditor, moved a vote of thanks. After a remarkable speech, displaying the most intimate knowledge of the conditions of the Flintshire coalfield, he said,† "He hoped that 200 years were not to see the exhaustion of the mineral wealth of England, for – having immense confidence in the resources of this country, as well as in the character of the people, which, under God, was the best of all its resources – he did think that there was nothing certainly which he for one should contemplate with such apprehension as the exhaustion of its mineral wealth, and especially of its supplies of coal."

It only needs to be considered further whether the financial arrangements of the country have reached such a point that a change of policy is natural. Fortunately the country is now so well instructed in the doctrines of Free Trade, that almost every one can discern the difference of a tax imposed purely for the purpose of raising revenue, and one which protects a certain branch of industry, and thus tends to alter the application of labour and capital.

The corn tax not only diminishes the consumption of corn by raising its price, but it also causes much corn to be grown within the country under disadvantages which would have been imported from abroad. In a twofold manner it thus cuts down our imports; our exports correspondingly diminish, and it is on these that our manufacturing population are employed. But the tax on tea has no effect beyond that of simply reducing the consumption of this article. The whole that we do use is still imported, so that our foreign trade and the employment of our population are affected only in a simple and minor manner.

It is of course desirable to do away with all taxes as soon as possible, for they all press more or less upon industry and enjoyment. But the general opinion of the public appears to accept what is probably the truth – namely, that all the taxes of exceptional hardship and of distinctly protective tendency are now removed. Future remissions of taxation will affect our enjoyment of luxuries rather than the strength of the springs of industry. The question thus arises whether we are to enjoy everything which the lavish use of coal can give, or whether we are to have some thought for our great-grandchildren.

"What has posterity done for us?" is a question that suits well the bantering tone under which an Englishman loves to hide a subject of serious concern. But why does our aristocracy uphold every vestige of

† *Times*, January 2, 1865.

feudal power? Why does it almost over-esteem every element of stability in our Constitution, unless it be to defer a little later that advent of popular power which centuries hence they fear may considerably modify the form of our society? Why do our great governing families cling to the law of entail if they have no thought of their grandchildren? And yet it is folly to cling to the shell when the kernel is gone; and the kernel of this country, as some think, is being insidiously filched away.

The only question that remains, then, is whether our posterity will really be richer by our raising revenue now, to invest it in the payment of debt "Where there is a will there is a way," and endless fallacies will doubtless be brought forward by those who have the will to show that it is better to owe than to pay. The main strength of these fallacies, however, lies in one plausible phrase, "that it is better to leave the money to fructify in the pockets of the people."§ This phrase will doubtless appear sufficient to those who never look beyond the first aspect of a question, and imagine that there must necessarily be a loss if we take money from merchants and manufacturers who are making 10 per cent. upon it and invest it in funds at 3 or 4 per cent.

But a moment's thought will show that, even supposing taxes come at one end out of capital, yet, in paying off the National Debt, it is returned at once to the fund of productive capital. In proportion as the debt is paid off an equivalent amount of capital will be set free for other investments, and, through the multifarious channels of the Stock Exchange and the Money Market, will find its way into the hands of those best able to use it.

The fact is, however, that only a minor portion of the revenue comes out of the fund of capital. For if a tax be remitted, it is not to be supposed that every one will lay by the whole amount which he formerly paid to the Government. Some may, but most will simply live rather more luxuriously than before. So, in imposing a tax or retaining one already imposed, the savings of some individuals will be reduced and the capital fund affected, but the Government will receive a large sum which individuals would have spent unproductively. Now if the Government invests the proceeds of such a tax by payment of debt, it is obvious that the capital of the country will receive a considerable increase.

It is the stomach, then, rather than the pocket which will suffer by our abstaining from a continuous and excessive reduction of taxes. If we can make up our minds to abstain even in a very slight degree from the full immediate enjoyment of the wealth which Free Trade is developing from our stores of coal, we shall have reason to expect that our grandchildren will enjoy an increased capital fund, and an immunity from a galling

§ See J. S. Mill *Of a National Debt*, Principles of Political Economy, Book v. chap. vii.

burden which we have already too long borne. Even were "the great coal argument," as it is called, put aside, our duty would hardly be less plain. This argument may not possess a definite numerical certainty; we apprehend that no one attributes such to it. But when we consider that our unprecedented wealth is gained by a consumption of fuel equally unprecedented, and exceeding that of all other countries put together; when we consider the depth our mines have already reached, and the still greater depths we must penetrate to if we are to meet the ever-growing demand, while the shallow fields are being worked out; and if we finally remember that in a Transatlantic land are coal-fields many times the extent of our own, shallow, and in the easiest condition for working: we must feel that our present peculiar supremacy must be of limited duration. It is not a foreign people we fear as competitors – it is our own people: the coal-miners and the iron-workers of Staffordshire and South Wales and Northumberland and Scotland are those we have to fear. For they will go, and they do go, and perhaps they ought to go, where high wages and expanding employment are enjoyed.

Let us not then be rendered thoughtless by the power and wealth which is undoubtedly ours at present and for some time to come. Our forefathers incurred this debt in great part for the purpose of securing the liberties we enjoy. Our fathers could not undertake its repayment, and our children and grandchildren will hardly be as well able as we now are to set the stone rolling. "Well begun is half done," and public opinion with singular unanimity allows that we should now make a good beginning. There is even that sign of perfect conviction which consists in imagining that the new thought is a familiar old one. Newspaper editors are just beginning to remember how often they impressed upon their readers the duty of repaying the debt, and the average political Englishman may be heard to exclaim that he always thought we were very neglectful about it.

What has wrought this change? Is it Mr. Neate's motion, or Mr. Mill's profoundly thoughtful and memorable speech; or the "coal argument;" or the lapse of time and the natural change and reaction of public opinion? Whatever it is, there can be no doubt it is Mr. Gladstone's financial skill which has brought us so soon to the crisis when a new policy may be wisely adopted. And it would be folly and ingratitude indeed if we should fail to acknowledge that, so far as appears, the new policy has proceeded consistently from him. If he has suffered a conversion, it must have been in progress years before any one else thought about it. In him we have a leader whose varied feelings and powers fitly represent the many interests of the British nation. To the minutest care and comprehension of our pecuniary interests he unites the highest aspirations towards the future greatness and moral elevation of his country. And on

this question of the National Debt, at least, the party of his warm supporters should include the whole country.

III ON COAL

Lecture delivered in the Carpenters' Hall, Manchester, 16 January 1867

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PROFESSOR ROSCOE, who presided, introduced the lecturer, and stated that his subject would be "Coal, its economical value, and its importance in the arts and sciences." Professor Roscoe added that the lecturer had made a special study of the subject of coal, and had published a book which had attracted great and deserved attention from scientific men, manufacturers, and the Government, and had led to the appointment of a Royal Commission for inquiring into the subject of coal, the amount of its consumption, its probable duration, &c.

Professor JEVONS explained that his remarks would be a continuation of what Dr. Roscoe had told them in his lectures about coal, its numerous uses, and the great power evolved from it by its conversion into heat and motion. Perhaps, continued Professor Jevons, the best way of showing you what coal does for us is to enumerate a few of the principal uses of coal as we apply it. First of all is its domestic use. We use it for warming our dwellings and for cooking. I think that during the present severe weather nobody will mistake the value of coal in warming our houses. I see a great number of carts of coal going about the streets – everybody seems to be trying to get a good supply; but Dr. Roscoe tells me that his coal cellar is empty, much to his inconvenience. I am afraid that a great many others may be in that unfortunate position, with the thermometer near zero. I will give you an idea how much coal is used for domestic purposes. According to the common estimate, the average consumption of coal for each person annually is one ton, which would make about 30,000,000 tons per annum, in the United Kingdom. It is obvious that we should not know what to do without coal, for there is not timber enough in the country to supply the fires. If we burnt wood, we should need to plant nearly the whole of the country with trees. In France wood is still used as fuel, and much valuable land has to be given up to the growth of forest trees. Even in the United States, which used to be considered an

inexhaustible country, the scarcity of wood is becoming felt in some parts, and the Washington government has recommended the planting of trees in some of the states. But the domestic use of coal constitutes a small part of its utility. The next use I may mention is in the working of the metals – for instance, in the blacksmith's forge. From the earliest times coal seems to have been used for the blacksmith's fire. It is peculiarly suitable for making that sort of "breeze" or small coal which is necessary for the blacksmith. It is very probable that the abundance of coal in Staffordshire and Yorkshire assisted in the formation of the iron trade, and the production of those numerous hardwares for which Birmingham, Wolverhampton, and Sheffield are celebrated. But in the present day we use coal in a much more extensive way than formerly, in the coal blast furnace, in making iron. Another use of coal is in the salt trade, which is confined to a limited district, where the salt rock occurs in Cheshire; but that small district supplies the greater part of the world with salt. Salt was originally derived from sea water, through evaporation, by the sun's rays; instead of the heat of the sun we now use heat from coal, which is employed for boiling the salt pans. Without this cheap fuel, salt could not be produced at its present low cost, so that we are able to send salt to India, Australia, and South America, and almost every part of the world. We use coal again in the chemical manufactures of this neighbourhood. It is almost impossible to carry on any chemical operation without an abundant supply of heat, for boiling, melting, evaporating, dissolving, &c. The chief chemical manufactures are situated between Manchester and Liverpool and on the Tyne, the banks of which river are covered with them, as is evident from the fumes and the great heaps of refuse. But far more important is the iron manufacture, or the smelting of iron with coal. This mode has arisen within the last 100 years. It was not until the middle of the last century that men succeeded in making iron by the use of coal; previously it had been done by charcoal. To such an extent has this trade grown that during the last year 28 million tons of coal were used in smelting and puddling iron, that is making it into wrought iron. In all these trades coal produces heat, which is used directly.

The next use is where we turn the heat into force, as in the steam-engine. I need not in Manchester remind you how much the steam-engine does for us. It is used to do the greater part of our work, and such is its force that the people of England are said to perform as much work by the aid of the steam-engine, as all the people in the world could effect by hand labour. I will enumerate a few of the uses of the steam-engine. First of all the engine pumps for us, that is to say, it gives us the power of raising water. You may not at first appreciate the full importance of that use, but the engine was invented for the sole purpose of pumping the water from mines, and without the pumping-engine we could never have had our

mines to anything like their present depth. The iron trade, again, is impossible on a large scale without the engine; of course iron was made before the engine was invented, but not to the same extent. The utmost difficulty was felt a century ago in commanding blast power sufficient for iron works, and it was only by the engine that the power could be obtained which is necessary for producing large iron plates in the rolling mill. It would be utterly impossible to obtain this power by means of wind mills. From 20 to 50 wind mills would be required to produce the power often needed in a mill, and during one-half of the year there might be no wind at all, and the works would come to a stop. Again, the engine is necessary for all our machinery in Manchester. Steam-boats depend entirely on coal, for not only are their hulls and engines made of iron, but they are propelled by coal. I do not think that sailing vessels will be used much longer for passenger traffic and the conveyance of the more valuable class of goods. There will be as little travelling by sailing vessels as there is now by canal boats. If any of you remember the Liverpool harbour and docks 20 years ago, and know what they are now, you will realize how important a part coal plays in our steam navigation. Again, I need not remind you that our inland conveyance is carried on by coal. The locomotive is made by the use of coal, and it burns coal; the railroad is also made by the use of coal for it is an iron road; and although our railways do a great deal for us, I think they will yet do much more. I do not think we have reached the limit of railway construction even in this country, and as to the rest of the world, with the exception of a few countries, they have yet to make their railways. Probably you think that I have mentioned enough uses of coal, but you must not forget that this room is lighted with coal, and that all our best means of illumination are now derived from coal. For nearly 50 years we have had gas illumination, and it has been gradually extending until now every small town in the country is lighted with gas. But during the last twenty years we have commenced the production of petroleum or paraffin oil, that now fill our lamps. I think you can get a good lamp for sixpence, and a better light than by any tallow dip for about a farthing per night. Candles used to be made of wax, spermaceti, and other expensive materials; as fine looking candles, and much cheaper ones are made from paraffin, which is derived from coal. Nor can we see any end to the uses to which the oil derived from coal may be applied. The thicker oils are used as lubricants, taking the place of palm and other oils. We have used tar for a long time as a kind of paint to preserve wood, but it is only of late years that it has been found to yield a multitude of valuable things, such as colours and scents. The beautiful mauve and magenta colours are derived from coal-tar, as well as the pine apple and other flavours that are used in the manufacture of sweetmeats. We used to think that all the wealth came from India; it

comes rather from the "black diamond," as coal has been appropriately named. The coal mines are our Indies. Dr. Roscoe told you the other night that the diamond was nothing but carbon. A diamond hardly larger than your finger end would be worth thousands of pounds, but I think that, according to a just estimate of utility, a ton of coal is far more valuable. Yet you can in some places get a ton of coal at the pit's mouth for five shillings.

Now, considering all these things that coal is capable of producing, we cannot be surprised to find that the coal fields are the chief seats of our industry. I can give a very simple reason for that, namely, that if you carry coal far its price is very much enhanced. Coal at the pit's mouth is perhaps the cheapest thing we use, but its transit to any distance doubles its price. Iron costs £8 a ton; copper, lead, and other metals nearly £100 a ton, yet coal, which is capable of producing all these things costs but 5s. a ton. Although we have developed ways of carrying things cheaply, you cannot carry coals to London without about doubling its price. The best coal, which will be 9s. or 10s. at the pit's mouth, will cost about 20s. in London. In Brighton Dr. Roscoe informs me that coal is 32s. a ton; it is obvious, therefore, that no business can be profitably carried on in Brighton which requires a great consumption of coal. A large number of iron ship-builders in London (15,000 it is said) are out of work. Various reasons have been assigned for this, but I believe the real cause is the high price of coal and iron in London, owing to the cost of carriage. Iron cannot be carried to London without increasing its price about 15s. per ton. The quotations of iron in the London market are always higher than in the Staffordshire market and in the other iron and coal fields. Coal is also dearer in London, consequently shipbuilders cannot compete with builders on the Mersey and the Clyde. I could never quite understand why the masters established iron ship-building in London, where the articles used are so much dearer; and it is not surprising that several of them have failed. The unfortunate result of this misplaced trade is, that when bad times come, and the demand for iron ships falls off, thousands of workpeople are idle and suffering. To show you how the trades arise upon our coal fields and stick to them, I will show you a plan of the English coal fields. [Professor Jevons exhibited on the illuminated screen a series of maps showing the coal fields and the grouping around them of the great trades of England.] There was no part, it appeared, where population was so concentrated as about Manchester. The South Wales coal fields were said to be inexhaustible. In Staffordshire the coal was 30ft. thick and near the surface. The fields in Yorkshire, Shropshire, Durham, Cumberland, and Scotland, were pointed out. There was a small field of coal in the Forest of Dean, a tract of country which was formerly very celebrated. An immense trade had sprung up in South Wales. The Newcastle field

was the oldest. For five centuries Newcastle had supplied London with coal through the coasting trade. From the Whitehaven field Ireland was supplied. The Scotch fields were in Ayrshire, Fife, and the Lothians.

The Professor next pointed out the scarcity of manufacturing towns in the agricultural districts, such as Lincoln and Bucks. In the agricultural counties there were handicrafts carried on, such as straw platting, making boots, gloves, lace, &c. These trades were unknown in the mining and iron districts, where they had more profitable trades. He mentioned instances to show how trades shifted their locality through the discovery of coal. The woollen trade of England, he said, was for many centuries its staple trade. The Lord Chancellor sits upon a woolsack, as an emblem of England's power. The wool trade was formerly most prosperous in Norfolk, but it had almost disappeared from that county, and was transferred to Yorkshire, because the weaving, &c., was now done by steam power, for which a new and cheap supply of coal was necessary. A more surprising instance was the iron trade. Formerly the iron used in England was made by means of charcoal, and the chief seat of the trade was Sussex. The charcoal was got from the woods, taken to a small forge, and power was got from a waterwheel. About 200,000 tons were thus yearly produced in this country a century ago, not more than is now turned out of one iron works. The iron trade has now removed to Staffordshire, South Wales, Newcastle, and Scotland, and there is not a ton of iron now made in Sussex, or anywhere near it.

It is difficult to express what a contrast Lancashire now presents to its former condition. About the year 1400, four centuries and a half ago, it was looked upon as a kind of morass or waste, and the people were supposed to be so uncivilized that travellers did not like to venture into it. Some ancient documents recently discovered, show it to have been about the poorest county in England.* One of the most reliable early English writers was Camden. In his "Britannia," a celebrated book, he speaks of Lancashire as "that country lying beyond the mountains towards the western ocean." He spoke of the people of Lancashire as if they were but half civilized. He says, "first of all, the people whom I approach with a kind of dread. However, that I may not seem wanting, I will run the risk of the attempt, hoping that the divine assistance which has favoured me hitherto will not fail me now." That is the way in which he regarded our forefathers – for I have the pleasure of being a Lancashire man.

An enlarged map showing the localization of the trades was then shown. Almost every trade was found around Manchester, excepting the great iron trade. He did not know why the metal trades were not more numerous on the Lancashire coal field – but perhaps it was because we

* See Professor Roger's History of Agriculture and Prices in England.

had so many other things to do. These trades were, however, springing up, and one of the finest steel works in the country, was that lately built at Gorton. He had hoped to have another map showing the railways, but the snow had prevented it being photographed. This map would have displayed the remarkable fact that the railways were most ramified and numerous close upon the coal fields. In the agricultural districts the railways were fifteen to twenty-five miles apart. The lines that paid best were those connected with the coal fields. Some of the earliest railways, such as the Great Western and the Great Eastern, which ran through agricultural counties, were now the most unfortunate, although at one time great hopes were entertained of their success. On the other hand the railways that ran through coal fields, or were connected with them, especially the London and North-Western, appeared to have the power of developing an endless amount of traffic. This connection of railways and the coal trade, the Professor added, is more intimate than you think. The fact is we owe the railway to coal. Railways were invented two centuries and more ago for the purpose of carrying coal and for no other purpose, and for nearly two centuries they were used only for carrying coal and a few other minerals. Again, it is by the use of the locomotive, another product of coal, that we have been able to spread railways. And what I want to point out is that the railway system is still necessary for the coal trade, for we could not carry the weight of coal we require by any other means. Twelve of the great railway companies last year carried 50,000,000 tons of coal, the remainder was carried by the other companies, and by canal and sea. The enormous amount of coal we raise depends greatly on the railways for its conveyance to the several towns and villages of the country, and it is only by extending our railways still further that we can develop the coal trade in a way that the coal owners desire. There are at present several schemes afloat for extending our coal railways: one line is to run all the way from Newcastle to London, purposely to carry coal; another is to run right through the Lancashire district, in order to carry coal to Liverpool and to ship it there, as well as to supply the steamers. Another line is designed to carry coal from South Wales to London. Now it is plainly by the use of railways that we develop the coal trade, and it is the coal trade that favours the extension of the railway system; they work one into the other. I will point out another proof of the result of the use of coal depending upon the density of population.

On an average of the whole kingdom there are 344 persons to a square mile. In Lancashire we have 1,280, that is nearly four times as many as in the rest of the kingdom. Staffordshire has 652, the West Riding 564 persons to the square mile. Now contrast that with some of the agricultural counties:—Bucks 230, Hereford 147, Dorset 192, Lincoln 148.

The most striking proof perhaps of what coal is doing for us is shown in the progress of population. All the coal producing counties are increasing very rapidly. Lancashire in the ten years from 1851 to 1861 increased in population 20 per cent, Staffordshire 23 per cent., West Riding 14 per cent, Durham 30 per cent. Glamorganshire 37 per cent. Now of these counties Durham and Glamorganshire are the two counties where the trade has been developed most rapidly. Compare those numbers with the following for the agricultural counties:—Bucks 3 per cent, Hereford 7, Dorset 2, Lincoln 1, Somerset no increase at all; but that is a great deal better than a falling off, which we find in a good many counties. Suffolk diminished 2 per cent in population, Wiltshire 2, Cambridge 5 per cent.

I might go on to point out the changes in towns. It is curious that the larger towns are the more rapidly they increase proportionately to their size. I will read a sentence from the census report:— "The towns where silk and woollen goods and gloves are made increased slowly; the towns famous for cottons, for stockings, shoes, and straw plait increased more rapidly. The increase of population was most rapid in the seaport towns, and in the mining districts, where hardware is made, in that direction the tide of natural industry has recently flowed."

I might show you in another way what coal does for our manufacturers, by accounts of the quantities of goods produced, by showing in short upon what we live. It is obvious that we live to a certain extent upon the wheat, barley, oats, potatoes, cattle, and garden produce of our fields, gardens and dairies. We also spin and weave the wool of our own sheep, and the flax grown in Ireland. But it is obvious that these products are not capable of much increase. On the other hand we use every year a great quantity of foreign produce, not only wheat but things that do not grow in England. Thus we get sugar from the West Indies, tea and silk from China, rice and spices from the East, and cotton from almost all parts of the world. How do we get these things? Of course we have to pay for them. For every £100 worth of material brought into the country we must send out £100 worth in return. To India we send a great deal of gold that we get from Australia, and we send silver got from South America. But how do we get the gold and silver? We must pay for them. We get them by means of our coal produce. We work all these materials up into things which other nations desire to buy, and it is only by constantly shipping more and more goods that we get more and more additions of material and food. The consequence is we must go on using more and more coal in our manufactures.

I will now draw your attention to the quantity of coal we use, and the value of it.

Perhaps you might say that it is not our coal alone that is so valuable, but our copper, iron, and lead mines. But these are unimportant in

comparison with coal. I can tell you exactly what these things are worth. Mr. Hunt, of the Mining Record Office, in London, states that in 1865, the value of the ores raised was:—iron, copper, lead, &c., £7,821,000; coal £24,537,000; so that the value of coal is three times as much as the other minerals. You may see this in another way. We not only use our own copper, lead, iron, and other ores, but we import largely from other countries. The fact is that the Cornish copper mines are beginning to fail, and we can get metals cheaper elsewhere. Many years ago there prevailed a notion that we were using a great deal of coal, but there were only wild guesses as to the quantity, until 1854, when the first return was made at 64,600,000 tons. Since then we have had accurate accounts of the consumption of coal every year. The following table shows the quantity of coal raised and exported in Great Britain from 1854 to 1865:—(See Postscript, p. 28)

COAL TRADE OF GREAT BRITAIN.

Year.	Coal raised.		Coal exported.	
1854	64,661,000	tons	4,309,000	tons
1855	64,453,000	,,	4,976,000	,,
1856	66,645,000	,,	5,879,000	,,
1857	65,394,000	,,	6,737,000	,,
1858	65,008,000	,,	6,529,000	,,
1859	71,979,000	,,	7,081,000	,,
1860	83,208,000	,,	7,412,000	,,
1861	85,635,000	,,	7,222,000	,,
1862	83,638,000	,,	7,694,000	,,
1863	88,292,000	,,	7,529,000	,,
1864	92,787,000	,,	8,063,000	,,
1865	98,150,000	,,	8,585,000	,,

Last year people were rather alarmed to find that the consumption had risen to 98 million tons. It is hard to form a notion of what a million is. At the Crystal Palace they have printed a piece of calico with a million dots, to enable people to see how many a million is, but you cannot take in the number with the eye at all, consequently you cannot conceive what a hundred millions would be. But to give you some notion of what the weight and size of this coal would be, I have drawn here a representation of the Great Pyramid of Egypt, and another picture by the side of it, of the much greater coal pyramid which we consume every year. The Great Pyramid, it is said by Herodotus, was twenty years in building, and it took 100,000 men all that time to raise it. It contains 3,394,307 cubic yards of stone. The coal raised last year would make a Pyramid of 100,000,000 cubic yards, since a cubic yard of coal weighs very nearly a ton. The

quantity of coal we raised is therefore thirty times as much as the Great Pyramid, which is considered one of the greatest works ever erected. The largest stone work in England is said to be the Plymouth Breakwater, but the Great Pyramid contains six times as much stone as that; yet our coal raised in one year was thirty times as much as the stone in the pyramid!

The question has been suggested by a number of writers as to whether sooner or later, we shall not get to the bottom of our coal mines. A hundred million tons of coal is an enormous quantity to consume every year; but it is not this amount that is so alarming as the rate at which the consumption increases year by year. In 1865 we used half as much again as in 1854. Now if we go on in that sort of way – if in 1876 we use half as much again as we do now, and still went on in that way, we should get to amounts that would be alarming to contemplate. Some people say we shall not do so – that we shall economise our coal, use it more carefully, and get more power out of it in the steam engine. The fact is, we are doing that now. Iron is now made by much less coal than it used to be, yet we use more coal than ever. Engines are better now than they were in 1854, but this has not cut down our coal consumption; then what is the likelihood that it will do so in the future? The fact is that coal is a thing of such value to us that we cannot help spending it – there is more temptation than we can resist. It is such a useful substance that we find wealth in it more and more every year. The consequence is there is one trade that always seems brisk. If you read the trade reports in the newspapers, you will see that the Cardiff steam coal trade always seems to be brisk. But, I ask myself, is it really favourable for us to be spending our capital at this rate, and will it always be so?

And again, it is not so much the amount of coal that we use, as that compared with the coal produce of other countries which is astonishing. It is obvious that our enormous power of coal partly explains our extraordinary position in the world. You will appreciate what I mean when I compare the total produce of coal in Britain and in the world. We used 98 millions; now the known coal produce of the whole world is said to be 164 millions, so that we used 60 per cent of the coal used in the whole world, although we are only 30 millions of people out of about 1,220 millions. All the Anglo-Saxon nations together use 116 millions, or 70 per cent – seven parts out of ten are used by one race. This may explain, in some degree, the advance of this race in material power and possessions. But then we ought to look at the comparative quantity of coal in different parts of the world. Professor Jevons referred to a map showing the proportion of the coal in various countries. Russia was said to have a large quantity of coal, but scarcely any of it was worked. Australia has a certain supply. New Zealand has a small deposit. The maker of this map has indeed inserted a large black tract, or coalfield, in the interior of

Australia. Now, if he is correct, and there are really those extensive coalfields, Australia will probably become the first country in the world. But I am very much afraid it is a mistake. But when you come to North America we have the most solid reality as to the extent of coal. In the interior there are great expanses of coal of the most perfect quality, and in circumstances most suitable for working, such as the Pennsylvanian and Mississippi fields. The better way will be to compare the relative extent of coal produced in different countries:— Great Britain, 98 million tons; Zollverein, 20; United States, 16½ (rapidly increasing); France, 10; Belgium, 10 (also rapidly increasing); Australia, 4½; Russia, 1½; Spain, 300,000; New South Wales, 250,000; Ireland, 123,000. The last quantity is as much as one respectable colliery in England would turn out. It is said that there is a large area of coal in Ireland, but it certainly is not worth much. Among all the reasons given for Irish misfortune, this absence of coal goes a considerable way.

Now let us compare these products of coal with the quantities believed to exist in different countries. I have represented the extent of the English coal measures by a black square indicating 5,400 square miles; Prussia contains 1,370, much less than England; so with France, 984. The United States contain the largest area of coal in any country – viz., 196,000 square miles. They have the means of developing the coal trade almost indefinitely.

The only thing that remains to be said is as to what we ought to do under the circumstances. The fact is that if other nations go on increasing their yield of coal – especially if America develops her resources, as she must do – then we cannot hold such a prominent position as we do now. I do not say that we cannot always be pretty well off, but we cannot take the lead in the markets of the world, and have the largest shipping and coal trades, and the largest manufactories, because not only shall we find it difficult to get coal for ourselves, but they will be getting a great deal more, and coal will be much more valuable 50 or 100 years hence, because it will be more and more a source of power. Some people think that we ought to begin cutting down our produce of coal, and that we ought to prohibit the exportation to France and other countries. But that is a very narrow-minded view of the question. I do not know that we have a right to keep things to ourselves in that manner. I think it is the duty of every country to use its wealth to the best purpose, and to communicate it in the way of free trade. We do not give them our coal for nothing – we get something for it; and it would be in every way a most short-sighted policy to violate those admirable doctrines of free trade which Manchester has done so much to establish. But if by increasing our trade we are diminishing our wealth for the future, then we ought to be thinking about that. It strikes me that the best way to prepare for future time is by taking

every advantage of the present. I do not think that our descendants will blame us if we take proper precautions to use our coal economically, and to get the best possible return for it – that is to say, the most force and the most wealth, and not to burn it needlessly upon waste heaps, as is sometimes done. And, secondly, when we get this wealth from our coal, we must take care to turn it to the best account. We must use our wealth as it ought to be used. If we use it in mere luxury and mismanagement, such as in our dockyards, we shall be justly blamed; but if we use it in improving the condition of every one, so far as it can be improved – if we use it in providing education, in improving the dwellings; and if we could by any possibility use it so as to do away with pauperism, and to provide libraries and institutions or anything that will increase the power and improve the character of our people, then I think we shall never be blamed for using our coal too fast. This is the way in which we shall best provide for any future difficulties under which our country may labour.

A vote of thanks to the lecturer, moved by one of the audience, and carried with applause, concluded the proceedings.

POSTSCRIPT. – Several years having elapsed since the delivery of the above lecture, the following additional figures can be given to show the subsequent progress of the coal trade of the United Kingdom.

Year.	Coal raised.		Coal exported.	
1866	101,630,000	tons	9,367,000	tons
1867	104,500,000	,,	10,565,000	,,
1868	103,141,000	,,	10,967,000	,,
1869	107,427,900	,,	10,744,000	,,

IV ON THE PROBABLE EXHAUSTION OF OUR COAL MINES

Lecture delivered at the Royal Institution, 13 March 1868

Originally printed in *Notices of the Proceedings at the Meetings of the Members of the Royal Institution of Great Britain,* with Abstracts of the Discourses delivered at the Evening Meetings, vol. v, 1866–1869 (1869) pp. 328–34.

I. THE coal raised from the coal mines of the United Kingdom in the year 1866 amounted to more than *one hundred million tons* (more exactly 101,630,544 tons), according to the excellent returns published by Mr. Robert Hunt, of the Mining Record Office. Reflecting upon the full significance of this fact it may be asserted:—

1. That the coal trade of this kingdom is the greatest trade, in regard to the bulk and weight of the commodity, ever carried on.

2. That every pound of that vast quantity of coal may be regarded as a pound of the most intrinsically useful and valuable substance ever discovered.

3. That the power and usefulness of coal is felt in every branch of industry, and in almost every operation which we carry on.

4. That Britain possesses the aid of this most invaluable substance in an altogether peculiar degree; and –

5. That we cannot hope to stand very long in this most happy position.

II. So vast a quantity as 100,000,000 tons cannot be represented to the eye or mind. Its bulk is 30 times as great as that of the greatest single work of human hands, the Pyramid of Cheops. Greater quantities of commodities are brought into British ports at present, than are recorded in the history of any nation, and yet it would take more than seven times as many vessels as those which enter our ports in a year to carry the quantity of coal we use.

More than half of the whole carrying power of the railways of the United Kingdom, devoted to goods traffic, is occupied in the conveyance of coal. So far as we can judge from returns, which do not always distinguish the kinds of goods carried, the goods traffic of the railways of the United Kingdom in 1865 was as follows:—

General Merchandise*	36,800,000
Minerals	18,300,000
Total	55,100,000
Coal and Coke	59,500,000
Total	114,600,000

III. This vast trade in coal can only be accounted for by considering the wonderful qualities with which coal is endowed. It is the MAINSPRING OF OUR MATERIAL INDUSTRY. It may be called the real Philosopher's Stone, which supplies us cheaply and plentifully with everything that can

* Not including live stock, of which the weight is not ascertained.

conduce to the service of man. This extreme usefulness of coal is due –

1. To the enormous power which is latent in it, and is brought forth when we burn it;

2. To the fact, now so clearly revealed by science, that *force is the key to all the changes of matter.*

By aid of the mechanical equivalent of heat, we can ascertain that good coal contains latent force sufficient to raise its own weight 11,422,000 feet, or about 2100 miles against the force of gravity. The coal raised in 1866 may further be calculated to contain force equal to that which would be exerted by 530,000,000 horses, or 2,650,000,000 men, working eight hours a day for 300 working days in the year.

IV. This vast power is turned to use in an indefinite multitude of ways, which may thus be rudely classified.

CLASSIFICATION OF THE USES OF COAL

(I.) AS SOURCE OF HEAT.

1. *For Household Use.* – Warming and ventilating houses, churches, public buildings, &c.
2. *For the Alteration of Cohesive Condition of Substances.*
   Melting and casting of metals; softening and forging of metals – the blacksmith's fire.
   Manufacture of glass, bricks, earthenware, &c.
   Boiling salt, soap, &c.; brewing; distilling; drying substances.
   Chemical manufactures.
3. *For the Production of Power by the Steam, Gas, or Hot-air Engine.* Pumping water; draining mines; supply of water; removal of sewage.

Steam navigation.
Railways, and road locomotives.
Hammering, rolling, and working metals.
Mill and factory labour.
Hydraulic and pneumatic machines.
Small machines moved by gas engine.
Machine agriculture; steam ploughing, &c.
Manufacture of ice.

(II.) AS REDUCING AGENT; SOURCE OF HEAT, WITH CHEMICAL AFFINITY.

Smelting of the metals – iron, copper, lead, zinc, &c.
Chemical manufactures.

(III.) As Indirect Source of Electricity by Magneto-Electric Machines.

Electro-telegraphy.

Electro-metallurgy.

(IV.) As Source of Light.

Gas manufacture; petroleum; paraffin candles.

Electric light-house illumination.

Photography by artificial light.

(V.) As Source of Material.

Tar, pitch, naphtha, lubricating oils.

Ammoniacal manures; carbolic acid; aniline dyes; ethereal odours and flavours, &c.

It is only by thus collecting together the multitudinous uses of coal that we can gain an adequate idea of its importance to us and the certainty that its use will extend.

V. Comparing, now, the present yield of coal (100,000,000 tons annually) with the quantity which Mr. Hull believes to lie in these islands, within 4000 feet of the surface and in workable condition (83,544,000,000 tons), we find that we might continue to consume coal at our present annual rate for 835 years at least; but when we remember that our consumption has increased by 36 millions in the last twelve years (from about 65 millions in 1854 to 101,000,000 in 1866), and that the causes of increase still continue in existence, we cannot attribute any importance to the above calculation. There is no appearance that steam navigation or railways have at all approached their full development in this country; while in the steam-plough, in schemes of steam-drainage or water-supply, the employment of steam-produced hydraulic pressure, in the use of small gas-engines in workshops, and in a multitude of other ways, we have some indication of the increased future demand for coal.

VI. Economy, it may be pointed out, does not tend to reduce the industrial consumption of coal, but acts in the opposite direction: by increasing the profitableness of coal-labour, it extends its use. Almost every improvement in the engine for the last century and a half has been directed to economizing the consumption of coal; and yet the use of the engine and the quantities of coal consumed advanced *pari passu* with its economical performance.

It is altogether irrational to argue that progressive economy, which has coexisted with and been the partial cause of advancing consumption in the past, will have the opposite effect in the future.

VII. As regards the law of increase of coal consumption, both experience and theory lead us to believe that the increase takes place in a geometrical series, by multiplication rather than by mere addition. The following numbers will illustrate the difference in question:—

Arithmetical Series, increasing by addition . .	1	2	3	4	5	6	7	8
Geometrical Series, increasing by multiplication	1	2	4	8	16	32	64	128

The following table will show that when we can get accurate statistics of the consumption of coal we find the increments indefinitely increasing, in the manner rather of a geometrical than of an arithmetical series.

Year.	Total quantity of coal imported into London	Increase in fifty years.
	Tons.	Tons.
1650	216,000	—
1700	428,100	212,100
1750	688,700	260,600
1800	1,099,000	410,300
1850	3,638,883	2,539,883
1863	5,119,887	5,696,170*

The above and other statistics quoted in the 'Coal Question,'† Chapters IX. X. and XI., show that our industry grows by multiplication, and by multiplication at a rising rather than at a falling rate. The temporary depressions of trade which occur at intervals may sometimes seem to check the rapidity of this increase; but we have only to wait a year or two to see our industry advancing again with growing strides.

No statements of the total amount of coal produced in this kingdom are the least to be relied on, except those collected by Mr. Robert Hunt, the Keeper of Mining Records, and the following is a statement of the general progress of the coal trade of the United Kingdom as ascertained by him:§—

Year.	Coal raised. Tons.	Coal exported. Tons	Year.	Coal raised. Tons.	Coal exported. Tons.
1854 ..	64,661,000 ..	4,309,000	1861 ..	85,635,000 ..	7,222,000
1855 ..	61,453,000 ..	4,976,000	1862 ..	83,638,000 ..	7,694,000
1856 ..	66,645,000 ..	5,879,000	1863 ..	88,292,000 ..	7,529,000
1857 ..	65,394,000 ..	6,737,000	1864 ..	92,787,000 ..	8,063,000
1858 ..	65,008,000 ..	6,529,000	1865 ..	98,150,000 ..	8,585,000
1859 ..	71,979,000 ..	7,081,000	1866 ..	101,630,000 ..	9,367,000
1860 ..	80,042,000 ..	7,412,000			

It is impossible to view, without some degree of alarm, so rapid an increase of the coal trade as the preceding figures indicate. Without doubt our production will advance to 200 millions before very many years are past; and the alarming calculation may be made that if we went on

* Increase as for fifty years, if continued at same rate as during the thirteen years experienced.

† 'The Coal Question: an Inquiry concerning the Progress of the Nation, and the Probable Exhaustion of our Coal Mines.' By W. S. Jevons, M.A. 2nd ed. revised. London, 1866. (Macmillan.)

§ I am kindly informed by Mr. Hunt that when the returns of the consumption of coal in 1867 are completed, the total will probably amount to 104,000,000 tons, showing continued increase in spite of the depression of trade.

increasing our production of coal for 110 years as rapidly as we have done during the last 12 years, our coal seams would be worked out to a depth of 4000 feet. But such a supposition is put forward, not as a serious possibility, but as a *reductio ad absurdum*. The conclusion to be drawn from it is simply that the nation cannot possibly progress in material wealth for 110 years more as rapidly as it has done in the present century. The limited extent of our coal-fields would not allow us to go on increasing the draught of coal as lavishly as we have done. But it is the very necessity of changing from a highly progressive to a less progressive or stationary condition, that is most grievous. Population and production, when once set in motion, move with a certain impetus, and it is the check to such motion which is distressing and threatening.

VIII. The subject wears a more serious aspect still when we consider the coal resources and production of other countries as well as our own.

According to the latest returns which are at hand, it would seem that the total known produce of coal in the world is thus distributed over the chief nations:—

	Tons.
Great Britain	101,630,000
United States	25,800,000
Prussia and the Zollverein	20,610,000
France	10,710,000
Belgium	9,935,000
Austria	4,500,000
British North America	1,500,000
Russia	1,500,000
Spain	300,000
New South Wales	250,000
Ireland	123,500
Total	176,858,500

It would appear then that of the total *known* produce of coal in the world we raise considerably more than half (57 per cent.), although we form probably not more than one in forty of the population of the world. If to our own coal produce we add that of the United States and our colonies, we may conclude that the Teutonic race enjoys 73 per cent., or almost 3 parts out 4, of the coal raised. It is hardly possible to over-estimate the forces acting in our favour which are represented by this partial monopoly of the most powerful material agent of civilization.

The total quantity of coal existing can hardly be said to be known in the case of any one country; but some notion of the comparative coal resources of different countries may be gained from the following

statement of the area of the coal-measures in the chief coal-producing countries, as estimated by Professor Rogers:—

	Area of Coal Lands in square miles.
United States	196,650
British North American Possessions	7,530
Great Britain	5,400
France	984
Prussia	960
Belgium..	510
Bohemia.	400
Westphalia	380
Spain	200
Russia	100
Saxony	30

Though Great Britain is far more abundantly provided with coal than any continental nation, our resources sink into insignificance beside those of North America, and no very long period will elapse before this comparative poverty in coal will make itself felt.

IX. It is continually suggested, indeed, that before coal is at all likely to be exhausted, some substitute will be found for it, and appeal is made to some old proverb, like *Necessity is the mother of invention*. But it requires very little philosophy to see that the proverb is very partially true. We live in a chronic state of necessity and difficulty, and the great discoveries which we enjoy are but so many exceptional instances in which we have been unexpectedly relieved from labour and evil. We have no real ground for supposing that when one exceptional advantage is withdrawn from us, another will immediately be extended to us.

The favourite notion that electricity will be the future source of power is entirely fallacious; for the coal-driven engine moving the magneto-electric machine is now the cheapest source of electricity, and by gradual improvements, such as that in Mr. Wilde's machine, coal will become a still cheaper source of electricity. Even the elements of the electric battery have always been practically furnished by the reducing power of coal. If coal then become, as there is every reason to suppose it will, a cheaper and cheaper source of electricity, it is obviously absurd to suppose that electricity should supersede the power of coal.

It is conceivable, indeed, that in the course of ages some wholly new source of power might be discovered; but there is no reason to suppose that this island, which forms but the one four-hundredth part of the total land-area of the globe, would be as richly endowed with the new source of power as it is with coal. If the sun's beams are in the future to be the direct

source of power, it is the plains of Africa or of Australia that will be the seats of industry and not this cloud-obscured Isle.

X. The conclusions we must come to on this subject are then as follows:—

1. The power of coal is extending itself and making itself more widely and deeply felt every day. It is more and more taking the place of wind, horse, or manual power, and is becoming the universal-assistant.

2. We are naturally led every day to extend our consumption of so invaluable a substance, and experience shows that the more we use the more extensive are our augmentations.

3. Our consumption is already commensurable with our total supply; that is to say, we can form some notion how long our supply will endure with a stationary consumption.

4. As this consumption increases by multiplication, our national life becomes shortened, and it is apparent that the increase cannot go on very long at the present rate.

5. The moment we are forced to draw in, other nations, possessing far more extensive fields of coal compared with their annual consumption, will be enabled to approach and ultimately to pass us.

6. The exhaustion of our mines, as it will probably manifest itself within the next hundred years, will consist not in any stoppage of supplies, but an increase of cost, and the impossibility of increasing the consumption each year as at present.

XI. At some future time then, when coal will be even a more useful agent than at present, we shall stand in a position of comparative inferiority. For such a time we can best prepare ourselves, not by short-sighted restrictions on the consumption or evaporation of coal, but by freeing the nation from its burdens of debt and ignorance and pauperism. We have many great tasks to perform, which can only be undertaken with a fair hope of success when the nation is in a state of high prosperity and progress. It will be too late to think of such great undertakings when our progress is checked, and the pressure of population and the want of employment are grievously felt. It is in a period of free expansion like the present that we can alone take any effectual measures for raising appreciably the standard of education, comfort, and morality of the people; and if we do not use the abundant wealth which our coal resources now afford us to fulfil such duties, we undoubtedly misuse it.

V ON THE PROGRESS OF THE COAL QUESTION

A paper read before Section F of the British Association for the Advancement of Science, Bristol, 1875.

Abstract printed in Report of the 1875 Meeting, *Transactions of Sections*, p. 216.

The purpose of this paper is to compare statistical facts concerning the recent progress of the output of coal with various predictions and theories which had been published on the subject in the previous fifteen years. The quantity of coal raised in the United Kingdom in the year 1873 amounted to the enormous weight of 127,000,000 tons, according to the mineral statistics of Mr. Hunt. Professor Hull, in his valuable work on the English Coal-fields, had questioned the power of the coal-fields to admit of a much greater drain in any one year than 100,000,000 tons, at which rate he believed the supply would be sufficient for eight centuries. Facts now entirely negative the hypothesis of any such fixed limit.

Sir W. Armstrong, in his Presidential Address of 1863, put forward his celebrated calculation, that the produce of coal was advancing by a uniform arithmetic annual addition of $2\frac{3}{4}$ millions of tons, at which rate the coal in the country, as then estimated, would last only 212 years. According to this law of increase the produce in 1873 ought to be 119 millions, which is 8 millions *less* than the truth, the increase in the interval being at least 41 millions, instead of 33 millions, as it would be according to Sir W. Armstrong's method of calculation. The annual average addition to the output is now nearly $3\frac{1}{2}$ millions of tons, instead of $2\frac{3}{4}$ millions; but the true law cannot really be that of arithmetic increase, which, if followed backwards, would lead us to zero about the year 1830.

The true law of increase is that of a geometrical series, with the average annual ratio of $3\frac{1}{2}$ per cent. According to this law, as described in the 'Coal Question' in 1865 (1st ed. p. 213, 2nd ed. p. 240), it was calculated that the produce of coal in 1871 would be about 117·9 millions. According to Mr. Hunt's statistics it proved to be actually 117,352,028 tons. On the same method of calculation the produce of 1873 would be about 126·3 millions; and the actual quantity raised, as already stated, exceeds this by about 700,000 tons. In spite of the extraordinary rise of price of coal in the years 1872 and 1873, the law of geometric increase is thus remarkably verified.

In the Report of the Royal Commission on Coal some calculations of Mr. Price Williams are put forward, in which the average consumption

(apart from exportation) of coal per head of the population is assumed as rising from 3·9636 tons in 1871, to 4·4266 tons in 1881, 4·5786 tons in 1891, and so on, to a maximum of 4·6526 tons in 1941. But, according to this method, the *consumption* (not including coals exported) of the year 1873 would be nearly 6 millions less than the truth. Mr. Price Williams believed that the rate of increase of consumption of coal per head had passed its maximum, and was declining, whereas the most recent statistics show that between 1869 and 1873 the advance was more than double that in the interval 1865–69. The whole theory of Mr. Williams rested upon the assumption that there was a continuous decrease in the rate of increase of the population, whereas his own tables showed that this increase was, in the last decade (1861–71), 11·736 per cent., compared with 11·197 per cent., that of the decade 1851–1861.

It is further pointed out that the remarks of the Commissioners upon the "Coal Question" proceed from an entire misapprehension of the arguments given in that book. No one asserted that the production of coal in Great Britain ever would rise to the higher quantities given by the geometric law of increase. The true conclusion drawn was, "*that we cannot long maintain our present rate of increase of consumption; that we can never advance to the higher amounts of consumption supposed. But this only means that the check to our progress must become perceptible within a century from the present time.*"

In the year 1872 the price of coal rose in many places to a height two or three times its previous highest amount. This rise was in some respects exceptional, but was mainly due to the increased demand which, in spite of the enormous price, advanced 5 per cent. per annum. The great increase in the number of collieries produced by the extraordinary demand, will no doubt render the price more moderate for some time to come; but the coal famine of the years 1872–73 may be regarded as the first twinge of the scarcity which must come, and it has taught us that coal has now become the first necessary of life in this kingdom.

VI THE IMPORTANCE OF DIFFUSING A KNOWLEDGE OF POLITICAL ECONOMY

Delivered in Owens College, Manchester, at the opening of the session of Evening Classes, on 12 October (originally published as a separate pamphlet, Manchester, 1866).

This is the full text of the introductory lecture to public primary school teachers which 'brought some little criticism from the Radicals' on

Jevons. The full circumstances are detailed in Vol. I, pp. 207–8; see also Letters 269 and 270, Vol. III, pp. 132–8.

I HAVE been requested by our Principal to give the opening lecture of the present session of Evening Classes, because, by the appointment which I have recently had the honour to receive in this College, my connection with these Evening Classes becomes of a permanent and somewhat peculiar character. The Cobden Memorial Committee have given a certain endowment to the Professorship of Political Economy in Owens College, and have laid it down as a condition that all teachers in schools supported by public funds or contributions in Manchester or Salford shall be admitted to an evening course of lectures in Political Economy without payment of the class fee.

As Professor of Political Economy, I thus become likewise the Cobden Lecturer on the same subject, and have to undertake the work of carrying out, as far as possible, the excellent intentions of those who have founded this Lectureship. While I may safely say that there is no occupation which I should undertake with more pleasure and prosecute with more effort, I must also add how well I am aware of the difficult work to be done.

It seems very appropriate that I should take the present opportunity to enter at once upon the work of the Lectureship by explaining the exact purpose and nature of the course of lectures which I have to deliver. I have endeavoured to ascertain as closely as possible the object which the Cobden Memorial Committee have in view, and to this of course I shall adhere, as far as my ability may go.

The founders of the Cobden Lectureship desire to take a step towards disseminating through the community, and especially among the working classes, a comprehension of the principles of political economy which govern the relations of employers and employed, of rich and poor, of buyer and seller, of debtor and creditor – those social and industrial relations on which the prosperity of every one and of the whole nation depends.

It is thought desirable that instruction in political economy should be given, at least in the case of the poorer classes, at a very early age, – almost as soon, in fact, as a boy has acquired the power of reading with facility. It is desired that all teachers of boys from about eight years of age and upwards should devote a certain portion of time to instructions in social economy, and should qualify themselves for the purpose by attendance upon a course of lectures. Though the teacher will of course only have to communicate to his boys lessons and maxims of a very simple character, it is almost indispensable that he should himself acquire a thorough

comprehension of the science from which his lessons are drawn. Incidentally I may say that there seem to be at least three strong reasons why a teacher should know far more of a science than he can ever hope to communicate to young pupils.

Firstly, he ought conscientiously to assure himself of the truth of what he is going to deliver, and not repeat the lessons by rote, as if he had no further concern with them.

Secondly, without a knowledge of the science the teacher cannot have any feeling of its value, and will probably think his time and trouble uselessly spent in trying to teach social economy to boys. Bacon, indeed, says of studies – "they teach not their own use; but that is a wisdom without them and above them, won by observation." While on the one hand it is obvious that if a person keeps entirely to one study or science he cannot well know its value or use comparatively to other studies, it must be allowed on the other hand that those who know nothing of a science cannot possibly judge whether it will be useful or not, nor whether it can be taught to any given pupils. I fear that to most persons political economy is a mere name and suggests hardly the slightest notion of what the science is.

Thirdly, the lessons will come with far more force and clearness if they come from a powerful comprehension of their nature and foundations in truth. I need say nothing to establish this.

The instructions of the Cobden Lecturer are to be opened freely to all teachers in public schools in this neighbourhood, in order that they may have some inducement to begin or proceed with the study with such slight advantages as I can give them. It is hoped that many may thus gain both the desire and the power to introduce the subject successfully into their schools. Those teachers who disregard or are prejudiced against this movement will undoubtedly be those most ignorant of the nature of political economy.

I propose now to describe as well as I can the special reasons, as I conceive them, for promoting the diffusion of a knowledge of political economy. In stating these reasons I shall indeed feel as if I were attempting to add a sequel to the very able Introductory Lecture lately given by my colleague, Professor Ward, in the Town Hall. His subject was "National Self-Knowledge." Γνῶθι σεαυτὸν, "Know thyself," was the famous precept, the importance of which he proved by illustrations drawn from the history of ancient and modern nations and persons. He showed how a mistake as to our own nature and powers leads pretty surely to failure and ruin. It is indispensable that in every thing we do we should obey the natural laws under which we are placed, and we cannot be sure we obey them unless we know them.

Si vis omnia subjicere, subjice te rationi – 'If you wish to conquer all things,

subject yourself to reason,' – is a wise maxim, the meaning of which has been even better expressed in one line by Tennyson, who speaks of

"Ruling, by obeying nature's powers."

Now, it is obvious that these great precepts, *Know thyself* and *Obey thy own nature,* must be observed not only in the policy of a great nation but in every slight act of an individual. Where we do not observe them we are as likely as not to make nature herself our opponent and to incur the reward of ignorance and presumption.

Knowledge, indeed, cannot do everything, and we need something above knowledge. Still, the greater part of the misfortunes and unhappiness of life may be avoided by knowledge, and our appointed way to avoid them is by energetic efforts to gain the necessary knowledge, and to act according to it.

We have been endowed at our creation with powers of observation and reasoning which seem capable of penetrating by degrees all the secrets of nature. When we are suffering under or are threatened with any evil we should not content ourselves with hoping or praying for its removal only, but we should set in action all our faculties, and by first acquiring and then diffusing all the knowledge we can gain of its nature and causes, we should place in the hands of men the means of averting it. It is not our own power we use, it is the Divine power of knowledge.

As man by intelligence and cultivation delivers himself from positive physical want and becomes capable of a higher life and activity, he seems to incur at the same time new dangers. The first man, for instance, who mounted a horse has caused the death of many careless and unskilful riders, but he has contributed to the advantage of infinitely more. Ships have on the whole grown more useful and more safe from the time when our Celtic ancestors paddled about in coracles. But nowadays when a vessel is faultily fitted in some small particular, or carelessly managed, we have a catastrophe like the sinking of the "London" or the burning of the "Amazon." Our ancestors, again, could hardly imagine the benefits which we derive from railways, but they could hardly, on the other hand, conceive to themselves a disaster so instantaneous and terrible as a railway collision. The carelessness of a single man, the disorder of some delicate mechanism, or the breaking of a single pin or bar, may bring the most dreadful slaughter and mutilation to hundreds.

The greater our triumphs over nature the worse the punishment we incur for any remissness or faulty ignorance.

The same is exactly true of moral and social affairs. Our population multiplies, our towns spread, our industry grows and diversifies indefinitely by the aid of knowledge and skill. But there is hardly an advance which is not qualified by some risk or disadvantage incurred. We

cannot fail to be proud of our vast metropolis and other great towns; but the overcrowding of people occasions sanitary evils with which we can hardly cope.

The progress of our commerce, again, brings us at intervals into dangers and distresses comparable in intensity to the advantages which it usually provides for us. Thus the cotton famine was an event that had long been dreaded, and I think reasonably dreaded. Its worst results were, however, averted when the time came, by a loyal love of order on the part of the suffering operatives, by a liberality on the part of the country generally, and by a skilfulness and energy in organization on the part of gentlemen on the spot, which cannot be too much admired.

But when, last April, the very greatest of our financial houses, a very pillar of the money market, as it was thought, broke down – when a monetary panic set in which might have stopped the industry and exchanges of the whole country, and when the Bank of England itself might have been obliged to suspend payments, – then we must have felt that we had a vast machine in operation in our midst the working of which we did not fully understand and could not safely control. Nor do the unreasoning acts of speculators and merchants, and even bankers, or the various and absurd opinions expressed by most persons as to the causes and remedies of the catastrophe inspire us with much hope that similar disasters will be avoided for the future.

The best example which I can give, however, of the evils and disasters which may accompany progress is to be found in trade unions and the strikes they originate and conduct. Of these I may say, in the words of a recent article of the *Times,* that "every year sees these organizations more powerful, more pitiless, and more unjust. Such atrocities as that reported from Sheffield are but the extreme cases of a tyranny which is at this very moment paralysing the large part of the trades of the country."*

In mentioning trade unions I must advert to their political bearings on the present occasion, because as I am considering the importance of the science of economy I must look beyond it, according to the maxim of Bacon. But I must add that in my classes I make a point of keeping within the subject and taking a perfectly neutral position with respect to political questions, just as in all the classes of the College my colleagues and myself are bound by the will of the founder to abstain from inculcating any theological doctrines.

While these unions are in many respects proofs of admirable self-control on the part of the working classes, they cause great uneasiness

* This quotation has been interpreted as meaning that the trades unions were responsible for the occurrence of trades-outrages: but I did not attribute this meaning to it, nor had I the least intention of making such an assertion. The useful purposes which unions may serve are adverted to on pp. 48 and 49.

among those entrusted at present with the government of the country. England, we are fond of believing, is the country in which exists the truest liberty and the truest toleration, and we may well be happy in the belief that this liberty becomes year by year truer and greater. By liberty I do not mean merely what is vulgarly regarded as liberty by many, the privilege to vote for a representative in Parliament. I mean what Mr. Mill upholds as true liberty, in that noble essay which is perhaps the best of his great works. According to Mr. Mill, human liberty comprises – first, liberty of conscience, absolute freedom of opinions on all subjects; secondly, "liberty of tastes and pursuits, of framing the plan of our life to suit our own character;" thirdly, from this liberty, says Mr. Mill, follows the "liberty . . . of combination among individuals, freedom to unite for any purpose not involving harm to others." He adds, "no society in which these liberties are not, on the whole, respected is free, whatever may be its form of government, and none is completely free in which they do not exist absolute and unqualified. The only freedom which deserves the name is that of pursuing our own good in our own way, so long as we do not attempt to deprive others of theirs, or impede their efforts to obtain it."[1]

This is the kind of liberty and toleration which we desire to cherish in this country. It cannot but happen indeed that where perfect individual liberty of this kind is enjoyed many must err and injure themselves by their error. It is for no want of regret for such error, or want of care for what we think the true and good that we uphold liberty which tolerates the false and, possibly, the evil. Toleration reposes on a profound trust in the value and strength of truth, a trust that truth will prevail and that error will show its worthlessness.

It may be confidently asserted that almost the whole of the upper classes of this country not only desire to uphold and advance the liberty of opinion and combination, but even to introduce a large part of the working classes within the governing power of the state by giving them the franchise. Mixed, however, with the strong desire to achieve progress such as this, is a fear that political power may be misused through ignorance. We wish every working man to be not only free, but privileged; but to this end he must have intelligence and education, else he is not free but in name. He must know what are the true principles of free thought, and free action, and free combination. He must learn to see that in the trade unions, in which he chiefly places his hope at present, there is no true individual freedom, but that he is entirely at the mercy of the prevailing opinions of his fellow-workmen, often in fact of a few leaders of the union.

[1] J. S. Mill, *On Liberty* (ed. R. B. McCallum, Oxford, 1946), p. 11.

I have enumerated many great disasters arising from a want of knowledge; but there is one great disaster almost the greatest that I can figure to myself. It is that our working classes, with their growing numbers and powers of combination, may be led by ignorance to arrest the true growth of our liberty, political and commercial. This fear is not so chimerical as it might seem. If we look to the English colonies in Australia we see that the extension of the franchise has been followed by the overturn of free trade and the establishment of protective tariffs. Having personal acquaintance with some of the Australian colonies, and having noticed from the first the rise of the protection doctrines there, I may venture to assert with the more confidence that there is hardly any part of the earth's surface where such doctrines will do more harm. The doctrines of protection, whatever they may be elsewhere, are wildly irrational when applied to Australia. Yet they are in the ascendant there among a body of electors who are through ignorance doing all they can to retard the progress of rising states which are in all other respects the source of the greatest pride to Englishmen.

I might point again to the United States as an example of a great nation where the true commercial interests of all classes are sadly misconceived from an ignorance of the principles of economy and freedom of trade as they have been discovered, expounded, and put in practice, with the utmost success in Europe.

To avoid such a disaster as the reversal of the free policy of the country we must diffuse knowledge, and the kind of knowledge required is mainly that comprehended in the science of political economy. The working classes are doing harm to themselves and the country by the want of such knowledge; they have done harm ever since (by advancing freedom) they had the opportunity, and as freedom advances further they will do more and more harm, to an extent we cannot measure, unless they act from a better knowledge of their position and true interests. They act from wholly mistaken notions of their relations to their fellow-workmen and their employers. Not only is this to be regretted in itself as tending to sap the foundations of the industrial prosperity of the country, but it is to be regretted because it tends to retard the extension of the franchise and the advent of many true social reforms.

I hope that I may never be found among those who would wish to stay that progress towards all that is noble and free, which marks the course of English history. But the more I desire that this nation may attain the highest possible point of development, morally, politically, and industrially, the more do I regret any tendency which seems to me to be contrary to that development. And truth compels me to admit, against my inclinations, that those numerous classes of the population, whose hopes are usually thought to be on the side of liberty, do not always

estimate the character of liberty aright. I fear especially that they are prone to act in a manner directly contrary to the laws of free industry.

Having thus attempted to point out the necessity for a better comprehension of social laws among our population, I should like, if I could, to put before you the extreme difficulty which there is in overcoming the unreasoning prejudices of men on the subject. In questions which have economical and political bearings, the dictates of science and reasoning, are not calmly listened to. Every man thinks himself alike able and privileged to form his own opinions by his own unaided intelligence. Yet it is not so in any other branch of learning or science. So great and frequent have been the triumphs of physical science that the most ignorant crowd would feel some deference for the superior knowledge of a chemist, an electrician, or an astronomer on their own subjects. No sane man disputes the calculations of the Astronomer Royal and the predictions of the "Nautical Almanack," for people are aware not only how often astronomers have been proved right, but that astronomy itself is a science which cannot be understood without long study.

How unenviable would be the position of the Astronomer Royal if he had not only to ascertain and predict the moon's place to a nicety, but had every now and then to convince a crowd of persons at the hustings of the truth of his predictions by making plain to their untutored intellects the minutest details of the lunar theory. How much worse would it be if, when he failed to convince them of some point in the problem of the three bodies, they forthwith accused him of inventing the whole for interested purposes, to maintain his own emoluments or the privileges of his class. Such, however, is really the unfortunate position of any person who endeavours to discuss a question of social economy with an uneducated mass of persons. The teacher of physical science is never in such position. When an astronomer predicts an eclipse or a comet, when the analytical chemist detects poison or adulterations, when the meteorologist discovers the approach of a gale, they are listened to with almost unquestioning deference; and even one scientific man hardly ventures to question the results of another whose subject of study is at all remote from his own.

A little reflection will show how different it is in the case of the social sciences. These sciences, in the first place, deal with subjects far more difficult than the physical sciences. To convince you of this I would refer you to Mr. Mill's chapters upon the logic of the moral sciences, at the conclusion of his great treatise on Logic. Political economy is an older science than chemistry, and is far older than the science of electricity and several other most prolific branches of physical science. Yet so difficult is the subject that we have not yet advanced safely beyond the lowest and simplest generalisations. Political economy is not yet an exact science.

But the difficulty of his subject is not the worst difficulty in the way of the political economist. The worst difficulty is the obstinacy, prejudice, and incredulity of those he has to convince. Bentham has said, with regard to moral science and jurisprudence – "Gross ignorance descries no difficulties; imperfect knowledge finds them out and struggles with them; it must be perfect knowledge which overcomes them."

The best student and teacher of social science is but struggling with his difficulties and imperfect knowledge; as to the rest of the population they are involved in that state of mind which descries no difficulties at all, and is but too ready to act accordingly.

The mechanic, for instance, finds no difficulty in comprehending his social and economical position. He sees that his employer gives him just as little wages as he can. It is obvious then that the workmen of a trade should combine and refuse to work for so little and then they will get more. Common sense is quite sufficient to show that.

A workman, again, sees that a machine, requiring the attendance of one or two men, does the work of many. If such a machine comes into use his own sense tells him, he thinks, that many will be thrown out of work, and himself probably among them. The instinct of self-defence leads him to destroy the machine.

The tradesman sees that the more a rich man buys from him the more profit there is to trade, the more employment to men. Common sense shows that free expenditure sets trade going, and there arises a feeling of approbation in the community in favour of those who live well and spend freely, as compared with those of a saving disposition.

The merchant feels that the more money he can borrow to trade upon the more he can gain. An extended issue of paper money is what he thinks requisite for diffusing activity of trade and general prosperity.

As regards the poor and dependent classes of the population, it is clear that a gift gives satisfaction to the receiver. Few, then, of charitable disposition can realise the fact that charity, unless it is given with the utmost discrimination, does far more harm than good. And who is there that is not offended by the political economist when he proves that a poor law must be harsh and niggardly if it is not to undermine the sources of our welfare? Even the most eminent men – such as Mr. Dickens and Mr. Hughes – have enlisted their common sense and high talents against the conclusions of the political economist.

Common sense yet rules in social discussion, and few can be made to see that economical science is but founded on common sense, refined and more intensely applied. Every workman and person of common intelligence has felt his way roughly to certain conclusions, so obvious to him that he refuses to look further. He cannot be made to see that he has reached only the beginning of a series of results and effects, of which the

last would very much surprise him by its difference from the first. He would find too often that what is evidently beneficial in the beginning is immensely and widely hurtful in the end.

It is the duty of the political economist to try to trace out the ultimate effects of actions, and conditions, and laws on the wealth of individuals and the nation. This is well expressed in the title of an admirable little work of M. Bastiat, "What is seen, and what is not seen." This work has been translated by Dr. W. B. Hodgson, and was published first in the columns of the *Manchester Examiner and Times* in 1852, and afterwards in a separate form. I shall have to direct the attention of my classes to it, because, with a simple clearness of language, and a brilliancy of wit and illustration to which no English economist can lay claim, M. Bastiat contrasts, in a number of different incidents, the apparent and the unapparent results, and leads the most unwilling reader to confess that the prepossessions of his common sense are proved by a more penetrating course of reasoning to involve error and injury.

There was a time not many centuries ago when men thought that the earth stood still, and the sun moved round it. Their common sense told them so, and they were prejudiced in favour of this opinion to the extent of imprisoning and persecuting those who thought otherwise. There is hardly a child who does not know the contrary now, and in place of a mistaken prejudice we have now a noble science. It is for us to endeavour to overcome similar prejudices which lie in the way of the social science, and thus to bring on the time when the natural laws which govern the relations of capital and labour, and define inexorably the rates of profits and wages, will be obeyed.

I should like now to spend a few minutes in putting before you the proofs how much the opinion and will of the workman in these economical questions influence and will influence the prosperity of himself and his country.

In the first place, I think it is hard to exaggerate the extent to which the progress of industry and invention is hindered by the antipathies of workmen to the introduction of machinery and improvements. It is true that we do not now have bands of Luddites collecting after dark and destroying whole factories full of machinery. In the textile and certain other trades the use of machinery is so fully established that there is little or no further difficulty in the matter. I believe, too, that trade unions often now refuse to support their members in opposing the introduction of new machines. But there is still an immense force of passive resistance in occupations to which the use of machinery is new. Workmen are usually able to destroy machinery in an underhand manner, by over-loading or over-running it, or by secretly inserting a bar among the wheels and hidden parts. Employers are thus much deterred from erecting new

expensive machines. Only two or three weeks ago I saw, in the Dudley Midland Exhibition, samples of chain cable of which the links were very successfully shaped and forged by machinery. Only four miles off I saw a fine new works in course of erection for the manufacture of cables by hand forging. The proprietors of the new works were fully acquainted with the success of the new machine, but hesitated to introduce them in their Staffordshire works, fearing the hostility of the many chain-makers in the neighbourhood. If introduced at all, these machines will probably be erected in works at a distance from Staffordshire. Thus will the ignorance of the chain-makers tend to drive away an important branch of manufacture from its ancient seat.

In the Great Exhibition of 1862, many must have noticed the very interesting type-composing and distributing machines. It would be of the greatest advantage to the diffusion of knowledge to lower the cost of setting type; but the use or even the fair trial of these machines has been prevented by the absolute refusal of compositors to work in a shop where they are tried.*

At the late Social Science Meeting it was stated that attempts had been made to lower the cost of erecting workmen's dwelling and lodging-houses, and thus improve their domestic condition by employing bricks of a larger size than usual. The insuperable difficulty was at once encountered that no bricklayers could be found who would set such bricks.

Many must be the cases of inventions and improvements which, when once frustrated by opposition, have been abandoned and forgotten. I am peculiarly acquainted with the case of a machine for making horse-shoes invented by an American gentleman many years ago. My father purchased the patent for the United Kingdom, and had no difficulty in making shoes as good and cheaper than they can be made by hand. On trying to introduce these, however, he found that every farrier in the kingdom declined to have anything to do with machine-made shoes. As those who shoe horses are almost invariably the same men who make the shoes, it was soon seen to be hopeless to overcome the prejudice, and the attempt, I believe, has never been repeated.

It avails not to say that in these or any other cases the machines did not work successfully or cheaply enough. It is only after long experience and improvement by actual working that a machine can be brought near its maximum of efficiency. There is cost and difficulty enough in bringing any invention or improvement into use without the opposition of the whole series of labourers and tradesmen on whom its use depends. If a composing machine, a brick-making machine, a chain-forging machine,

* A compositor, writing in the *City News*, has denied that the trial of the machines was prevented, but he allowed that the rules of the Printers' Trade Society prohibited the employment of women to work or attend upon the machines in any way.

or any other machine, will not and cannot succeed, why should workmen hesitate to try it and demonstrate its failure. The fact is they needlessly hate its success, and will not allow it even to be tried.

Had I time I should like to advert again to strikes and trade unions, and point out by examples and details how contrary they are to the principles of industrial freedom. It will be, however, our work in the classes to consider this fully. I will only say that they are in their nature and present designs directly contrary to the principles of free labour, the promulgation and establishment of which by Adam Smith has led in a main degree to our present prosperity. In the 10th chapter of the 1st book of the "Wealth of Nations," Adam Smith pointed out with all his beautiful clearness of argument and illustration the evils which the policy of Europe has inflicted upon labour, "by not leaving things at perfect liberty." Those are his words. "The property," he says, "which every man has in his own labour, as it is the original foundation of all other property, so it is the most sacred and inviolable. The patrimony of a poor man lies in the strength and dexterity of his hands; and to hinder him from employing this strength and dexterity in what manner he thinks proper without injury to his neighbour, is a plain violation of this most sacred property. It is a manifest encroachment upon the just liberty both of the workman and of those who might be disposed to employ him. As it hinders the one from working at what he thinks proper, so it hinders the others from employing whom they think proper."

These remarks were aimed against the incorporated trades and guilds, or universities, as they were called, which, by strict regulations and restrictions as to the admission of apprentices and members, tried to secure their own advantage, indifferent to the public good. Such things are swept away in this country, and there are hardly any laws now existing in this kingdom which can be said to press upon the free employment of labour. But Dr. Smith could not have anticipated, when more than a hundred years ago he opposed laws and customs then in existence, that a hundred years afterwards there would arise among free bodies of workmen unions and corporations of vast extent, distinctly aiming at the restriction of employment.

Let it be distinctly understood that it is not the existence of combinations the political economist protests against. We cannot have too much co-operation and combination among men for purposes in accordance with the laws of nature and the laws of the country. All classes of people, all districts, towns, and villages, should have their unions, institutions, and societies, and meetings of various kinds. And it is highly desirable, at the same time, that every class of tradesmen and workmen should meet in their societies and unions to exchange information and assistance, and to concert every means of really and permanently

benefiting their own body and the community. Any matter concerning the convenience and health of the workman – such as the length and arrangement of the hours of labour and the time for meals, the allowance of holidays, the mode and time of paying wages, the wholesomeness and safety of factories – should be discussed by workmen among themselves in their unions. But this is where a want of a knowledge of economy and the laws of the working of society is so indispensable. When they pass from these matters in which an employer should consult the welfare of his men collectively, to regulate or raise the rate of wages, to enforce equality of work and wages, they bring their own and others' welfare into peril; and what I want you especially to see is, that, with the increasing intelligence and habit of co-operation among labourers, there is the more urgent need of a knowledge of economy, that they may restrain their power within natural laws - that they may, in short, know themselves.

It is only knowledge that can enable workmen to draw the rather nice boundary between what their unions may very properly interfere with, and what they should not touch.

As it is, however, the unions are becoming every day more arrogant in their attempts to coerce their employers and rule their own trades by exclusive corporations or universities, embracing the whole labour of each trade in one inflexible and resistless body. I quoted to you a sentence from the *Times*, which, I believe, is quite within the truth. It is hardly possible to take up a newspaper without seeing several accounts of strikes, dissensions, and sometimes even of trade outrages.

In order to show you how the matter is regarded by persons engaged in trade, and competent to judge, I will read you extracts from a letter I happened lately to receive. "In our business as iron merchants," says the writer,[2] "we are continually hearing of the despotic tyranny they display in their conduct towards the ironmasters, who are now positively afraid of them, and hardly dare speak to them. There is a strike now pending in the Cleveland iron district against a reduction of wages, the issue of which is very uncertain, though it has continued for several months. The manufacture of iron has become a losing business with the masters, owing to the long-continued depression of business and the competition with foreign manufacturers; and yet the men will not submit to any reduction of wages from the highest point. We know it for a fact, from our own experience, that the French and Belgians have been supplying the Continental demand for iron for the last two or three years, and have supplanted English iron almost entirely by their lower prices. Our business with the Continent has dwindled away to nothing, owing to that cause; and we have many letters telling us, in reply to our quotations and

[2] Timothy Jevons. See Letter 265, Vol. III, p. 127.

solicitations for orders, that the writers can buy what they want cheaper in France and Belgium. What, then, is to be done? Until lately, England was the cheapest market in the world for iron, and now we are undersold by our nearest neighbours. The wages now demanded by our workmen are far more than what their fathers and predecessors were paid for the same kind of work; and yet they will not submit to any reduction. Is England, then, to lose its prestige in one of its most important productions, owing to the unreasonable conduct of its workmen. In our own business, the common labourers whom we employ in the warehouse in handling and weighing iron, to whom we for a long time paid 3s. 6d. a day, have lately demanded 4s., and have compelled us to pay it, for they will not permit a strange man to be employed at all, though we could get plenty at less money. And this kind of thing is not confined to the iron trade: it pervades almost every branch of trade and manufactures. You have probably seen in the papers what riots have recently taken place in the South, from the introduction of some foreign navvies, on a railway. Such is the spirit that pervades our whole labouring population. It seems probable that they will deprive the country of all the benefit of our free-trade policy. We certainly want free trade in labour quite as much as we wanted free trade in corn twenty years ago."

We must remember that the trade of this country will have difficulties to meet in future years from which it has in times past been comparatively free. The very staple commodity on which it works, coal, will before very long rise in price, if it is not already rising. Not only in France and Belgium have we competitors whom it never occurred to us to fear, but in the United States there are mineral resources, inventive skill, and mercantile energy which may easily leave us behind. Let us remember, too, that our productive population, and our productive capital, have a great tendency to emigrate and increase the powers of our competitors. If, then, there be superadded to all these tendencies which will act against us, a truculence and tyranny on the part of the workmen unknown in other countries, we need nothing else to make us fear that capitalists will gradually withdraw their capital from home employment and invest it in the colonies, United States, and foreign countries.

It will be our work in the class to consider the nature of capital and the strong reasons which economists have discovered for believing that the average rate of wages in a trade cannot be raised by strikes and unions, and that thus the strikes and contentions which have occurred between employer and employed since the combination laws were repealed in 1824, represent a vast loss to workmen as well as to capitalists and the country in general.

I have wished by this and previous instances to make plain that advancing intelligence and freedom may but lead our operatives into loss

and disaster unless they are furnished with appropriate knowledge of natural laws which they cannot escape from, and must ultimately obey. Men think that by the repealing of human laws they become free to act as they like. They must learn that there are natural laws even of human nature which they cannot break, but against which they can easily, through ignorance, throw themselves to their own destruction.

I will now only consider, in conclusion, how we may best hope to impress upon the people generally a knowledge of economy. To publish cheap treatises, though they be the very best treatises, like the People's Edition of Mr. Mill's works, will not have the desired effect, for in few cases will they be bought by the working classes. We cannot expect that men working hard during the day, should spend their evenings in the study of abstruse and difficult treatises. Mr. Mac Culloch published, some twelve years or more ago, a sixpenny work on wages and labour, intended to be generally read among the working classes. "There are none," he says in the preface, "who are more deeply interested in having the truth, as respects their situation, honestly and fairly stated, than the workpeople. It will be seen that at bottom they have no exclusive interests, and that their prosperity is intimately connected with, and is indeed inseparable from the prosperity of the other classes." But this work was not much read by those for whom it was intended, nor was its style well adapted to the purpose.

Miss Martineau made a very different and clever attempt, more than thirty years ago, to spread a knowledge of political economy in a series of tales entitled "Illustrations of Political Economy." The tales are very interesting and readable, and the doctrines clearly inculcated and sound. But like many other moral tales, they have not been so much read as they deserved, nor have they been read by the classes in whom we are concerned.

The works of M. Bastiat, especially his "Harmonies," and his tract before mentioned, "What is seen and what is not seen," are excellently adapted for general readers, and have, I believe, been much read in France. They have been both translated into English, but in spite of Dr. Hodgson's efforts, are not so well known as they should be.

Dr. John Watts, again, of this city, the secretary of the Cobden Memorial Committee, has published cheap tracts on trade societies, machinery, co-operative societies, and strikes, excellently adapted for reading among the working classes, by whom several of them I believe were favourably received.

Still it must be apparent that efforts like these, even when attaining the measure of success hoped for, cannot produce any deep and wide-spread influence upon the opinions of a large population. We must begin upon children, and impress upon them the simple truths concerning their

social position before the business of life has created insuperable prejudices.

The first writer, so far as I know, who produced a work on social or political economy suited to the use of children was Archbishop Whately, than whom a sounder and more judicious thinker and writer never lived. We may be sure that we are doing nothing wild or impracticable when we are following him. Many years ago he printed, through the Society for Promoting Christian Knowledge, a little book entitled "Easy Lessons on Money Matters for the use of Young People." It was, by the bye, my own first text book on the subject when I was certainly not more than ten or twelve years of age, possibly only eight. In 1843 it had reached the 7th edition, and it is still in common use, having reached the 16th edition.

An extract from the preface to this little work will show very distinctly Whately's opinion on the subject of this lecture:— "The following short lessons," he says, "were designed, and have on trial been found adapted, for the instruction of young persons from about eight years of age and upwards. Care has been taken to convey elementary knowledge on the subjects treated of, in such simple language that it is hoped these lessons will be found, with the help of explanation and *questioning* on the part of the teachers, easily intelligible, even to such as have but the ordinary advantages in point of education; and there are few subjects on which it is for all classes of people more important to inculcate correct principles, and to guard against specious fallacies. All persons in every station must, when they grow up, practically take some part, more or less, in the transactions in question. The rudiments of sound knowledge concerning these may, it has been found by experience, be communicated at a very early age: and that they should be inculcated early is the more important, because at a later period there are more difficulties in the way of such elementary instruction. Many, even of what are called the educated classes, grow up with indistinct, or erroneous and practically mischievous, views on these subjects; and the prejudices any one may have casually imbibed are often hard to be removed at a time of life when he imagines his education to be completed. When such simple elementary principles as those here taught are presented to him he is likely contemptuously to disregard them as childish 'truisms;' while the conclusions deduced from those principles are rejected by him as revolting paradoxes. Those, therefore, who are engaged in conducting, or in patronising or promoting education, should consider it a matter of no small moment to instil betimes just notions on subjects with which all must in after-life be practically conversant, and in which no class of men, from the highest to the lowest, can, in such a country as this at least, be *safely* left in ignorance or in error."

I conceive that the success which has attended the use of this little book

is sufficient to show that social economy can be taught to children even from the age of eight years.*

Of late years an effort has been made by Mr. William Ellis, the patron of the Birkbeck Schools, by Dr. W. B. Hodgson, Mr. Shiel, lately a teacher in University College School, London, and others to introduce the teaching of Social Economy into schools for young boys generally. Though only some half dozen schools have been tried in this movement the success has been so encouraging as to lead the founders of the Cobden Lectureship to desire its general introduction in this neighbourhood. We do not in fact need to go far for an example of success. For in the Manchester Free School, in Deansgate, about five minutes' walk from here, the teaching of social economy was introduced by Mr. Templar, of Manchester, with complete success. On Mr. Templar's promotion the teaching has been continued with like success by the present head master, Mr. Mellor. At the Liverpool meeting of the Social Science Association, in 1858, Mr. Templar pointed out most distinctly the importance of the views now more widely adopted. He showed not only the utility of the information which may be given, but also its suitability for the purpose of exciting and exercising the thoughts of the pupils.

Those who are at all incredulous about the possibility of teaching such a subject to young boys should be present at one of Mr. Mellor's lessons and hear with what accuracy and interest a number of little ragged boys out of Deansgate and other parts will answer questions concerning the variety of wages in trades, the division of labour, the use of money, and so forth. The subject is taught in this school to all boys who have learned to read with facility a small work called "Reading Lessons in Social Economy for the use of Schools," prepared for the purpose by Mr. Templar. A portion of the lesson is read over by the boys in turn, and its meaning and contents fixed in the mind by numerous questions.

It may be confidently said that if schoolmasters generally would make themselves acquainted with the doctrines and value of economical and social science, they would at once perceive the inestimable service which they might perform to their pupils and the community generally by introducing it as a subject of their lessons. And I will add a word to remind those engaged in elementary education, that in their hands lies the destiny of the country. Any one who has followed the late admirable debates on education in the meeting of the Social Science Association, or any one who only reflects on what is seen every day, must feel that our only chance of a permanent amelioration is by a comprehensive and thorough system of education for all.

* I may also especially recommend a little work entitled *Outlines of Social Economy*, published by Messrs. Smith, Elder, and Co., as written in a peculiarly clear and excellent manner.

In these days of high wages I believe there is nothing to prevent any mechanic or operative, as a general rule, from saving money by degrees. He may invest it in Savings' Banks or the Government Annuities, and insurance office, or better still in co-operative stores and undertakings. He may thus secure himself and his family from the accidents of life, and may even become a capitalist sharing in the profits of capital as well as labour; able again by the funds at his disposal to move and establish himself where he likes, or if he prefers, to emigrate with comfort and advantage. There is nothing in short but prejudice to prevent him gaining a position enviable for its independence. But it is distressing to think how much might be done by appropriate education when we see how little is done. No country ever enjoyed wealth and opportunities at all approaching to what the various classes of English society now enjoy. The working classes alone have been calculated to earn £400,000,000 sterling, and it is a reasonable estimate that £80,000,000 annually are spent upon drinks and tobacco. It is assuredly then not the want of means and money that makes our population so different from what it ought to be. It is the want of knowledge.

VII TWO LECTURES ON POLITICAL ECONOMY

Delivered at the Mechanics' Institute, Hyde, Cheshire (*North Cheshire Herald*, 6 February and 13 March 1869)

Of these lectures Mrs Jevons wrote – 'In February and March 1869, he (Jevons) gave a course of lectures on political economy to working men at Hyde, near Manchester. Some influential gentlemen of that neighbourhood desired that a course of such lectures should be given, and when they asked Mr. Jevons' help he would not refuse it, for no one felt more strongly than he did the need of extending political economy to the working classes' (LJ, p. 246). Of this course, only the report of two lectures, published in a local newspaper, has survived.

I

The PROFESSOR commenced by expressing his sorrow at disappointing them a few weeks previously by not attending according to announcement, but added that as he was ill at the time, he had no alternative. He then proceeded to say:— In the present lecture we will attempt to give

some notion of the subject we have to treat, and the arrangement of the course. Political Economy means, of course, the economy of the State. The very common word "political," is derived from a Greek word signifying city or State. Again, economy means management. In reality it means management of the household, from the Greek words for house and law, or regulation. Good economy means a thrifty management, in which we get the best for our money. But we also apply the word generally, as in the economy of a factory, of a farm, rural economy, and when we wish to speak of the house especially, we call it household economy. It may perhaps partially explain the meaning of the name if we say with Mr James Mill (Elements of P. E. p. 1), "Political Economy is to the State what domestic economy is to the family. The family consumes, and in order to consume it must be supplied by production. Domestic economy has, therefore, two grand objects in view, the consumption and supply of the family." But I think there is a difference. In the economical management of a house we look only to the wise spending or consumption of income. But the economy of the State, even a more important branch of the subject, regards the gaining of the income, or production. We ought to take care that we do not form an exaggerated notion of what we can do in Political Economy. To suppose that it could treat of the whole management of State affairs, of all that concerns the welfare and prosperity of a nation, would be absurd. There are a number of sciences which are more or less conducive to such welfare. Moral philosophy considers the grounds of men's duties and obligations towards each other, and the effects of their characters and actions on the general good. Jurisprudence shows how some of the more definite and important rights and duties of men may be embodied in laws and enforced by the united power of the community or State. International law contains a system of moral rules which ought to guide the actions of nations towards each other. Political philosophy treats of the power by which laws are made and enforced, the mode by which the judgments of the country may be most wisely evoked. In our country, the Government has proceeded through so long a course of almost unbroken progress – 800 or 1000 years – that its growth becomes almost the subject of a science, as you will find in Mr. Hearn's work on the Government of England. Social and statistical science, such as it is treated at the meetings of the Social Science Association, is hardly a science, but a great collection of facts – concerning the condition of the people, evils, and their remedies. Sanitary science is a branch of social science. After all the administration of State affairs, though it should always be guided by the results of these various sciences, is really an art, and a very difficult art, in which no abstract principle must be allowed to govern alone, but regard must be had to all the circumstances of the time, the state of public opinion, the foreign relations

of the country, the state of trade, &c., &c. The navigator would indeed be foolish who should calculate the bearings of his port, and then declare that he must go straight to that port, or not at all. He must have regard to all the rocks and intervening headlands, to the tides and currents, and the winds. So the statesman has to be conversant indeed, and has ever to be actuated by the principles of the several social sciences, but he must be aware also of the rocks and currents of public prejudice, and all the facts and circumstances of the time. I have gone into these remarks that you may not misapprehend the scope of Political Economy, and imagine that any sensible teacher of it would set it up as an invariable rule for the management of State affairs. Political Economy treats only of wealth, or as we may say of the weal or welfare of the nation, so far as it depends upon the plentiful supply of commodities and services. We consider men as governed by the want of food, and clothing, and shelter, or as actuated by a greater or less desire for possessions, for a comfortable house, furniture, adornments, amusements, literature, in short, a supply of most various commodities. To obtain these commodities he is endowed with the muscular power of his body, the intellectual powers of his mind, and the possession of the land with its materials and forces. We have to consider how he may best apply his labour to satisfy his wants. How, in short, he may acquire most wealth at the expense of the least labour. Thus Political Economy treats only of wealth. This can easily be shown from some of the definitions. Adam Smith's great work was called the "The wealth of nations," and he says in its opening, that according as the produce of the labour of the country "bears a greater or smaller proportion to the number of those who are to consume it, the nation will be better or worse supplied with all the necessaries and conveniencies for which it has occasion." To come down to one of the most recent, Mr. J. S. Mill says, prelim. p. 1., "Writers on Political Economy profess to teach, or to investigate the nature of wealth, and the laws of its production and distribution, including, directly or remotely, the operation of all the causes by which the condition of mankind, or of any society of human beings, in respect of this universal object of human desire, is made prosperous or the reverse."[1] But you will observe that it is only welfare so far as is dependent on wealth that is considered. Many persons have objected to Political Economy as a low and narrow minded science, because it treated only of wealth. But this is a most superficial objection. As Archbishop Whately says in his lectures, p. 11, "This sounds very much like a complaint against mathematicians for treating merely of quantities, or against grammarians for investigating no subject but

[1] J. S. Mill, *Principles of Political Economy* (People's Edition, 1865), 'Preliminary Remarks', p. 1.

language." Each science must treat one subject, or there would be such a confusion of facts and principles that no science could exist. But then we must not suppose that one science will give absolute indications of what should be done. It does not follow that because war interrupts trade and the accumulation of wealth that we are never to go to war, for the maintenance of freedom, and justice, and of moral principles, which are above wealth, may be involved. It does not follow that because the poor rate subtracts from the wealth of the country that we are to have no poor rate. Poor relief and voluntary charity is [*sic*] given for the most part on moral considerations with which Political Economy has nothing to do. But Political Economy will show, to some extent, how it may best be raised and expended. Political Economy thus gives us qualified or partial advice, and the statesman or the individual should take it into account *quantum valeat*, or for as much as it is worth. "It is thus," says Whately, "we judge in all other cases. When a physician tells his patient 'You ought to go to the sea,' or 'You ought to abstain from sedentary employment,' he is always understood to be speaking in reference to health alone. He is not supposed to imply, by the use of the word 'ought,' that his patient is morally bound to follow the prescription at all events, which would imply the incurring of ruinous expense, or the neglect of important duties." I will not promise, however, to confine myself in this class entirely to the strict subject. We shall show that the wealth of the community is promoted by industrial freedom, that is, by allowing every man to engage in whatever trade, or manufacture, or occupation he wishes. In a purely economical point of view a man's own instincts and self-interest is the best guide to his occupation, both as regards himself and the community. But from other considerations many restrictions are imposed even by Government; thus, by a new Act just come into operation, no one can begin to act as a pharmaceutical chemist without passing an examination. The price of drugs may thus be raised a little perhaps, but then we shall run less chance of being poisoned by an ignorant druggist's assistant. We shall have to discuss the very nice question how far the various restrictions imposed by trades' unions are warranted by economic or other considerations. As a general rule it will be shown that individuals or companies working for their own profit do best and most cheaply, but we shall find striking exceptions to this in the post-office and other monopolies, and we must consider how to draw the line here if possible. In many cases we shall find that classes of men are possessed by prejudices opposed to the true interest of the nation. Then every tradesman naturally rejoices in the high prices of his goods, as he gets more profit thereby, and there is an impression that low prices are ruinous to everyone. But a little reflection will show that the truth is directly the opposite of this, and that all improvement of industry aims at reducing

prices, and everyone is benefitted – not by the money wages or profit he gets, but by what he can buy with that money. There is a strong prejudice afloat against capital. The capitalist seems to be drawing a large part of the produce of labour without doing anything for it. I have seen it said that past labour has no right to rob present labour; that the dependence of labour on capital is altogether wrong and tyrannical – if it means anything, this means that capital should be done away with. But we shall readily see that capital means the very subsistence on which we live, while they are engaged on a long work or series of operations; it means those tools, machines, buildings, and works of various kinds, which no one can deny to be necessary. What mechanic, or what body of mechanics, will undertake to make a locomotive without tools, lathes, planing machines, steam hammers, and all the buildings necessary to hold them. Again, what mechanic did you ever meet who was willing or desirous to forego [*sic*] receiving wages until the locomotive was done and sold. Capital was required to advance his wages during the progress of the work. Since the necessity of possessing the tools and other capital cannot be denied, either the men must possess them, or they must consent to hire them from those who do. We shall find, therefore, that the possession of capital in the product of past labour gives advantages, power, productiveness, and independence which cannot be replaced by anything else. Then, in the present state of things, men must either possess capital, or they must depend upon those who do. I will say a word or two about the value of the study of political economy. Some persons may be inclined to run it down as a very poor sort of science. My colleagues at Owen's College, for instance, in chemistry and natural philosophy, who are accustomed to prove a thing to one thousandth part of a grain or one thousandth part of a foot, may think that is not a science which cannot exhibit exact numbers. I shall often have to admit the imperfections of a science. There are many questions on which the most diverse opinions are held, and wherever such difference of opinion exists we have hardly got to a scientific basis. But on the other hand we cannot doubt that even a slight insight into Political Economy is better than none at all. There is an excellent proverb that "half a loaf is better than no bread," and we may apply it to Political Economy. Even the few economical doctrines, which are placed on a sure footing, are far better than nothing at all. Let us remember that we are every day, and every waking hour, doing things, or having dealings with other men in which the principles of the science are concerned. We are acting with or against those principles, and are either benefitting or hurting ourselves and others. It is impossible, therefore, that we should ignore the existence of a science which alone can show us whether we are acting rightly or wrongly. And it is a fact too that those who have no knowledge of a scientific Political Economy almost

invariably have a Political Economy of their own. There is not a member of Parliament, a tradesman, a mechanic, nor even a labourer, but has a Political Economy of his own, generally a very narrow one. The banker thinks that things are going on very well when the rate of discount is high, and there are plenty of bills to discount. The merchant's one idea of Political Economy is running up the price when he has got a good stock of goods. The shopkeeper thinks that the country is prosperous when his customers are spending freely, and his stock moves off quickly. The mechanic sometimes supposes that a good close trade, active demand, and a difficulty in supplying the wants of the public is the great thing to be desired. Now these are all small, narrow systems of Political Economy, but they are all short-sighted. Every tradesman acquires a most acute sagacity in regard to the immediate causes of his own success, but he cares not to look further. It has often and truly been said that science is after all but a better kind of common sense. Every man's peculiar notions of Political Economy are only common sense applied to his own affairs. But in order to have a true Political Economy we require to look further, and trace out the less apparent results of things. We may then see that the high rate of discount, so pleasing to the banker, is ruinous to the merchant; that the high price of goods is so much loss to the consumer; that the lavish expenditure in which the tradesmen delight diminishes the productive capital of the country; and that the close union and high wages earned in some trades is not only burdensome to the community as a whole, but unfair to the rest of the working-classes, who are excluded. Every trade for itself is the rough Political Economy of common life. The good of the whole country is the aim of the Political Economist. I cannot too much recommend to your notice a little work entitled "What is seen and what is not seen in Political Economy, in one lesson," by the excellent French writer, Bastiat. It has been translated by Dr. W. B. Hodgson, and is published by the *Examiner* Office, where it is to be had at a low price. Here Bastiat beautifully shows that the ultimate effect often differs strangely from the immediate. A boy throws stones and breaks a window, or a hailstorm comes and breaks many. That improves the glazier's business; if there were no windows broken the glazier's business would be nearly done away with. Hence the impression arises that to set trade a-going, even at the expense of breaking windows, is good rather than bad. Bastiat beautifully shows the absurdity of this when we look a little further. So he considers the immediate and real result of dismissing soldiers; of discontinuing unproductive public works; of opposing the introduction of machines, of establishing protection doctrines, and so on. In dealing with this subject it will be well to adopt as a text book Mr. J. S. Mill's work on Political Economy. That is the generally recognised treatise on the subject, and is published at 6s., but perhaps it might be purchased for 5s.

There was another little work issued by Professor Rogers that costs 4s. 6d., and many chapters in it were excellent. If you could meet with Professor Fawcett's "Manual of Political Economy," that contains the substance of Mr. Mill's work, written in simpler language. I am in the habit of recommending students in my own classes to take notes of the subject advanced. It is almost indispensable in attending lectures to take notes more or less, and it is invariably done in college classes. I think those who attend the classes are almost sure to lose the memory of what they hear before very long if such means were not taken to retain it. But taking notes is also necessary in getting clear notions of what you are learning. Then again, I think it is desirable to have discussion at the end of each lecture. In the evening classes at college I ask questions during the lecture if it does not interfere with the subject, but it will perhaps be better to have a quarter of an hour's discussion upon what has been brought before you. I shall be very glad to answer any question to-night.

There were no questions asked.

II

The PROFESSOR commenced by referring to the lecture of the previous week, which was on partnerships between masters and men, and stated that during the week he had received the report of a company established on the principle, which showed that nothing above five per cent on the capital employed in the business had been realised during the two years it had been in operation. Still it had the advantage of being a means to prevent strikes, and the promoters seemed to have great confidence in the scheme. He proposed to notice in the present lecture the division of labour, and its effect on wages and profits in different employments. They had seen that wages were turned into commodities used by the people, therefore anything that increased the production of articles used increased also the comforts of the people. Among the things that increased the production the division of labour was the most important. The term simply meant dividing any kind of work into different parts, so that one man should do one part of the work, and another man another part. The agriculturist or farmer did every kind of work on his farm, but the man occupied with the labour in a factory did one kind of work only. They had a good instance of the division of labour in pin making, as conducted in the Birmingham factories, for in the making of a pin ten or twelve persons were employed, some to make the head, others to fasten it on, &c. That division of labour ran throughout the whole of society, and not only had every factory different kinds of work, but different kinds of work were divided among different factories, and there was now an inclination for one firm to take up one branch of a business only. It was important to notice how it was that it was so advantageous. The

advantages had been described by Adam Smith, and afterwards by other writers. The first advantage was in the dexterity that was acquired by repetition. Everybody knew that when a man or a woman first tried at anything they felt very clumsy, but if he or she continued at work of the same kind they would accomplish it better. There was a good example in the case of making nails, which was considered by Adam Smith. A person not accustomed to use a hammer could hardly make a nail, and even a good blacksmith who was familiar with the use of the hammer could not make more than 200 or 300 nails a day, yet a nailer made 2,300 a day of some sorts of nails, or a man accustomed to the work would make ten times as many nails as the blacksmith. The second advantage was that which arose from the saving of time in changing tools, and passing from one kind of work to another. Everyone must be aware that when one kind of work was once begun, time would be saved by keeping at that work, instead of passing from it to something else, and if they had to change tools many times during a day, considerable time would be lost in that way also. The third advantage arose from the invention of machines that tended to facilitate labour, and enabled one man to do the work of many. It would be apparent that if they only had to do a particular kind of work they would be able to do much more by the aid of elaborate tools and machines than they would with ordinary manual labour. Where a factory had a particular kind of work to do it had an enormous demand for that kind, and a considerable amount of money could be spent in machines to do it in the best way. Then, again, it was said that a man occupied with one kind of work was more likely to invent machines that would facilitate that kind of labour. Those were the three advantages that Adam Smith had named, but he (the lecturer) would mention a fourth, which was of great importance – it was the power that arose from doing a great many things at a time, and thus multiplying results, as when the same thing was done for a great many people. There was a remarkable instance of that in the post-office. It seemed impossible to send a parcel to any part of the country for a penny, or indeed for a halfpenny – for one halfpenny was paid to Government for every letter – and it could only be done from the fact that a man could carry a hundred letters instead of one. If they appointed a messenger to carry a letter for them it would cost as much as if the messenger carried letters for the whole town, and in that way there was an enormous saving. There was also an instance of that advantage in the employment of police or a guard of soldiers, for it was obvious that a few police could protect a man much better than he could protect himself, or even better than a large number of people could protect themselves. The fifth advantage arose from repeating the operation in a machine-like manner, as it were – it was what they might call the multiplication of efficiency from repetition. He meant to say that when

once they got a machine in work they might produce many things from the same mould with a comparatively small amount of labour. The printing press was a remarkable instance of this. In former times it was necessary, in order to have a copy of a book, either to copy it, or else get someone else to do so. At that time £50 of our present money would have been a cheap rate for a book. Books were now very much cheaper, simply because when the type was once set the number of copies could be readily multiplied *ad infinitum*. The same applied to a variety of other things, such as the coining of money, engraving and striking medals from moulds, as in the manufacture of the small Birmingham goods, where there seemed to be no end to the number of articles that could be produced. The sixth advantage that arose from a division of labour was what he called personal adaptation – it gave everyone an opportunity of choosing the kind of work for which he was best adapted: that was to say, when there was a variety of trades and professions which could not be the case in a primitive state of society, when every man had to do much the same as every other man. But in the present state of the country everyone had a chance of choosing what he would do, according to the abilities he might possess. It was obviously to the advantage of society in general that every person should have an opportunity of exercising his ability or strength in the most profitable way, for it was evident the greatest amount of wealth would be created, and the greatest amount of good would be done, if everyone could get into the right place. There were two ways of getting men in the right place, one of which was by Government promotion – though that did not work very well – and the other was by competition, which he apprehended was the most practicable. There was a further advantage from the division of labour that might be noticed, namely that of local adaptation. Every place was more or less suited to some particular kind of industry of its own. No one thought of producing wine, or to grow silk in England. If they were wise they would leave each country to provide what was best grown there. This gave rise to what was called territorial division of labour, and resulted in making one a corn-growing country, another a wine-growing country, and another a coal and iron-producing country, such as this country is. These were the advantages which resulted from a division of labour, but one of the results was that considerable difficulty existed in different trades as to the profits, that was what portion should be set apart for wages, and what for interest of capital employed in a trade. Several weeks ago he had said a little about what regulated wages, and he then stated that it depended upon the amount of capital in the country compared with the number of those who were supported on that capital. It was, as it were, a sort of dividend of money appropriated to pay wages divided among those who were to receive it. But that only determined the average rate that should be paid

to each, and did not determine who should get the biggest share of the money paid. In different trades there was always an extreme in the rate of wages paid, which depended more or less on the demand and supply. Of some kinds of men there were much larger supplies than of other kinds, and if there happened to be more of one trade than there was work for, some would have to take any other kind of work they could get. They would see how it was that supply and demand of persons in different trades were governed, and to understand that they would consider the circumstances that had been laid down by Adam Smith as governing them. The first circumstance that governed supply or demand was the agreeableness or disagreeableness of employments. By that was meant that if an employment was very agreeable there would be sure to be a large number flocking to it, if they could only get into it. In this way they could account for various employments being readily taken up. There were several occupations that would present examples, for instance the occupation of a barrister was poorly paid in reality, yet they were attracted to it by a certain position which it gave them. Secondly, there was the easiness or cheapness by which a trade could be learned. If a trade were difficult to learn there would be fewer able to do it, but if it were easy to learn there would be many people to do it. The poor wages paid to seamstresses was an example, for there were sure to be an extraordinary supply of those who could sew so long as their labour was necessary; they therefore could not expect to get as high wages as in some other kinds of labour that was more difficult to learn. He supposed the science of a soldier or a policeman was not very difficult to learn, which would account for the low wages paid to them. The third law they must notice was the constancy or inconstancy of an employment in trade. If a man had a trade in which he would be more liable to be thrown out of work than another, he would require more wages whilst he was in work, and on the other hand if an employment was constant he would be satisfied with less wages. That accounted for the low rate of wages paid in many employments, as for instance that of the schoolmaster, and some others. Fourthly, they had to notice the small or great trust that might be reposed in a man. If a man was required for a trustworthy situation he must possess a character for being trustworthy, which was worth money. Fifthly, there was the probability or improbability of success in trade. If a man entered a trade in which there was a probability of failure, then he must be attracted to it by a prospect of more profits than he would be likely to meet with in ordinary trade. These circumstances rendered it impossible for there to be a uniformity of wages in all trades; for instance it was impossible that a man should go to a great expense in learning a business if he were only to receive the same as other people who had not been at such expense. If there were not great degrees of success or great

rewards to be occasionally had, no one would be led to exert his faculties more than another, or if all were insured [*sic*] a certain amount of wages, there would be no particular motive for hard work. This touched upon a subject that often turned up, namely what were called socialistic ideas. Schemes had been proposed with the view of arranging people in the places they should hold; and that promotion should be conducted on some arbitrary system, but competition, after all, seemed to offer something better. He thought all would admit that the motive for pushing their way and exerting their talents was what really conduced to the wealth of the country. In connection with this he might notice what governed the profits in different trades. That was a similar question to the one of wages, because it really would depend upon supply and demand in the same way. If there was any business or manufacture that seemed to offer more than ordinary advantages or profits, or was more agreeable than others, then there was sure to be people looking out for an opportunity for the use of their capital, who would turn their attention to it. First of all they might consider which business yielded the greatest profits, and judge as best they could from the knowledge they possessed. It might be that agreeableness in business influenced the capitalist as well as the labourer. It might be that an employment in London might be more agreeable than one in the provinces, but he thought that as a general rule the profits would be pretty sure to govern everything else. They required to look into the matter a little before they could make out the profits of any business. If they were to investigate the books of a firm they must first of all make allowance for the capital advanced, a part of the remainder went to pay rent, and another part to pay wages. When all these were paid there should remain interest of capital employed, and beyond that there should be a certain amount of profit. It might be asked, "Why do men want more than the ordinary interest for their capital?" A little reflection would show that a man using his money in business must look for interest and for something else. Interest means what a man could get by lending his money, or by investing in ordinary security, such as railway shares. If a man had money he could get five per cent for it without any trouble, then if he employed that money in business, and spends his whole time in using it to the best advantage, of course he looked for something that would remunerate him. In this way a man's profit in business consisted of two parts – interest for his money and remuneration for his trouble. This was well illustrated by the partnership scheme already referred to, in which the employers took five per cent as a fair remuneration before there was a division of the profits. Then there came in an element beyond that, namely, the risk a capitalist underwent in being employed in any trade. When they looked at the number of bankrupts that were published, they would see that there was a great risk,

and there was hardly any employment where there was not occasional losses. The risk of a business becoming a losing one was a disagreeable circumstance, which had a tendency to keep people out of it, and if there was one business more risky than others, people would avoid it and put their money into a surer business. – There was a short but interesting discussion afterwards.

VIII ON THE INTERNATIONAL MONETARY CONVENTION, AND THE INTRODUCTION OF AN INTERNATIONAL CURRENCY INTO THIS KINGDOM

Read before the Manchester Statistical Society, 13 May 1868. Published in *Transactions of the Manchester Statistical Society, 1867–8*, pp. 79–92.

The increase in the gold supply and the number of trading countries whose currency was effectively based on gold had made the possibility of an international coinage a real one in the eighteen-sixties, and Jevons was a prominent supporter of this proposal. The background to, and details of, it are fully set out in this paper. It was in connection with it also that Jevons undertook, during the year 1868, an extensive statistical study of the amount and condition of the gold coinage in circulation in the United Kingdom. The results of this were published in a paper read before the Statistical Society of London (afterwards the Royal Statistical Society) on 17 November 1868, and entitled 'On the Condition of the Gold Coinage of the United Kingdom, with reference to the question of International Currency' (*JRSS*, 31 (1868) 426–64).

This latter paper was included in *Investigations* and a note attached to it there states that 'part of the substance of this paper . . . had been previously communicated to the Manchester Statistical Society. . . . To prevent repetition, the Manchester paper is not reprinted in this volume.'[1] In fact the extent of repetition is very small, and the two papers were more complementary than overlapping.

It does not seem to be sufficiently known to the English public that changes of the utmost importance are taking place in the systems of metallic currency of continental nations. They amount to a complete revolution in the ancient and customary standards of value of most

[1] *Investigations*, first edition (1884) p. 244.

countries, and they open a fair prospect of ultimately attaining that which has hardly hitherto been conceived possible, namely, a world-wide *uniform currency*. These changes have been partly brought about by the deliberations of the International Statistical Congresses; they have been much forwarded by a natural cause, namely, the excessive supply of gold from California and Australia, but they seem to me to be very much due to the enlightened views of M. de Parieu and the French Government. With the aid of an able pamphlet on the subject, privately printed by Mr. Frederick Hendriks together with some official documents, I will first describe how the scheme arose, and then consider the motives which might lead us to join and promote it. The disturbances in continental currencies commenced in the year 1850, when the Belgian Government demonetized their gold coinage, and made silver the sole legal standard. This was done from a fear that the value of gold would be extensively depreciated and all contracts falsified. But as the Belgian coinage is nearly identical with the French coinage and the countries are conterminous, it was found impossible to prevent the French gold coin from passing into Belgium. Thus it came to pass, that in 1861, Belgium found it desirable to accept the French system of currency, including the double standard of gold and silver. Somewhat similar difficulties had at the same time been experienced by Switzerland and Italy, which also possessed a coinage resembling that of France, or were partially conterminous with France. As to France itself, it is well known that the action of the alternative double standard since 1850, has been such as to convert a coinage substantially consisting of silver into one consisting chiefly of gold.

Under these circumstances, the French Government readily accepted a suggestion that France, Belgium, Italy and Switzerland should undertake a joint investigation and arrangement of their currencies. The result was the convention signed on the 23rd December, 1865, which established what has been called the Latin Monetary Convention, or, as M. de Parieu names it, the Latin Münzverein. By this first step towards an uniform currency, the four nations in question bound themselves to issue from their several mints an uniform series of coins on the basis of the franc, these coins to be accepted indifferently by the Public Treasuries of the four governments. A year or two previous to the accomplishment of this convention, namely, in September, 1863, the International Statistical Congress had arrived at clear views as to the mode in which it was best to attempt the great problem of an international coinage. It was felt to be hopeless to choose any one system of currency and expect all nations at once to adopt it. But it was observed that the principal unit coins already in use were nearly multiples of the franc or half-franc, and were consequently connected by simple ratios with each other. Thus, approximately—

$2\frac{1}{2}$ francs = 1 florin.
5 ,, = 1 dollar.
25 ,, = 1 pound sterling.

Slight alterations in the coins would thus enable the franc, florin, dollar, and pound sterling, to pass as multiples, or sub-multiples of each other, and the identically same coins might be current in almost all countries, the name alone altering as they passed from one to the other. Thus, one pound would pass in France for 25 francs, in the United States as a half eagle, in Austria as a 10 florin piece. This scheme seemed so feasible, that the French Government suggested the assembling of a conference to consider it during the period of the International Exhibition. No less than twenty states, including all the principal European nations together with the United States, sent representatives, and the whole subject of international monetary arrangements was minutely discussed, and decided with a degree of unanimity which could hardly have been anticipated. I will now give a brief outline of the results as made known to us in the official report of the Master of the Mint and Mr. C. Rivers Wilson, who attended the conference as representatives of the British Government. The possibility of creating a single uniform system of universal currency was first discussed, but however great the advantages of such a scheme might be if accomplished, the difficulties were soon felt to be insuperable. The conference therefore came to the conclusion that—

"Monetary unification may be most readily attained by the adjustment of existing systems, taking into consideration the scientific advantages of certain types, and the number of the populations by which they have already been adopted."

It was however felt, at the same time, that the system of French currency claimed a preponderance of attention, both on account of its theoretical perfection, and because it was already accepted by four nations included in the convention of 1865, with a population of 72 millions of persons, in addition to the Papal States and the Kingdom of Greece, which have since acceded to that convention.

The conference next proceeded to consider what metal should be recommended as the general standard of value. So equal are the claims of gold and silver to serve this office, that the best economists have never been able to arrive at any distinct and well-founded opinion in favour of either. In most European countries, indeed, silver was from early times the standard, and in England, the adoption of a gold currency arose at the first unintentionally. To habit and prejudice, rather than to deliberate judgment, we must attribute the preference for gold which many English writers, including Lord Liverpool, have expressed. The statesmen of the

French Revolution indeed endeavoured to combine the use of both metals as standards, by making both legal currency, at the fixed rates of $15\frac{1}{2}$ parts by weight of silver to 1 part of gold, and so late as last May, the Imperial Commission, which has lately been inquiring into the whole subject of the French currency laws, pronounced in favour of this system. Of all the countries represented at the conference, only two, viz., Great Britain and Portugal, actually possessed an exclusively gold standard, and it is very surprising to find under these circumstances, that the conference unanimously decided in favour of a gold standard. If this decision were the sole result of the meeting, it might yet be said to have effected a revolution in the currencies of the globe; but the full significance of the fact will only be apparent to those who know the eagerness with which the battle of the standards has been waged in monetary discussions, and the invincible differences of opinion to which it gave rise. Of the soundness of the decision there can hardly, I apprehend, be any doubt. Natural circumstances rather than theoretic arguments have brought about unanimity. The extraordinary supplies of gold thrown on the market since 1849, have not only furnished abundance of this metal, but have also to some extent depreciated both gold and silver. At the same time, the general increase in the wealth and activity of trade in many parts of the world has naturally led to the increased use of the more intrinsically valuable and portable metal.

Gold, thus tended by the force of uncontrollable natural events to become the general medium of exchange, and it will probably prove that the members of the conference showed the highest wisdom in promptly accepting the necessary changes. We may congratulate ourselves that we already employ gold and silver in our currency in the very method recommended by the conference; gold as the absolute standard, silver as the material for the fractional token coinage, passing as legal tender to a limited sum (£2). Eighteen nations have unreservedly adopted a standard of value hitherto upheld almost solely by ourselves; this surely should be sufficient to appease the pride of Britons, and prevent them from rejecting with their customary scorn the slightest suggestion from abroad that our laws and customs could be amended.

The first point in which we should need to make a slight concession in accepting the provisions of an international currency regards the proportion of alloy in our coins, which at present is $\frac{1}{12}$ part in the case of gold. But all other civilized nations now coin gold with $\frac{1}{10}$ part of alloy, and the practice has been adopted by our own mint at Hong Kong in the coinage of silver dollars. The higher fineness of our gold coins has hitherto been upheld on the ground that they are rather harder than coins of $\frac{9}{10}$ fineness, but Mr. Graham, than whom there can be no higher authority, considers that this opinion has arisen from a misapprehension

of experiments made more than half a century ago, and he holds that the advantage lies rather the other way. There cannot be a doubt that we shall be wise in accepting the foreign system and adding $\frac{1}{60}$ more alloy to our coins, a change of wholly inconsiderable importance in itself, but indispensable to the introduction of international currency.

The most difficult point upon which the conference touched was the common unit of value which might be recommended for ultimate adoption. The majority were in favour of the five franc piece, or gold dollar, and a resolution was passed that the common coin of five francs should be made a legal tender throughout the countries which might unite in a monetary convention. In this vote the English representatives did not join, and their opinion is in favour of a higher unit of value. The point which is of most immediate importance to us next came under consideration, namely, the introduction into the international system of a 25 franc piece. It is that coin which forms the possible link between the British and international currency, and the conference adopted the general currency of the 25 franc piece, avowedly on the ground that the adhesion of Britain might thus be received. It is also most important to note that Mr. RUGGLES, the American representative, warmly supported its adoption, and informed the conference that the United States were prepared to lower their coinage 3 per cent. and re-coin the whole of the gold, provided the convention gave currency to the new 25 franc piece, which would pass in their country as a half eagle.

Passing over points of minor importance to us, we have now to consider the difficulty which arises in assimilating our sovereign to the future 25 franc piece. It is well known that according to the par of exchange—

$$£1 = 25{\cdot}2079 \text{ francs.}$$

so that our sovereign is ·825 per cent. too heavy, when newly and accurately coined, to circulate as international money. The difference is only ·988 of a grain of pure gold, worth about 2d. Even this small difference between the sovereign and 25 franc piece would prevent their common and indifferent currency, so that it would be indispensable either to raise the franc a little, or to lower the sovereign. For us to demand the former would be quite out of the question, because the French currency is nicely adjusted in connexion with the metrical system of weights, and is adopted by six nations representing a much larger population than that which now uses the sovereign. It would be, moreover, a far more difficult task to raise a currency one per cent. than to lower it by so much. If we are to join the convention, then we must lower our sovereign 2d. in the pound, and it is for the government to decide by the aid of the Royal Commission now sitting whether the advantages of an international currency are worth the inconvenience of making this change.

I will now briefly enumerate the inconveniences and advantages so far as they are known to me, beginning with the former. When the lowering of the currency is officially proclaimed, it will be necessary, supposing the present system of free coinage be maintained, to authorize every creditor to add 2d. in the pound to the nominal amount of his debt. Suppose the change were effected on the 1st January, 1870, then every debt of £1000 contracted before that day would become £1008 6s. 8d., the sovereign having been lowered, so that this sum only represents as much pure gold as £1000 did before. But the necessity for any disturbance of contracts will be altogether avoided by the proposed imposition of a seigniorage, or charge for coinage of one per cent. At present the cost of turning bullion into coin in London is only 1½d. per standard oz., or $\frac{1}{6}$ per cent., the commission allowed to the bank in acting as the agent of the mint, and the government bear the whole costs of the coinage of gold. This is quite contrary to the practice of other countries; in France, according to the information obligingly furnished to me by Mr. Hendriks, the cost of converting bullion into coin is at least one per cent; in the Philadelphia mint the charges altogether amount to one per cent.; and in our own branch mint at Sydney, N.S.W., the charge is one per cent on sums below £10,000, and $\frac{3}{4}$ per cent. on larger sums. The present free coinage system of the British mint has really failed in practice. It has no effect in keeping our currency up to its full weight, because the new and heavy coins, instead of driving out the old and light ones, are picked out for melting and exportation, and are used in preference by gold beaters, electro-gilders and others. The Master of the Mint says:—

"There is reason to believe that large masses of new British sovereigns are occasionally treated, so as to separate out the heavy pieces, and these are disposed of as bullion; while the lighter pieces, which may still be all of legal weight, are preserved and put into circulation. This fact will not surprise those persons who are aware of the small margin of profit upon which bullion transactions are often conducted."

It is absurd that the nation should be at the expense of coining money which to the extent of many millions is only to be melted down again for the profit of bullion speculators. In entering the monetary convention, it is most reasonable that we should impose a mint charge equal to what other nations now impose, and that the mint regulations of all countries should be reduced as nearly as possible to complete uniformity by treaty obligations. At present it appears to be difficult if not impossible to say what the real par of exchange between nations is, because in addition to all other complications the mint charges are variable and very uncertainly known. All such uncertainty would be removed by the adoption of uniform mint regulations, and the coins of one country would be

enabled to pass into the currency of another without any depreciation. Thus the objections to a mint charge raised by Lord Liverpool in his celebrated Letter on the Coins of the Realm, fall to the ground almost entirely. He opposes a mint charge for four reasons—

1st. – Because the principal measure of value would not in such case be perfect.

2nd. – Because merchants in exporting the coins would lose the mint charge, and would raise the price of foreign goods in order to transfer the loss to consumers.

3rd. – Because a reduction in the weight of the sovereign would be necessary, and consequently –

4th. – A re-coinage would be requisite.

Of these reasons it will be observed that the third and fourth are now altogether annulled, or rather reversed. We wish to reduce the sovereign and we shall require to re-coin a portion of our gold currency. The imposition of a seigniorage facilitates in a most remarkable manner the desired alteration, and renders the re-coinage a profit instead of a loss.

The second reason is also entirely annulled, because under uniform mint regulations contemplated by the monetary convention, coins will not lose in value by exportation. It is no doubt true, that in theory free coinage gives the most perfect measure of value, but inasmuch as our mint cannot manufacture coins of perfectly equal and accurate weight, inconveniences arise in practice, described below. The views of Lord Liverpool were adopted in the law of 1816, which at present regulates our metallic currency, but it is probable that had he regarded the question from the point of view which we now enjoy, he would no longer have opposed a mint charge.

The second inconvenience would consist in the requisite recoinage of a portion of our gold currency, the silver coinage being unaffected. In the report of the English representatives, the amount of our gold circulation is vaguely stated as lying between £80,000,000 and £120,000,000; but facts have, I believe, recently come to light showing that large quantities of newly coined sovereigns have been melted for exportation. An investigation which I have recently made leads me to believe that the gold currency is really under eighty millions. I have, moreover, evidence kindly furnished to me by a number of bankers and other gentlemen in many parts of the kingdom, showing that something like one gold piece in every three is on an average too light to be legal tender, but would serve as a 25 franc piece. Separate evidence is derived from careful weighings of 280 sovereigns, which I made upon an excellent chemical balance in Dr. Roscoe's laboratory, at Owen's College. Out of 280 sovereigns drawn on three occasions from Manchester banks, I find that there are—

Weight or above weight	6	per cent.
Within remedy	68	,,
Below weight	26	,,
	100	

Comparing the weight of these sovereigns with the weight of the future 25 franc piece, and allowing a remedy of $\frac{1}{2}$ per cent. in excess or defect, I find the following results:—

Sovereigns too heavy to pass as 25 franc piece	54	per cent.
Of proper weight	38	,,
Too light	8	,,
	100	

It thus appears that we have actually in circulation in Manchester sovereigns which are lighter than 25 franc pieces, and there is every reason to believe that in other parts of the country where there is no branch Bank of England in the immediate neighbourhood, the proportion of old to new or light to heavy coins would be greater. The half sovereigns there is no doubt are rather worse than the sovereigns.

To be brief, I will only say that I believe our present currency law has broken down; that the practice of weighing and rejecting light sovereigns is almost entirely discontinued, except at the Bank of England and in a few localities in Ireland; and that we now have a currency which is wearing more and more light every year. I need hardly say too, that it is very difficult to drive light coins out of use, because no individual and no bank will incur the loss of 4d. or 6d. in the pound if they can contrive to pass off the coin again at its full value. Every device is therefore employed to keep light coins back from the Bank of England which invariably weighs them, and at the same time the melter and exporter of sovereigns has an equal interest in picking out the new ones. I am inclined to think that there is no fair and reasonable mode by which the currency of the kingdom may be raised again to its legal weight but by the Government undertaking the work and bearing the loss, which would probably amount to £200,000 or £300,000. From this loss we should, in a certain sense, be saved by reducing the sovereign. In fact as the mint expenses for coinage amount only to $\frac{1}{3}$ of a penny per sovereign, there would be a profit by calling in our present coinage and issuing 25 franc pieces, whereas, before long a formidable loss must be incurred in the re-coinage of sovereigns if we resolve to adhere to our present system.

There remains the inconvenience which might arise in effecting the change of currencies. Two modes present themselves:—

1st. – On the day fixed for proclaiming the change, to make the light sovereigns between 121·58 and 122·80 grains a legal tender, and to authorize the currency of heavier sovereigns at a nominal increase of value of 2d.

2nd. – To lower the limit of the legal currency of sovereigns to 121·58 grains, and to leave the heavy ones temporarily current as at present, until they be reduced by wear, or melted, or exported. The fact is, that if the mint began to issue a plentiful supply of new 25 franc pieces, the heavier coins would rapidly disappear from circulation, and as the Government now practically permits the circulation of sovereigns varying between 119½ grains and 123½ grains, and every person who has a light sovereign now is liable to a loss of 4d. to 6d. upon it, I conceive that it would be needless and over-scrupulous for the Government to secure to every holder of a heavy sovereign its slight difference of value compared with the 25 franc piece.

The profit on melting and exporting heavy sovereigns would not really fall exclusively to the bullion dealers. By rendering the export of gold profitable, it would tend to reduce the quantity of coin in circulation and raise its value. So long as there were heavy sovereigns to export, the lighter ones would really bear in trade the value of the heavy ones; only when the supply of heavy coins was exhausted, would the value of the currency fall 2d. in the pound.

I have now only to advert to the advantages which would arise from the introduction of an international currency. There seems to be a great difficulty in appreciating these advantages; for merchants, and especially bullion brokers and those engaged in business connected with the foreign exchanges, affirm that it would be no advantage, and that they get on very well as they are at present. I believe, however, that just as we find it convenient to have an uniform currency within the kingdom, we shall in time find the highest benefit in having something like a world-wide currency. The advantages I can enumerate are four or five in number.

First, and least, I place the convenience to travellers in being able to pass the same money in whatever country they may visit. We find it a great convenience already that the sovereign will generally be received for 25 francs, at a loss of 2d.; but if we accede to the convention, the new sovereign will probably be received all the world over for its full value.

Secondly. – The reduction of sums of money from their expression in one currency to another will be simplified. To turn pounds sterling into francs, florins, or dollars, it will only be necessary to divide by 25, 10, and 5, respectively, and as these are all multiples of 5, both multiplication and division may be effected by one significant figure with alteration of the decimal point. This convenience, however, will not be fully experienced until we have a decimal subdivision of our unit of value.

Thirdly. – The international currency of coins would render the adjustment of the exchanges more rapid and accurate. So long as there is gold in each of two countries, the exchanges can never vary between them more than by the cost of transmitting gold from one to the other. At present a large part of the gold and silver trade consists in the transmission of bars, and the trade falls into the hands of a special class of dealers, who, no doubt, make a fair profit out of it, in addition to paying the costs of melting and assaying when necessary. Another portion is transmitted as foreign coin, of which the Bank always holds a considerable value, counted among the bullion. Still large quantities of British gold coins are annually exported and re-imported. Thus in the year 1866, the exports and imports of gold were in value as follows:—

	Exports.		Imports.
Bullion.	£5,282,164	. .	£9,099,064
Foreign Coin	3,452,806	. .	10,356,854
British Coin	4,007,089	. .	4,053,723
	£12,742,059	. .	£23,509,641

The bullion brokers assert that they can transmit bars just as easily as coin; why then do we find the larger part of the trade already conducted in coin? It must be because the transmission of coin is more easy and less costly, and coin would evidently be still more suitable for foreign trade if it were indifferently current in all countries.

But I conceive, that after all the greatest advantages are the indirect and ultimate ones, which will arise from the world-wide extension of the monetary convention. The adhesion of Austria is already secured by a preliminary treaty, signed at the termination of the conference; the United States are perfectly willing to join, and if we, with our wide-spread colonies and all-pervading trade, lend our aid, a general reform and unification in the currencies of the world is almost a necessary result. It must be remembered that by far the largest part of the gold supplies of the world is in the hands of the British Empire and the United States, and the sovereigns coined on an uniform system will pervade the world somewhat in the same manner that the Spanish dollar has for two centuries or more been the international currency, and has been of the greatest services to trade.

As from natural causes, gold is replacing silver as the main medium of currency, some gold coin will take the lead, and if we are only wise enough, we shall make the sovereign suitable for this purpose. We must remember, that the advantages are not to be experienced within this

kingdom so much as by the promotion of our foreign trade. We have admitted foreign vessels and foreign goods, and have thrown ourselves unreservedly upon foreign trade, as our main stay: we are now as much interested in the welfare and prosperous course of trade in other countries as in our own. Exchange is always mutual, and if there is anything wrong at one end, harm will be felt at the other end. If trade is injured by a bad and depreciated currency, we are liable to suffer through the losses of our merchants. In the great scheme of international money, I consider we are far behind our proper place. It is England that should have suggested free trade in money to the world; it is Manchester that should have suggested it to England, as it has suggested other great ideas before. The unification of currencies is the appropriate sequel to the introduction of free trade. It is a new step in the *rapprochement* of nations and the spread of civilization.

We have lost the opportunity of initiating this great reform, but if we refuse to accept it when offered by an enlightened foreign government, whether it be from the shortness of our vision, or the pride of our hearts, I hold that we shall stultify ourselves, and act unworthily of that proud position which we occupy in the commerce and civilization of the world.

IX. THE PROGRESS OF THE MATHEMATICAL THEORY OF POLITICAL ECONOMY

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The full title of the paper adds 'with an Explanation of the Principles of the Theory'. As Jevons states in the opening paragraph, it was largely the outcome of his becoming acquainted with the work of Walras and other continental mathematical economists to whom Walras directed his attention. On 13 September 1874, Jevons wrote to Walras: 'I have been thinking how I could make [your book] known in this country, but am sorry to say that there are only one or two publications which I could ask to admit an article on so unpopular a subject.'[1] On 9 October Jevons wrote to Johan d'Aulnis de Bourouill: 'I am about to prepare a memoir, to be read to the Statistical Society of Manchester, upon the subject of the mathematical theory of political economy, and if the book which you are proposing to publish is sufficiently advanced I should much like to draw the attention of the Society to it.'[2] The paper does contain one or

[1] See Letter 391, Vol. IV, p. 65.
[2] See Letter 393, Vol. IV, p. 70.

two mentions of d'Aulnis, but without any enlargement or explanation of his work.

Jevons later made extensive use of this paper as a means of propagating the ideas of Walras and himself, sending copies to G. H. Darwin, Alfred Marshall and others likely to be interested.[3]

The very recent publication of an important work on "Political Economy," by M. Leon Walras, the ingenious professor of the science in the Academy of Lausanne, induces me to draw the attention of the society to the mathematical theory of economy. The work of M. Walras is entitled "Eléments d'Économie Politique Pure," and although constituting only the first part of a complete treatise, it is divided into three books, which discuss respectively the "Objets et Divisions de l'Economie Politique et Sociale," the "Théorie Mathematique de l'Echange," and lastly the subject "Du Numéraire et de la Monnaie." The first of these divisions is a general discourse upon the subject and method of the science; the second contains a highly remarkable mathematical analysis of the laws of supply and demand and the conditions of value; the third applies the result of this analysis to the special case of the currency.

It is to the second of these essays, that I wish particularly to direct your attention. Commencing with a sketch of the operations which take place and the motives which govern those operations upon any extensive market, like that of the French Rentes at the Paris Bourse, M. Walras proceeds to attach definite ideas to the familiar terms value, price, effective offer, effective demand, satisfaction of wants, &c. Regarding all these notions as strictly mathematical, as they certainly must be, because they deal with definite quantities, he proceeds to invent a notation, accurate and ingenious, but perhaps a little complicated, for expressing their relations in the briefest and most general manner. He shows also that the variation of the quantities can be very clearly expressed graphically by curves representing the supply and demand of any commodity at different prices. The causes of these variations are next investigated, and discovered to depend upon the extension and intension of utility of the commodities, which notations, again, are represented by curves of the variation of utility. The intensive utility of an article is stated to be identical with its rarity, arising from the limited character of the supply. Finally, M. Walras arrives at this fundamental theorem, that the current prices of commodities, or the prices *in equilibrio*, are equal to the ratios of the rarities, or, as otherwise expressed, the values in exchange are

[3] See Letters 399, 415 and 416, Vol. IV, pp. 81, 99 and 100.

proportional to the rarities. It is a remarkable circumstance concerning this theorem that, although expressed in different language and reached by a different course of reasoning, it is yet precisely identical with the chief result of the mathematical theory of political economy of which the first brief outline was made known at the Cambridge meeting of the British Association for the Advancement of Science in 1862, and of which a fuller exposition, under the name "The Theory of Political Economy," was published in 1871. I cannot help reiterating here my feeling that in England the progress of true economical science is being immensely retarded by the excessive popular reputation attaching to the writings of the late Mr. Mill. So peculiar was the power excited over his friends and readers by Mr. Mill's zeal, his fearless independence of opinion, his high moral character, and his lucid, persuasive, and apparently logical style of composition, that his works have acted upon English readers like a spell, which it may take many years to break. Already, however, his exposition of the wage-fund theory has been overthrown by Professor Cliffe Leslie, and his fundamental propositions concerning capital have been shown to involve various fallacies and self-contradictions by Mr. George Darwin, and quite recently by Governor Musgrave, of South Australia. After studying the writings of Mr. Mill for twenty years, and teaching from them for more than ten years, as I am unfortunately obliged to do by the public recognition which they receive at the Universities, I feel bound to express my confident belief that they will in the course of time be allowed to consist to a large extent of a series of ingenious sophisms.

In our own subject of political economy, it has been much too commonly assumed that Adam Smith founded the science, that Ricardo systematised it, and that Mill finally expounded it in a nearly perfect form. An orthodox economical creed has thus been established, and all who can call its truth in question are too likely to be treated as noxious heretics, or, at the least, as harmless crotcheteers. But in spite of all danger of being thus regarded, I maintain that it is only by going back and reconsidering the primary notions of the science that we can arrive at a true theory of economy, and be enabled to distinguish between the true and the false in ancient doctrines. It is probably a mistake to put forward the new views of the science as forming specially a mathematical theory. In truth, there is nothing more theoretical, and but little more mathematical, in the views of M. Walras, M. d'Aulnis, and myself than in the ordinary doctrines. The laws of political economy must be mathematical for the most part, because they deal with quantities and the relations of quantities. If we turn to the explanations given of the principal elements of the subject in any of the chief authors, we shall find that they deal continually with quantities. Adam Smith says, "The value of any commodity to the person who possesses it, and who means not to

use or consume it himself, but to exchange it for other commodities, is equal to the quantity of labour which it enables him to purchase or command. Labour, therefore, is the real measure of the exchangeable value of all commodities." Again, he says, "Equal quantities of labour, at all times and places, may be said to be of equal value to the labourer." Ricardo does not entirely agree with Smith's opinion on the origin of value, but his own ideas are not the less mathematical. "Possessing utility," he says, "commodities derive their exchangeable value from two sources – from their scarcity and from the quantity of labour required to detain them." And he proceeds to consider how the question of value is affected by the varying price given for different quantities of labour. There is hardly a page of his well-known treatise in which Ricardo does not reason about the equality or inequality, the proportionality, or the manner of variation of quantities of commodity, labour, value, utility, money and so forth. If we examine the treatises of Senior, of M'Culloch, of Say, of Mill, or of any other economist, in fact, we shall find that quantity is almost the sole theme, but that the manner of treating quantitative relations is of the crudest character, and that little or no aid is derived from the recognised modes of mathematical expression, which are found essential in all the other sciences dealing with quantity. Thus the chief difference between the old and the new doctrines is, that the old ones involve a crude and partially false mathematical theory, and the new ones, as I venture to maintain, a true mathematical theory. This difference arises, as I believe, from overlooking the importance of a thorough analysis of the notion of utility.

Economists, with few exceptions, have described utility as if it were a fixed and invariable quality of a substance, like its colours, density, hardness, or conductivity. They have probably confused utility with those fixed physical properties on which its utility is founded. Mr. Mill, for instance, on reaching the critical point of his theory of value, introduces a long quotation from that strange writer De Quincy [*sic*], who, in his "Logic of Political Economy," illustrates the relations of price, utility, and difficulty of attainment. Here, again, we have crude mathematical reasoning. We are told "the inertness of D (that is, difficulty of attainment) allowed U (that is, utility) to put forth its total effect. The practical compression of D being withdrawn, U springs up like water in a pump, when released from the compression of air;" and so forth. In parts of this curious passage De Quincy speaks of symbol U as denoting intrinsic utility, implying that the utility treated by economists is intrinsic or deeply seated within the objects and commodities which are the subject of the science. In this use of the term he is in perfect accordance with the generality of economists. Adam Smith says, "Nothing is more useful than water," meaning, in the absence of

qualification, that all water has qualities which render it exceedingly useful. In the works of Smith and most English writers it is indeed difficult to find any precise definitions of utility.

Turning to French economists we find clear, though it may be mistaken, definitions. According to Say, utility is "Cette faculté qu'ont certaines choses de pouvoir satisfaire aux divers besoins des hommes." Garnier still more clearly sums up the opinions of most economists when he says: "L'ensemble des qualités qui rendent les choses propres à satisfaire nos besoins et à procurer des jouissances, se nomme utilité." According to all such writers, then, utility is the *ensemble* of physical qualities which are capable of making the substance possessing them suitable to the wants of men. Among English writers there is one who, without perhaps being aware of the whole importance of the change, has given a different definition of utility. Nassau Senior, in the admirable introduction to his treatise on political economy, describes utility somewhat vaguely as "the power, direct or indirect, of producing pleasure;" but then he goes on to make the following most important remark: "Utility, however, denotes no intrinsic quality in the things which we call useful; it merely expresses their relations to the pains and pleasures of mankind. And, as the susceptibility of pain and pleasure from particular objects is created and modified by causes innumerable and constantly varying, we find an endless diversity in the relative utility of different objects to different persons, a diversity which is the motive of all exchanges." It is from the notions expressed in these two sentences, when fully interpreted and followed out, that a true theory of economy is unfolded. To illustrate the importance of the change, let us go back to De Quincy and his "intrinsic utility." He imagines a little romance in his agreeable style, and represents the reader as travelling upon Lake Superior in a steamboat, making his way to an unsettled region 800 miles ahead of civilisation. "One fellow-passenger, whom you will part with before sunset, has a powerful musical snuff-box. Knowing by experience the power of such a toy over your own feelings, the magic with which at times it lulls your agitations of mind, you are vehemently desirous to purchase it. In the hour of leaving London you had forgotten to do so: here is a final chance. But the owner, aware of your situation not less than yourself, is determined to operate by a strain pushed to the very uttermost upon U, upon the intrinsic worth of the article in your individual estimate for your individual purposes." Here we find, clearly, that the musical box possesses intrinsic utility and intrinsic worth; but if these words mean anything, each musical box of exactly the same physical construction must have exactly the same intrinsic utility, however many boxes of the same sort you may previously possess. Even then, if you had brought a box with you from London, you would be equally anxious to buy a second

exactly similar one from your fellow-passenger -- nay, twenty such if they had come in your way. Now, what possible use can attach to twenty exactly similar musical boxes in the wilds of the Rocky Mountains? You cannot set them all going at once, for the discord would be terrible. If you try to use them all, by starting first one and then the other, the monotonous and constant repetition of the same tunes would be equally intolerable. If you only have them going occasionally, then a single one will serve for many years; and if you keep a second and a third to meet the case of the first being worn out or broken, the remaining seventeen will be simply useless. It is true that if you have neighbours, these surplus boxes may be sold or given to them; but it is as regards your neighbours that they now acquire utility, and the very ground of the change of ownership is that what is useless to you will be useful to them. In short, then, utility, as Senior said, is not an intrinsic quality at all; it is accident of a thing arising out of its relation to the wants of an individual. Utility only exists when there is on the one side the person wanting, and on the other the thing wanted; and the utility consists in the *ensemble* of all the qualities and circumstances which actually do enable it to quench the thirst or relieve the hunger or satisfy any of the wants of some person. Just as the gravitating force of a material body depends not alone upon the mass of that body, but upon the masses and relative positions and distances of the surrounding material bodies, so utility is an attraction between a wanting being and what is wanted.

Now this view, properly followed out, leads to startling conclusions. We cannot stop at musical boxes, but we must allow that even food and water are continually varying in utility according as there are people who want them or do not want them. Imagine a man in total solitude upon an island in the Pacific Ocean, where there are twenty bread-fruit trees. If the fruit of one tree is amply sufficient to sustain him, then we must allow that the fruit of the other nineteen trees has no utility. In the ordinary circumstances of an industrial community the same principles hold true; but the question is complicated by the practice of exchange, which renders useful to one man what is useless to another. We must now take a further step, and allow that each different portion of the one same commodity may possess a different degree of utility. If a man, imprisoned or otherwise cut off from all other supplies of food, receive only one pound of bread per day, he could barely maintain life upon it; a second pound per day would therefore possess extreme utility for him in satisfying his hunger and maintaining his strength. Supposing, however, that a third pound of bread be offered to him daily, will it possess equal utility with the second? Clearly not; for though he may eat some of it still further to supply his need of nourishment, yet he can hardly eat three pounds of bread per day. As to a fourth pound per day it would be absolutely useless, and would not be

touched. We find, then, that the very same uniform commodity varies in utility according to the quantity which is already in possession. Exactly the same considerations apply to all other commodities in a more or less marked manner. One pair of boots is requisite; a second is very useful to replace the first when worn out, or temporarily unavailable; a third, and a fourth, and a fifth might be conceivably useful, though this would depend much upon the variety of construction adapted to serve a variety of purposes. No one can find equal use for 20 or 100 pairs of boots, as would be the case if the utility were intrinsic. We come, then, to the conclusion that the utility of a commodity is no intrinsic or unchangeable quality, but rather a relation which is essentially variable in degree and dependent upon the intensity of the want felt, which again depends upon the quantity of commodity which has been already consumed. Theoretically at least this variation must be regarded as taking place in the very smallest portions of the commodity. Not only is each pound of bread less useful than the pound already consumed, but each ounce than the previous ounce. The decline in the degree of utility may be regarded as approximately continuous, and is properly represented by a curve which more or less rapidly declined towards zero. While the height of this curve at any point above the base line represents the intensity or degree of utility of the commodity, when a certain quantity has already been consumed the area of the curve up to that point measures the total quantity of utility in the form of useful effect derived from its consumption.

We must observe that useful effect is a quantity of two dimensions – namely, the quantity of commodity consumed, and the degree of utility of each part of the commodity; in this sense their utility is correctly represented by an area. Degree of utility, on the contrary, is a quantity of one dimension, and is to be represented by a line. It is by thus giving precision to our ideas of utility that we can alone arrive at a correct comprehension of the relation between utility and value, upon which depends the solution of all the problems of political economy.

If these views concerning utility be accepted, the main branches of the science of political economy resolve themselves into the theory of the equilibrium of utility. The theory will apply, for instance, to the determination of the proper distribution of the same commodity when it is applicable to several different purposes. The commodity ought to be so divided and consumed that the final degree of its utility in each employment is the same. Each want should be satisfied up to the same point of satisfaction, because if one want is ever so little more pressing than another, there will be an increase of useful effect in applying a little more commodity to that, and a little less to some want which is not so acutely felt. The same principle holds true of the consumption of a store of

commodity at different times. We ought so to consume the commodity that in each day or other interval of time the wants of the individual are satisfied up to the same point. It is, then, a general principle that in the case of each individual the degrees of utility are to be equalised, and this is also the key to the theory of value. If a person has a great deal of one commodity and little or none of another – say a great deal of bread and very little tea – the degree of utility of part of the bread will be low, and he will readily part with some, whereas more tea will have to him a high degree of utility, and he will be very desirous of obtaining more. If, then, he happen to meet with a second person who has plenty of tea and little bread, there will be evident increase of useful effect in the exchange. So far there is no mystery. But how are we to determine how much bread shall be given for so much tea, or *vice versâ*. The principle of equilibrium again applies, and each will give of his superfluous commodity until, if he gave either more or less at the existing ratio of exchange, the useful effect would be diminished. The matter is complicated, however, by the fact that the price of one commodity in terms of the other may be higher or lower. Thus if 2 oz. of tea be given for 39 oz. of bread, then in order that utility shall be maximised the utility of 2 more ounces of tea must be exactly equal to the utility of 39 oz. of bread; and this must hold true of each person separately. Now, the total utility or useful effect of 2 oz. of tea is found by multiplying the degree of utility of each ounce (assumed, for the moment, to be of equal degree of utility) by two, the number of ounces; the useful effect of the bread, in like manner, is found by multiplying the degree of utility of the bread by 39, the number of ounces. When equilibrium is attained, the products will be equal; from which it follows as an evident inference that the quantities exchanged will be inversely proportional to the final degrees of utility of the commodities.

It is also to be observed that in an open market there cannot be at the same time two ratios of exchange for the same uniform commodity. Hence the whole quantities of commodity exchanged, will bear the same ratio as the last small quantities. Now, the value of a thing, as we use the term, is greater as we give less of that thing for a given object, and less as we give more. Thus the values of things are inversely as the quantities of them given, and therefore directly proportional to the final degrees of utility.

Now, as the final degree of utility is only another expression for what M. Walras calls the rarity of a commodity, we have arrived at the theorem that the values in exchange are proportional to the rarities. It is evidently impossible that I should in a brief paper give all the requisite explanations concerning a general theory of this kind; it is still more out of the question that I should develop the consequences to be drawn from the theory. The deductions are only in a very partial way exhibited in the

work of M. Walras, or in my "Theory of Political Economy." I should mention, however, that the laws of supply and demand, as generally accepted by economists, are easily deduced from the theory of exchange, so that the theory is verified by experience and statistical science. One all important point, however, is the relation between value and labour spent in production. Adam Smith vacillated between utility and labour as the causes and measures of value, and what perplexed Smith has perplexed subsequent writers. Thus we find Ricardo laying down that commodities derive their exchangeable value from the quantity of labour required to produce them, except in the case of commodities of which the supply cannot be increased by labour, and in these cases scarcity is the cause of value. The result of our theory, however, is to show that value always depends upon degree of utility, and labour has no connection with the matter, except through utility. If we can readily manufacture a great quantity of some article our want of that article will be almost completely satisfied; so that the degree of utility, and consequently its value, will fall. Production operates upon value only by varying the intensity of our desires for more of the same commodities; and it is plain that, in deciding how much of each kind of goods is to be produced, the principle of equilibrium of utilities must again guide us, so that each want shall be satisfied up to the corresponding point. Regard must now be paid, however, both to the ratios at which commodities exchange, and to the comparative quantities of different commodities which can be produced by the same labour.

The same kind of investigation which has been applied to the analysis of utility can also be applied to labour regarded as varying both in duration and intensity of painfulness. The general result, as explained in the "Theory of Political Economy," is to confirm the prevailing doctrine that the values of commodities tend to become approximately equal to their cost of production. The most important critic who has raised objections to this theory is certainly Professor J. E. Cairnes, who as I have said, altogether repudiates it in the very first chapter of his new work. He commences by remarking that I follow M. Say in maintaining that value depends entirely upon utility, and that he had regarded Say's views as long ago disposed of by Ricardo. So far, Professor Cairnes may be in a manner quite correct. M. Walras, M. d'Aulnis, and I do follow Say and several other eminent writers in regarding value as totally dependent on utility; but it is the exact nature of this dependence which is the all-important point, this which Mr. Cairnes has wholly misapprehended, or rather not apprehended at all. Altogether missing the distinction between total utility or aggregate useful effect, and the remaining degree of utility, which attaches to fresh supplies of the commodity, he remarks:—"A use of language according to which water is only useful where it is paid for,

and in proportion as it is paid for; according to which atmospheric air is only useful in diving-bells, mines, and other places, whither it is costly to convey it; according to which meat and corn are less useful commodities in the United States than in England, and clothing and cutlery less useful in England than in the United States; according to which diamonds are more useful than coal, and iron is the least useful of the metals – such a use of language, it will be admitted, requires strong reasons for its justification." No doubt; but anything more wide of my use of the term useful cannot be conceived. Water, in a certain quantity, is infinitely useful to every person; but when enough has been received, further supplies are not useful, and may be hurtful, as in the case of a flood, a damp house, or a wet mine. A person living by a stream of pure water pays nothing for water, because he experiences the total useful effect of water without paying. For like reasons we seldom pay for air, because, though infinitely useful at every moment of our lives, the portions of air requisite to produce the useful effect of respiration can be drawn straight from the atmosphere without cost, and further supplies would not be useful. In diving-bells, mines, and elsewhere, we pay to get air, because otherwise we should not have enough, and additional quantities are worth paying for. The same explanation applies to all Mr. Cairnes' other objections. Coal is vastly more useful than diamonds in its total usefulness; but as we have for the present plenty of coal and not plenty of diamonds, we may still want one small diamond more than we want an additional ton of coals. With his own interpretation of my use of the term utility, it is no wonder that Mr. Cairnes holds my theory of value to be groundless. It amounts to this, he thinks, "That value depends on utility, and that utility is whatever affects value." In other words, the name utility is given to the aggregate of unknown conditions which determine the phenomenon, and then the phenomenon is stated to depend upon what this name stands for. I am wholly unable to see how Mr. Cairnes reaches this view of the matter. Value does depend upon the degrees of utility of the commodities valued, and these degrees of utility depend upon the quantities of commodities available as compared with the wants of consumers. But, in reality, so long as Mr. Cairnes fails to distinguish between the total useful effect of a commodity and its remaining degree of utility, and so long as he interprets my employment of the term utility in a way which is totally opposed to my own use of it, there is no possible common ground of discussion between us.

I will only further add a few words as to the value of the theory itself. It might seem that it leads us to no new conclusions, because we found that the principal inferences from the theory were the laws of supply and demand, and the doctrine of the relation of value to cost of production already so well known in political economy. But though many parts of

economical doctrine as now accepted will be confirmed by the theory, other parts will probably be shown to be groundless. The results of any such theory must be of a triple character, destructive, conservative, and constructive; but it is yet too soon to attempt to trace out the actual character and extent of its effects in each direction. It might be thought, perhaps, that, being a mathematical theory, it cannot be of use until reduced to exact numbers and mathematical formula. Though numerical precision would be very vauable if it could be secured, yet it is no more requisite to this theory than to the old doctrines of economy, which are mathematical so far as they are anything at all. A true mathematical theory without numerical results can correct, or if necessary overturn, a false mathematical theory without numerical results. The laws of supply and demand are the best established part of the prevailing doctrines, although they have never been defined or analysed with any numerical precision; but, so far as they are known to be true, they form the verification in experience which ought to be applied to every theory. There is nothing, then, more theoretical, more speculative, more mathematical, more removed from experience or common sense in the new than in the old views. The new views simply arise from a more close and thorough analysis of the conditions of utility and its relations to value and labour. Ricardo said, "From no source do so many errors and so much difference of opinion in that science proceed as from the vague ideas which are attached to the word 'value.'" It will be a result of quite sufficient importance for the present if the new theory enables us to test the truth of prevailing doctrines concerning value, and to reject those which are false. It is quite doubtful whether the new theory will always lead us to such precise and dogmatic conclusions as we find in some of the principal treatises on political economy; but it will be allowed that precise and dogmatic conclusions do more harm than good if they be false, and that there is nothing of more worth in scientific matters than the touchstone which can decide between truth and error.

X REMARKS ON THE STATISTICAL USE OF THE ARITHMOMETER

Read before the Statistical Society of London, 19 November 1878. Published in *JRSS*, 41 (1878) 597–601.

If the previous paper displayed Jevons as a pure economic theorist, this one shows him as the applied statistician, very much alive to the value of aids to computation. The 'arithmometer', invented by Thomas de

Colmar about 1850, represented a very real advance on previous calculating machines. It employed the mechanical principle of toothed-wheel gearing, the wheels being engaged by setting stops to the figures.

It seems desirable to draw the attention of statists to the great saving of time and mental labour, which may be effected by the use of the Arithmometer, or French calculating machine. There is no great novelty in this machine. In principle it is the same as the original arithmetical machine invented by Blaise Pascal,* at the age of 19 or 20, about the years 1642–45, and imitated by several later mechanicians. The Arithmometer too, as actually manufactured by the late M. Thomas, of Colmar, has been a good deal used by actuaries, engineers, and others. It was made known to many people at the Paris Exposition of 1867, and to many more at the recent Exposition. English astronomers are now just beginning to use it for the tedious computations continually going on in observatories. Yet mercantile men, statists, and the English public at large remain unaware of the immense saving of labour which may be derived from the expenditure of 16*l.* or 20*l.* upon this beautiful machine.

It is true that the machine is of little use except for simple multiplication and division. The work proceeds entirely by addition and subtraction, which, when repeated time after time, constitute multiplication and division. But there is seldom any saving of time by employing the machine to perform simple addition or subtraction, because a computer of very moderate skill accomplishes this work rapidly on paper, and the transfer of the numbers from paper to the machine would occupy a good deal of time. The machine may be used also to extract square and cube roots; but it only does so by going through all the steps of the ordinary arithmetical processes, which are lengthy, and when not done on paper liable to blunders. For these and various other operations, logarithms would be more advantageous.

Nevertheless, the most common and troublesome operations of the computer consist in multiplication and division, and it is in this work that the machine can render inestimable service. A long sum can be put on the machine in ten seconds, and then a few turns of the handle give the product or quotient almost infallibly correct, and to as many places of figures as can possibly be required. The work for which the statist will find the machine most useful, is that of drawing percentages or ratios. There is little or no significance in any statistical number, except as compared with some other similar number, and in almost all cases that comparison

* "Œuvres Complètes de Blaise Pascal," vol. iii, pp. 185–208, &c. Paris, 1864.

should be made by calculating the ratio of one to the other. If then a statistical table is to be really intelligible and useful, every column of absolute numbers should be accompanied by a column of ratios. This accordingly is done to a certain extent in the Census Reports, the publications of the Registrar General's office, and some other important statistical tables; but it is never done as much as would be desirable. The reason is obvious. Each ratio can only be obtained by a tedious long division sum, or by the use of logarithms. Many hours of tedious mental labour must be endured before a large statistical table can be reduced to its proper intelligible form. The result is that, in the absence of an office full of clerks, the labour is almost always shirked, and the reader of our statistical publications is left to extract their meaning as well as he can – which means very badly.

With the Arithmometer at hand, however, the work becomes rather amusement than labour, especially to those at all fond of ingenious and beautiful mechanism. The amount of time saved will vary with the character of the operation and the nature of the calculations; but about the saving of mental exertion there can be no possible doubt. The machine will also be of great use in effecting the reduction of numbers from one denomination to another, as from pounds to francs, dollars, rupees, &c.; tons to kilogrammes, yards to metres, &c., &c. It is requisite, however, that all numbers should be expressed in the purely decimal form, so that our absurd systems of money, weights, and measures, present obstacles to the easy use of the machine. When frequent alterations of any numbers in a definite ratio have to be made, it will often be best to calculate at the outset a table of the multiples of that ratio; this can be done with the utmost facility by the machine, because each turn of the handle gives a fresh number for the table. A reduction table can thus be prepared as fast as the numbers can be written down, and all further labour of calculation is saved by reference to this table.

I should like to add, that if our science of statistics is to progress in the spirit of the times, frequent use must be made of the Method of Least Squares. This method is merely the method of means or averages employed in a more complete and elaborate way, to disentangle the probable values of several unknown quantities which happen to be involved together in our statistical data. The working of the process, as described in Merriman's "Elements of the Method of Least Squares" (Macmillan, 1877), in De Morgan's "Essay on Probabilities," and many other works on the same subject, can be carried on by mere rule of thumb; but it requires a great amount of multiplication. With Thomas' Arithmometer, however, the requisite calculations can be readily accomplished, and I conceive, therefore, that in this as well as in other cases, the frequent use of the machine is indispensable as a condition of

any distinct advance in statistical inquiry. Familiarity with the arithmetical machine would gradually lead to the undertaking of intricate numerical inquiries, which are practically impossible without its aid.

The use of the machine as employed by actuaries has already been described by General Hannyngton in the "Journal of the Institute of Actuaries," vol. xvi, p. 244, and a very able paper "On the Arithmometer of M. Thomas (de Colmar) and its Application to the Construction of Life Contingency Tables," was printed by Mr. Peter Gray, in the journal of the same Society for 1874, and issued separately as a pamphlet. The operations therein described are, however, far more complicated than what the statist will usually need to perform.

The working of the machine is so easy, that it can be learnt by any person of ordinary intelligence in the course of an hour, and with a few little precautions, which are stated in the explanatory book of instructions delivered with the machine, there need be no fear of its getting out of order. It is said that machines are often worked daily for many years in succession, without any mishap or error occurring; but other operators find that certain springs are apt to break, and require replacement. The machine, though constructed only in Paris, can be inspected and purchased at a depôt in London. The smallest machine now made gives a product not exceeding twelve places of figures, which would be sufficient for most purposes; but the medium-sized machine, giving a product of sixteen places, is said to be more convenient in use, as there is greater scope and freedom of action. My own limited experience of the machine leads me to think that this may be so.

I have been induced to bring the Arithmometer under the notice of the Society, by the feeling that there must be many who are (as I was myself a few months ago) imperfectly acquainted with the value of the machine. Had I purchased a machine when I first saw it at the Paris Exposition of 1867, I should have been saved a great deal of mental fatigue during the eleven subsequent years, and I might have undertaken statistical inquiries which are beyond the power of a private unaided arithmetician. The conviction that this machine must prove no inconsiderable factor in the progress of statistical and social science, renders it desirable for those acquainted with its value, to endeavour to overcome the inertia, which, especially in this country, impedes the introduction of any new labour-saving invention. A machine which was in its essential features invented by the youthful genius of Pascal, in the year 1642, is only now coming into use. For *two hundred and thirty-six years* (236 years!) practical men have ignored what may prove one of the most practically useful, as it is certainly one of the most beautiful products of human reason.

Professor Jevons's Description *of the* Calculating Machine; Discussion.

Dr. Farr said the Society was indebted to Professor Jevons for bringing forward the machine and explaining its uses. It was of great use in the Registrar-General's office in determining the ratios and the percentage of deaths, births, marriages, and so on, and this was done on a very large scale. The clerks were allowed to work by logarithms or by arithmetic, but they invariably preferred the machine. Undoubtedly in order to make it of universal application, there should be a decimal system of calculation in weights, measures, and money; but at present he recommended its use for calculations on a large scale.

Dr. Balfour said that for the last five or six years, when he was at the head of the Army Medical Department, they could make all their calculations as quickly as they could by the machine, but he thought it minimised the chance of error. In working out logarithms there was a source of error, which was avoided by using the machine. All the time it was used in the office under his charge he never had any cause to complain of it except that the springs that were worked on the pegs were apt to go wrong. He was indebted to General Hannyngton, who pointed out how this could be remedied, and after he had done so he had never found the machine to go wrong once. On one occasion the clerk of the Department said that the machine had gone wrong, but it was afterwards found that the error was on the part of the clerk, and not on the part of the machine. In working out ratios it minimised the chance of error, which was a consideration of great importance.

Mr. Walford said he had been familiar with the machine some years ago. He had seen some sixty calculating machines, but he thought on the whole that the one exhibited was the most available for general purposes. He did not think it was a safe thing to use, except by persons familiar with it, because if it was not set with great care errors would arise, and if one number was wrong, the whole would be wrong. He would minimise that difficulty by having two machines to commence at decennial points, and work the one with the other – not, however, by the same operator – and if the results were both the same, they might be pretty well sure that they were correct. It would save a great amount of labour, money, and thought, and simply required care.

Mr. A. H. Bailey, President of the Institute of Actuaries, said that the machine grew upon people the more they used it. There was a variety of purposes to which it could be applied. It was very useful in the distributing of a bankrupt's estate, for instance, and one of its great uses would be to introduce a decimal system of arithmetic; but even with our present system of weights and measures, and of pounds, shillings, and

pence, the machine could be used. It should, however, be understood that it was entirely a decimal machine.

The President, in moving a vote of thanks to Professor Jevons, said that he had shown that it was an extremely valuable instrument, and he thought it might be looked forward to as one of the principal instruments in Government offices. Although it might not save time, it would save a good deal of mental labour, and that was one of the greatest considerations in a Government department.

XI THE SOLAR INFLUENCE ON COMMERCE

This paper is hitherto unpublished. In December 1878 Jevons was contemplating the preparation of a paper to be entitled 'The Sun's Influence on Commerce' for the *Princeton Review*.[1] From internal evidence there seems little doubt that the following, of which the manuscript is in the Jevons Papers, is the one in question; but for reasons which are not now apparent Jevons left the article unfinished and it was never published. It is clear that it was written after the first two papers on his sun-spot theory which Jevons published in 1878[2] and thus at a fairly early stage in the development of that theory. Jevons was evidently attempting to set the theory out in a fairly popular form and it may be that he was not satisfied with the result.

The recent and present condition of industry in Great Britain imperatively demands the careful attention of economists and men of science. A vast calamity[3] has to be investigated, and its recurrence as far as possible provided against. Artizans have been thrown out of employment by tens of thousands, if not by hundreds of thousands. Through no apparent fault of their own, they find themselves suddenly reduced to pauperism, with families which can only be saved from starvation by public or private charity. To them the present state of trade would simply mean famine, did not the semi-socialistic organization of modern society provide a refuge against actual starvation. To other classes of people the state of things is almost equally disastrous. The breaking of several large

[1] See Letters 566 and 567, Vol. IV, pp. 303–304.

[2] 'The Periodicity of Commercial Crises and its Physical Explanation'; read before Section F of the British Association, Dublin, 19 August 1878; 'Commercial Crises and Sun Spots', *Nature*, XIX, 33–7. Both are reprinted in *Investigations*.

[3] replaces 'evil', deleted in original manuscript.

banks has reduced many shareholders to complete ruin, has swept away the savings of a lifetime or the widows' provision which can not be restored. Even when establishments are not broken up they have in many cases been reduced, and highly paid clerks, receiving two, three, four or more thousands of dollars annual salary are cast adrift in the decline of life. Pauperism in fact is not confined to the operative classes.

The state of things is not equally bad in all parts of the country; it chiefly affects Lancashire & Yorkshire where industry depends much upon foreign trade. No doubt, too, the destitution will be very temporary. In the United States the depression of trade seems already to have passed its worst point, and the collapse although long drawn out has not culminated in a crisis so severe as the English markets have been just enduring.

But when the lives and fortunes of so many are concerned, & when in fact the prosperity of the whole trading world is at stake we must not be contented with superficial discussion. We must not lay to the charge of trades-unions, or free trade, or intemperance, or any other pretext, a fluctuation of commerce which affects countries alike which have trades-unions & no trades-unions, free trade and protection; as to intemperance and various other moral causes, no doubt they may have powerful influence on our prosperity but they afford no special explanation of a temporary wave of calamity. We can hardly doubt that it will be temporary because on looking back thirty or forty years we find that crises of very similar character, followed by a temporary interruption of industry have repeatedly recurred. The distress of the Lancashire operatives in the years 1841 & 1842 has never been forgotten and it recurred in a less severe form in the years 1848–9, and again in 1858. Now it has come back again with a severity which almost promises to equal that of 1842.

The most casual inquirer can hardly fail to be struck by the fact that these epochs of distress are periodic. The crisis or collapse of credit which ushers in a period of destitution is more definite in date than the interval of destitution itself, and if we remember that there was, especially in the United States a collapse in 1837, another in 1847, another in England 1857, & again in 1866, and now a most distinct one in 1878, we may be tempted to carry our thoughts still further back to 1825–6 when there was likewise a most fully developed crisis followed by depression of industry. These events have thus recurred at intervals successively of say 12, 10, 9, and 12 years, and the approximation to an average period of about 10½ years is so remarkable, that no one who really contemplates the facts can fail to be struck by the fact. But many who have been forced to admit the periodic character of these events have shown a strange unwillingness to enter upon any scientific examination of its causes. They

say that they do not want mere theory; it is to facts, and to daily experience they look; to mention the sun or planets to them is only to call forth a denunciation of astrological speculations. Practical men must have practical arguments, which expression being interpreted, means arguments not going beyond the memory of the last few months, or at most the last few years. But I now make it my business to show that it is these so-called practical men who are the baseless theorisers, and that it is the astrological speculators who really base their explanations upon a large range of experience, upon facts widely gathered and carefully collated. I need not inform my readers that a series of eminent astronomers, meteorologists, and physicists of different ranks & branches of science, have gradually established the fact that the sun is a variable star, having a period of variation somewhere between ten and twelve years, as Professor Loomis states the fact in his newest work on astronomy. An eminent meteorologist, Mr J. A. Broun, lately the Director of the Magnetic Observatory at Trivandrum in the Madras Presidency estimates the period, as we shall see precisely at 10.45 years, and this period so closely agrees with the commercial period already pointed out, that a strong presumption of causal connection at once arises. It will obviously be impossible in an article to adduce the best array of facts by reference to which we can alone validly judge the worth of this presumption, and I must therefore confine myself to attempting to sketch out the course of inductive argument and enquiry which leads almost conclusively to a belief in the solar origin of commercial fluctuations.

In the first place, we must look to the general principles of inductive logic by which our inquiries must necessarily be guided. The relation which we are attempting to establish is one of cause and effect, and both cause and effect are supposed to be periodic in character, and the one is supposed to produce the other. To this case there applies a general principle of mechanics [which is][4] called *the principle of forced vibrations*, which has been clearly stated by the late Sir John Herschel in several of his works.[5] One statement of the principle is given in my "Principles of Science", but a more simple statement is found in Herschel's *Meteorology* (§ 144) where he says – "It is a dynamical law absolutely universal, and one which extends even beyond the domain of mere dynamics, that all periodicity in the action of a cause propagates into every, even the remotest, effect of that cause, through whatever chain of intermediate arrangements the action is carried out." I have elsewhere explained that Herschel was mistaken in stating this law as an *absolutely universal* one,

[4] deleted in original manuscript.

[5] Herschel, 'Sound', *Encyclopaedia Metropolitana*, (1845) IV, 811; *Outlines of Astronomy*, fourth edition (1851) pp. 410, 487–8; 'Meteorology', reprinted from the *Encyclopaedia Britannica* (Edinburgh, 1861) p. 197.

since his own discovery of fluorescence, or epipolarization of light as he originally called it, shows that a vibration of less period may under certain unknown conditions produce one of longer period; calorescence again as investigated by Professor Draper proves that heat vibrations may produce more rapid & small light vibrations, & many casual phenomena of water and other waves likewise furnish exceptions to the general principle of periodicity. Nevertheless the principle of forced vibrations holds perfectly true as a general law of mechanics and nature. The direct simple effect of any periodic cause is likewise periodic, and in the absence of disturbing causes, the period of the effect will be exactly equal to that of the cause. It will not usually be simultaneous, because an interval often elapses between the moment of action of a cause, and the manifestation of the effect which strikes our attention. If, for instance, a loaded repeating rifle be discharged at exact minute intervals against a distant target, the bullets will strike the target at intervals of one minute each and the sounds of those strokes will also be heard at similar intervals; but a second or two will intervene between the discharge and the stroke, and again between the stroke and the sound as heard at a distant spot. Now the solar influence, assuming it to be periodic in amount, will undoubtedly produce variations in industry, which variations will be periodic, but the several effects will follow in a chain at successively greater intervals after the occurrence of the cause. The greater intensity of the sun's rays will alter the condition of the atmosphere; this will affect the growth of crops, the price of vegetable food, subsequently the price of animal food; the currents of trade will then be varied in amount & direction, and the influence, if sufficiently great, will more or less manifest itself in the most complicated transactions of currency, credit & speculation. But it is, of course, quite likely that many of the remote effects of solar variation will be beyond the power of our insight, owing to great disturbing causes, such as wars, social disturbances, changes in currency and other social institutions, mutations of fashion, & habit, etc, etc.

But we have not yet done with pure theory; we have only learnt from an eminent physicist that a periodic cause will have periodic effects. When we perceive the existence of a periodic effect, such as commercial crises appear to be, how shall we proceed to discover its cause? We must proceed upon the great principle of inductive method, as laid down by Laplace and the several great mathematicians who created the theory of probability. This principle is to the effect that the most probable cause of an event which has happened is that cause which if it existed would most probably lead to that effect. This principle is at once the perfection of commonsense, and the most general result of the theory of inductive logic. If, for instance, a mariner at sea hears reports of guns at exact intervals of a minute, he infers at once that there is somewhere near a vessel in

distress. The reasoning, if carefully analysed, amounts to this, that if there were such a vessel in distress, she would in all probability fire minute guns, and the reports of those guns, if not too distant, would be heard at minute intervals; on the other hand, it is not easy (indeed almost impossible) to conceive any other cause which would be likely to produce reports regularly recurring at that precise interval in the middle of the ocean. If afterwards the mariner descries a vessel from which proceed puffs of smoke at minute intervals, it becomes practically certain upon a like method of inference, that she is the vessel in distress producing the periodic gun-reports. The outcome of inductive method as it affects our present subject is simply this, that if we perceive a distinctly periodic effect, and can discover any cause which recurs at exactly equal intervals, and is the only discoverable cause recurring in that period, this is probably the cause of which we are in search. Such is the *prima facie* result, drawn simply on the ground that such a cause if existing would have effects with the required period, and there is no other cause which could be supposed with any probability to give that result. But this *prima facie* probability is immensely strengthened if we can give other reasons for believing that a cause of the nature supposed, apart from the question of its period, is likely to have effects of the kind we are attributing to it. In short, mere equality of period is a perfectly valid ground of inductive reasoning; but our results gain much in probability if we can analyse and explain the precise relation of cause and effect.

In a paper read at the last meeting of the British Association (Dublin, 1879) and in a distinct article published in *Nature*,* I have given reasons for believing that the average period of recurrence of commercial crises in England between the beginning of the 18th century and the present time is about 10.46 years, whereas Mr J. A. Broun's latest investigations of the sun-spot period convince him, as I shall afterwards explain, that its period is about 10.45 years. These numbers are so closely equal that there arises at once a strong presumption of causal connexion, so strong that, supposing the observations to be well made & discussed without bias, they would almost establish the connexion however discrete and apparently remote the phenomena thus brought into theoretical relation. But, as just explained, it lends much strength to such an inference if we can show that a variation of the nature in question, namely sunspot variation, would be likely to produce variations in commerce which might constitute a commercial crisis. It will be most convenient to take the latter part of the investigation first, and to inquire whether sunspot variations are likely in their physical nature to affect commerce.

* *Nature*, 14 November 1878, vol. XIX, pp. 33–37. [This note was inserted by Jevons himself in the margin of the manuscript.]

It strikes me forcibly that those would-be 'practical men' who smile and sneer as soon as ever they hear the sunspots or planets mentioned in connection with trade, must either know, or else think, very little about the constitution of the solar and terrestrial system of which they form a part.[6] The very men who laugh at the notion of sunspots ruling their destinies are probably profound believers in that little formula, given in many almanacks, and falsely called Herschel's Weather Table. Upon no foundation either of fact or theory they will attribute the changes of weather to the moon, while they set down almost as lunatics those who attribute tides in human affairs to the sun's influence. The very name 'lunatic' embodies the popular impression that the periods of the moon do affect us, at least in certain states of health. No doubt the regular periodic appearance of the moon in its several phases has always impressed the imagination of man in a profound manner. To the moon we undoubtedly owe the chronological period of the month of 28 days, and there can be little doubt that the week is simply the fourth part of the month. If so, we owe to the moon the whole periodic variation of industry which completes itself within the week, the fortnight or the month. It need hardly be pointed out, too, that there are in the human constitution certain changes, which according to our inductive formula must be attributed with high probability to the lunar influence.

But, if the potency of the moon in human affairs is thus considerable, how vastly greater must be that of the sun. Let us consider the relative powers of these bodies. So far as we know at present, there are only three modes in which one cosmical body can possibly affect another cosmical body, namely (1), by gravitation; (2) by radiation; (3) by the actual communication of matter. Now, as regards gravity, it is true that the moon is about 400 times nearer to us than the sun, so that, in respect of this fact, its gravitating power is about 160,000 times as great as that of the sun. But then the mass of the sun is so enormous, namely 31,134,986 (thirty one million times) as great as the mass of the moon, that the actual force of gravity exerted by the sun on a particle of the earth comes out at about 194.6 times as great as the similar force of the moon.[7] So far, indeed, as such force is uniformly exerted upon all the particles composing the earth, it is incapable of creating any variation of phenomena in them, so that it is in fact only the differential force of gravity, that is the difference between an exterior body's gravity as exerted in one part and the other of the earth, which can be perceived by us. Now owing to the comparative nearness of the moon it is true that its differential force of gravity upon the earth is about three times that of the

[6] replaces 'one of the most insignificant parts', deleted in original manuscript.

[7] In the original manuscript Jevons here wrote 'sun'; 'moon' has been written above this in pencil possibly by another hand.

sun. Yet the absolute amount of this force is very small being only about one four millionth part of the sun's total attractive force upon the earth. So small indeed are these differential attractions that there is no phenomenon excepting the tides of the sea and atmosphere, which they have been observed to produce. Only through the tides then can the moon's gravitation affect human industry, so far as we know.

It seems excedingly unlikely then that either the moon or sun should by its mere force of gravity have any influence on human affairs except through the tides which of course affect navigation and commerce in a certain degree. Proceeding then to radiational power, comprehending under this expression both the heat and light rays of the spectrum, there cannot of course be the slightest doubt that the sun is almost incomparably superior in influence. The moon's rays are but a faint reflection of the sun's rays falling upon its surface. Wollaston long ago estimated the suns light as 810,072 times that of the full moon, and Bouguer made it 300,000 times. The more recent determination of this ratio by Professor G. P. Bond at the Harvard College Observatory† comes between these numbers, being 470,980. The considerable discrepancies between these results is of no importance to us, because in any case it is certain that the radiative influence of the moon is a wholly inconsiderable fraction of the suns power. The unaided eye is no safe measure in such a question, since in bright sunshine the pupil is contracted to its smallest dimensions, while in the brightest moonlight it would be found to be comparatively dilated.

In the second place the positive evidence of variation comes from many independent sources. There is the direct evidence of the eyes to the effect that during some total eclipses of the sun, enormous protuberances of a splendid pink colour are suspended in the suns atmosphere; during other eclipses these protuberances are seen to be comparatively insignificant. We have thus direct proof that in the sun there are periodic meteorological changes involving such immense masses of matter in such an intense state of heat and agitation that it is hopeless to attempt to form to the mind any adequate idea of this "Soul" of our system. The much ridiculed solar spots again can be no matter of ridicule to those who know what they are. Their magnitudes vary from the least which can be observed up to enormous cavities 40,000, or 50,000 miles or more in diameter. Spots have been observed so gigantic in dimensions that a score of bodies equal to the earth might be conceived as dropped in without filling them up. Now long continued telescopic observation completely establishes the fact that these inconceivably vast agitations of the solar surface only take place during certain intervals of years. In one year the

† *Monthly notices of the Royal Astronomical Society*, 10th May 1861, vol. xxi, pp. 199–200. [This note was inserted by Jevons himself at the bottom of the page of manuscript.]

spots occasionally grow so large that they may be seen by the naked eye; from five to seven years afterwards a telescope will not disclose anything to be called a spot. But it is well known now to every tyro in science that the numbers of spots when ascertained from records as completely as possible show a periodic variation almost as well marked and regular, at least in certain parts of the 18th and 19th centuries, as the rise and fall of the tides.

Most unfortunately astronomers and physicists have omitted to make any long series of direct experiments upon the heating power of the sun's rays as would prove the fact of variation and show clearly that the rays are more powerful whether in heat, light or actinic effect, in one state of maculation as compared with other states. Pouillet showed how the heating effect might be accurately measured in 1838, by performing the operation, with his Pyrheliometer, as described in his [8]

However these more speculative questions may be resolved it requires a very moderate acquaintance with physical science to know that almost all the motions and changes going on upon the earth's surface are ultimately referable to the energy of the sun's rays. We must except the tides, volcanic, and a few other inconsiderable phenomena; the winds & ocean currents are in some degree referable to the earth's own energy of rotation. But it is quite clear that vegetable life, & through that animal life is wholly dependent on solar radiation. True vegetable growth goes on only under the direct excitation of the suns rays, the so called actinic or chemical energy of which accomplishes the decomposition of carbonic acid. Hence the origin of all heat furnished by combustion whether in the wood fire, the coal fire, or the animal body. Long ago George Stevenson acutely anticipated the results of subsequent scientific inquiry when he said that coal was but sunshine bottled up; now it is among the mere common places of science that all the motions & energies of life, whether it be that of the windmill, the waterwheel, the steam engine, the beast of burden, or the human operative, are directly or indirectly derived from the sun. Happily did Milton describe that orb as "of world, both eye and soul." In a physical point of view it is simply the soul, the fount, the mainspring of life & energy of the planetary system. To our part of the material universe it is what the spring is to the watch, the weight to the clock, the water to the mill, the fuel to the engine. What then is there absurd or fanciful in the supposition that if the sun varies in power of radiation, those variations will in virtue of the principle of forced vibrations, manifest themselves in the course of industry and trade. The sun is altogether the body to which all scientific influence would point as

[8] In the original manuscript Jevons left a space of three lines at this point. For the reference to Pouillet's work which he may have intended to insert in it, see *Investigations*, p. 234.

the most probable cause of any periodic variations perceptible in animal & vegetable life but of course we must not assume without a full investigation of evidence that the sun does vary in power. In the last thirty or forty years however a constantly accumulating body of evidence has been forthcoming tending to constitute constructive proof that the sun is a variable star, or at all events that its energy as showered down upon the earth is periodically variable. The limitation of space will not allow me to do more than briefly indicate the several sources and kinds of this evidence.

In the first place the analogy of other variable stars renders the hypothesis of solar variation an *a priori* reasonable one. A great number of fixed stars are now known to go through well marked variations of brightness, in periods of a few days, a few years, or it may be many years. The remarkable star Algol has a regular period of just 2.86 days. As long ago as 1596, the star O Ceti or Mira was observed to vary, and it reaches a maximum of brightness about twelve times in eleven years, its period being therefore about 331.3 days. Rudolf Wolf has gone so far as to point to the star of *Argus Navis* as one whose complex periodic variations are not improbably similar to those of our own sun. But however this may be there is certainly no antecedent improbability attaching to the hypothesis of periodic variation in a series of complex periods.

XII PREFACE TO THE ENGLISH TRANSLATION OF COSSA'S *GUIDE*

On 5 May 1879 Luigi Cossa, Professor of Political Economy at the University of Pavia, wrote to Jevons seeking to enlist his help in securing the publication by Macmillan of an English translation of his *Guida allo Studio dell' Economia Politica*.[1] Jevons considered the proposal worthy of support, for, as he later wrote to Alexander Macmillan, 'the *Guide* contains a great deal of information quite inaccessible hitherto to English ordinary students.'[2]

The 'former lady student . . . of the Cambridge Society for the Extension of University Teaching' who prepared the translation was Margaret A. Macmillan.[3] It was published as *Guide to the Study of Political Economy* by Macmillan & Co., London, in 1880. The short preface which Jevons contributed to it is interesting as showing both his desire to make the work of Continental economists better known to English economists

[1] See Letter 610, Vol. V, p. 59.
[2] W. S. Jevons to A. Macmillan, 24 March 1880, Letter 643, Vol. V, p. 94.
[3] Cf. Letters 603 and 651, Vol. V, pp. 53 and 101.

and his great respect for, and interest in, the historical method. This latter point has often been overlooked, mainly because of the rigorously deductive character of his *Theory of Political Economy*.

To a reader fairly acquainted with the English Literature of Political Economy it will be evident why this translation of an Italian text-book has been undertaken. The sufficient reason is that no introduction to the study of Economics at all approaching in character to Professor Cossa's *Guida allo Studio dell' Economia Politica* is to be found in the English tongue. This work presents, in a compendious form, not only a general view of the bounds, divisions, and relations of the science, marked by great impartiality and breadth of treatment, but it also furnishes us with an historical sketch of the science, such as must be wholly new to English readers.

Every economist would grant that we have in English the works of the father of the science, Adam Smith, and of not a few successors or predecessors who have made the science almost an English science. But this fact, joined perhaps with the common want of linguistic power in English students, has led our economic writers to ignore too much the great works of the French and Italian economists, as well as the invaluable recent treatises of German writers. The survey of the foreign literature of the subject given in this *Guide* will enable the English students to fix the bearings of the point of knowledge which he has reached, and to estimate the fraction of the ocean of economic literature which he has been able to traverse.

Of course it is not to be expected, nor even to be desired, that English students of Economics should at once endeavour to master treatises in the French, German, Italian, and other languages. A few may be able thus to extend their studies; and it is believed that they will find in Dr. Cossa a safe pilot to the course of reading they may best pursue for their special purposes. The ordinary student must necessarily be contented with a second-hand and superficial acquaintance with the masses of literature here indicated. But it would be a mistake to treat such knowledge as worthless. The late Professor De Morgan said, or at least very happily repeated the saying, that "true education consists in knowing everything of something and something of everything." Applying this maxim to our science, the judicious student of Economics must necessarily select the works of Adam Smith, of Ricardo, of J. S. Mill, of Cairnes, or of some one or a very few leading English economists, and must study them, so to say, completely. They will be the something of which he must learn everything. But, when this has been sufficiently accomplished, he cannot

do better than learn the something of everything in economic literature, which is admirably given in this *Guide*.

One valuable result which will probably be derived from the reading of Professor Cossa's work is the conviction that the *historical method* must play a large part in economic science. Without for a moment admitting, with some extreme advocates of that method,* that there is no such thing as an abstract science of Economics, the student will readily become convinced that in such matters as land tenure, agriculture, the organisation of industry, taxation, &c., theory must be applied with very large allowances for physical and historical circumstances. National character, ancient custom, political condition, and many other conditions, are economic factors of great importance. Although some of our best English economists were fully alive to this fact, there is nevertheless an almost inevitable tendency to regard the complicated industrial organisation of England as if it were the natural and best organisation, to which other nations have failed, in a more or less serious degree, to attain. Wider study will show that economic as well as political and social development must bear relation to the historical and physical circumstances of the race. It is surely time to abandon the idea, for instance, that the landlord system of land-tenure of England, even supposing that it is the best for English agriculture, is necessarily the best for France, Belgium, Norway, India, Australia, Ireland, and the rest of the habitable world in general. In the fourth chapter of the First Part Dr. Cossa has very clearly refuted some of the prevailing errors on the subject of the historical method.

Now and again we meet opinions and expressions in the *Guide* in which it is impossible to coincide. On page 124 of this translation, for instance, the author speaks of "the notable advantages to industrial organisation and progress," which he thinks have been conferred in its time by the Protective System. Few, or probably no English economist, would now accept this opinion, unless with qualifications and explanations which would really reverse the writer's meaning. Nor is this, as we think, the only scientific or doctrinal blemish of the work. Yet after all exception is taken it must be allowed that the author has performed his difficult task in a most judicious and impartial manner.

As Dr. Cossa has passed over without mention most of his own economic labours, it should be stated that he has been, since the year 1858, Professor of Political Economy in the University of Pavia. During nearly a quarter of a century he has devoted himself entirely to the promotion and dissemination of economic science, and not a few of the rising economists of Italy owe their success to his instructions. Among his principal works may be mentioned the *Primi Elementi di Economia Politica*,

* See, for instance, Professor Cliffe Leslie's Essay on the "Philosophical Method of Political Economy," in *Hermathena*, No. iv., 1876.

first published at Milan in 1875, of which a fourth edition, considerably augmented, appeared in 1878. Spanish and German translations were printed in 1878 and 1879. His second work was the *Primi Elementi di Scienza delle Finanze* (1875), of which a third edition is about to appear. Various essays on economic subjects have been reprinted in a volume under the title *Saggi di Economia Politica* (Milan, 1878).

The *Guida allo Studio dell' Economia Politica*, of which the following pages contain an English version, was originally published at Milan in 1876; a second revised and enlarged edition being issued in 1878. A Spanish translation was printed at Valladolid in 1878, and it is said that a German translation by Dr. Edward Moormeister is to appear during the course of the present year at Freiburg. The considerable use which is thus evidently being made of Professor Cossa's text-books will not surprise a reader who can appreciate the extraordinary extent and accuracy of Dr. Cossa's knowledge of the economic literature of almost all nations. This characteristic of his works may be partly explained by the fact that he was in early life a pupil of that most learned and eminent economist, Professor Wilhelm Roscher. In England we cannot hope to compete with the polyglot learning of a Roscher or a Cossa, but it is to be hoped that not a few English students of economics, who are seldom polyglots, will use this translated *Guide* in order to make themselves a little less insular than they would otherwise be.

The work of translation has been carried out by a former lady student in one of the excellent classes of Political Economy, conducted under the superintendence of the Cambridge Society for the Extension of University Teaching. Acknowledgments are due to Professor Cossa for corrections and additions, which bring up the work to the present year.

XIII LIST OF SELECTED BOOKS IN POLITICAL ECONOMY

Monthly Notes of the Library Association of the United Kingdom, III (1882) 105 11

An enthusiastic book collector who had amassed a considerable private library, Jevons was always interested in libraries and bibliography. He was a member of the Library Association, and occasionally attended its conferences; for these reasons, no doubt, Ernest C. Thomas, the editor of the Association's *Monthly Notes*, turned naturally to Jevons for a list of economic works to guide public librarians.

Adam Smith's *Wealth of Nations.*

The basis of every economic library. The best "library" edition is that of Thorold Rogers, in two vols. (Clarendon Press). 1st ed., pp. xlvi., 423; viii., 594. McCulloch's one vol. edition is valuable for reference chiefly on account of the good index. Gibbon Wakefield's edition, in four vols. (12mo. London, Knight, 1843), should be secured when it is met with; the notes are good. There is a very cheap (3*s.* 6*d.*) reprint edition, pp. 781 (Ward and Lock), which gives the text complete; but there are plenty also of good old three-volume editions.

J. S. Mill's *Principles of Political Economy.* (Longmans.)

The cheap "People's Edition" is, except as regards type, equally good with the more expensive library editions.

The following works are recommended as treating of the science generally:—

Some Leading Principles of Political Economy newly Expounded. By J. E. CAIRNES. (Macmillan.) 1874. Pp. xix., 506.

Harmonies of Political Economy. By FRÉDÉRIC BASTIAT. Translated from the 3rd edition of the French, by P. J. STIRLING. 2nd ed. Edinburgh (Oliver Boyd). Pp. 528.

Economic Sophisms. By FRÉDÉRIC BASTIAT. Translated from the 5th edition of the French by P. J. STIRLING. Edinburgh (Oliver and Boyd). 1873. Pp. viii., 235.

The Wages Question: A Treatise on Wages and the Wages Class. By FRANCIS A. WALKER, Yale College. (Macmillan.) 1878. Pp. 428.

The Economics of Industry. By ALFRED MARSHALL and MARY PALEY MARSHALL. (Macmillan.) 1879. Pp. xiv., 231

Political Economy. By NASSAU WILLIAM SENIOR. 5th Edition. London (Griffin). 1863. Pp. viii., 231.

Indispensable as a student's text book. The original edition of the book is found in the "Encyclopædia Metropolitana" (Division – Useful Arts).

James Mill's *Elements of Political Economy.* 3rd Ed. 1826. Pp. viii., 304.

Easily procured and excellent.

For the history of Political Economy it is desirable to have the following works:—

Principles of Political Economy. By WILLIAM ROSCHER. Translated by JOHN J. LALOR. Chicago (Callaghan and Company). 1878. 2 vols., pp. xxi., 464, 465.

The chief value of the work lies in the foot notes, which are replete with information and references.

Histoire de l'Economie Politique en Europe. Suivie d'une Bibliographie raisonnée des principaux Ouvrages. Par BLANQUI. 4th Ed. Paris (Guillaumin). 1860. 2 vols., 12mo, pp. 384, 412.

This work has been recently (1880) translated into English by E. J.

Leonard, with a Preface by David Wells (George Bell and Sons). But this edition is said to lack the bibliography which adds value to the original.

Guide to the Study of Political Economy. By Dr. LUIGI COSSA. Translated from the Second Italian Edition. With a Preface by W. STANLEY JEVONS. (Macmillan.) 1880. 12mo, pp. xvi., 237.

Principles of Political Economy. With sketch of the Rise and Progress of the Science. By J. R. MCCULLOCH.

There is a cheap (3*s.* 6*d.*) edition (Ward and Lock), pp. 360.

The Literature of Political Economy: A Classified Catalogue of Select Publications in the different departments of that Science, with Historical, Critical and Biographical Notices. By J. R. MCCULLOCH. London (Longmans). 1845. Pp. xiii., 407.

Indispensable to an economic library, but difficult to obtain. Though far from being complete and perfectly accurate, it is practically the only bibliography of Economics in English.

Dictionnaire de l'Economie Politique. Publié sous la direction de MM. Ch. COQUELIN ET GUILLAUMIN. Paris (Librairie de Guillaumin). 1852. 2 vols., pp. 971, 896.

A very valuable work, especially as regards the biography and bibliography of economic writers. The later edition appears not to be superior to that named.

The Romance of Trade. By H. R. FOX BOURNE. London. (Cassell, no date.) Pp. vi., 379.

A readable and instructive book.

The Growth of English Industry and Commerce. By W. CUNNINGHAM, M.A., Cambridge, at the University Press. 1882. Pp., xiv., 492. 3 Charts and 2 Maps.

In spite of its extensive and therefore somewhat expensive character, it is impossible to omit mentioning the following great economico-historical work:—

A History of Agriculture and Prices in England from the Year after the Oxford Parliament (1259) *to the commencement of the Continental War,* 1793. Compiled entirely from Original and Contemporaneous Records. By JAMES E. THOROLD ROGERS, M.A., Oxford, at the Clarendon Press. Vols. I. and II., 1876. Pp. xvi. 711; xviii., 714. Vols. III. and IV., 1882. Pp.xvii., 775; xx., 779.

Passing now to books treating of special departments of the Science we must note:—

The Economy of Machinery and Manufactures. By CHARLES BABBAGE. 3rd Ed. London, 1832. Pp. xxiv., 392.

A work of great excellence. Easily purchased second-hand, but said to be still in print.

History of the Middle and Working Classes; with a Popular Exposition of

the Economical and Political Principles which have influenced the Past and Present Condition of the Industrious Orders. By JOHN WADE. London, 1833. Pp. xx., 604.

A book which, though old, has not been superseded by anything better. It is partly founded on Eden's celebrated work. There is a cheap reprint, 4th ed., 1842. Edinburgh (Chambers). Pp. 174, double col.

Political and Social Economy; its Practical Applications. By JOHN HILL BURTON. Edinburgh (Chambers). 1829. Pp. xii., 345.

Political Economy for Plain People. Applied to the Past and Present State of Britain. By G. POULETT SCROPE, F.R.S. 2nd ed. London (Longmans). 1873. Pp. xxv., 353.

English Factory Legislation. By ERNST EDLER VON PLENER. With an Introduction by ANTHONY JOHN MUNDELLA, M.P. London (Chapman). 1873. 12mo, pp. xxiv., 175.

Essays in Political and Moral Philosophy. By T. E. CLIFFE LESLIE. Dublin (Hodges, Forster and Co., University Press Series). 1879. Pp. xii., 483.

Contains some valuable articles on gold, prices, wages, philosophical method of political economy, &c.

Essays in Political Economy, Theoretical and Applied. By J. E. CAIRNES. London (Macmillan). 1873. Pp. xi., 371.

Treats of depreciation of gold, land, free trade, &c.

The Character and Logical Method of Political Economy. By J. E. CAIRNES. 2nd and enlarged Edition. London (Macmillan). 1875. Pp. xvii., 229.

Essays on some Unsettled Questions of Political Economy. By JOHN STUART MILL. (Longmans.) 1844.

The Conditions of Social Well-being; or, Inquiries into the Material and Moral Position of the Populations of Europe and America, with Particular Reference to those of Great Britain and Ireland. By DAVID CUNNINGHAM. (Longmans.) 1878. Pp. xv., 357.

As regards economic statistics, it is especially recommended that every library should have a copy of the following very cheap annual Parliamentary paper:—

Statistical Abstract for the United Kingdom. 8vo. (Price in 1881, 10*d.*)

There are several other almost equally valuable and cheap official publications, such as the *Statistical Abstract of the Colonial Possessions of British India*, &c.

For the older economic statistics the best work is *The Progress of the Nation.* By G. R. PORTER. New ed. (Murray.) 1847. Pp. xxiii., 846 (Later edition, 1851.)

MacCulloch's Commercial Dictionary, contains a mass of information. The earlier editions are to be easily found, and any edition is better than none. There is a quite new edition, edited by A. J. WILSON. (Longmans.)

There are numerous books, taking various views of socialistic dis-

cussions, but the following can be confidently recommended:—

Robert Owen, and his Social Philosophy. By W. L. SARGANT. London (Smith, Elder & Co.). 1860. Pp. xxiv., 446.

Social Innovators, and their Schemes. Same author and publisher.

On the Land Question the following works are to be named:—

The Land Question, with Particular Reference to England and Scotland. By JOHN MACDONNELL. (Macmillan.) 1873. Pp. 250.

Primitive Property. Translated from the French of EMILE DE LAVELEYE by G. R. L. MARRIOT. With an introduction by T. E. CLIFFE LESLIE. (Macmillan.) London, 1878. Pp. xlvii., 356.

One of the best works of the so-called historical school of political economy; to which also belongs the following earlier but very excellent book:—

An Essay on the Distribution of Wealth, and on the Sources of Taxation. By the Rev. RICHARD JONES. London, 1831. Pp. xlix., 329 (49).

The following was published under the sanction of the Cobden Club:—

On the Agricultural Communities of the Middle Ages, and Inclosures of the Sixteenth Century. Translated from the German of E. NASSE by Colonel H. A. OUVRY. London (Macmillan). 1871. Pp. 100.

Systems of Land Tenure in Various Countries. A series of essays published under the sanction of the Cobden Club. Edited by J. W. PROBYN. London. (Cheaper edition, 1876, title page undated, Cassell.) Pp. viii., 418.

All the other publications of the Cobden Club are desirable acquisitions. The larger volumes, such as the "Cobden Club Essays," 1872, and the Essays on "Local Government and Taxation" are not easy to find, but there are numerous minor publications. The secretary of the Club is Mr. Richard Gowing, 53, St. John's Park, London, N.

Among the more useful and readable works on finance, money, &c., may be named:

Goschen's *Theory of the Foreign Exchanges.* Any edition.

James Wilson on *Capital, Currency, and Banking.* London, 1844.

Laing's *Theory of Business for Busy Men.* 2nd Edition. (Longmans.) 1868. Pp. viii., 285.

Bagehot's *Lombard Street.* 6th Edition. (Kegan Paul & Co.)

Chevalier's *Cours d'Economie Politique.* 3me Tome, "La Monnaie." Paris.

Essays in Finance. By ROBERT GIFFEN. London (George Bell & Sons). 1880. Pp. xii., 347.

Money. By FRANCIS A. WALKER. New York (Henry Holt & Co.); London (Macmillan). 1878. Pp. xv., 550.

Money in its Relation to Trade and Industry. By F. A. WALKER. New York

(Henry Holt & Co.). 1879. 12mo. Pp. iv., 339.

A Treatise on the Coins of the Realm; In a Letter to the King. By Charles, First Earl of LIVERPOOL.

A masterly work, which contains by far the best history and general account of the English Currency. The original edition (4to, 1805: Oxford, pp. 268) is scarce; but the 8vo reprint, issued by the Bank of England (Effingham Wilson, 1880, pp. xii., 295) is fortunately to be had.

Turning to the subject of Banking:—

The Principles and Practice of Banking. By J. W. GILBART.

Any of the later editions; but the best is a new edition by Michie (George Bell and Sons).

The Scottish Banker; or, A Popular Exposition of the Practice of Banking in Scotland. By W. H. LOGAN. New Ed., 1850.

A small but good book.

The Practice of Banking. Embracing the Cases at Law and Equity, bearing upon all Branches of the Subject. By JOHN HUTCHISON. London (Effingham Wilson). *Title undated,* 1880? Pp. xxviii., 526.

Banking Reform: An Essay on Prominent Banking Dangers, and the Remedies they Demand. By A. J. WILSON. London (Longmans). 1879. Pp. vi., 192.

The history of banking may be found either in *Lawson's History of Banking,* which is scarce, or in

The Theory and Practice of Banking. By HENRY DUNNING MACLEOD. 2 vols. Longmans. 1855. Pp. xxiv., 436; lxxxii., 542.

In regard to Finance and Taxation, the works to be sought for are as follows:—

The Financial Statements of 1853, 1860–63; *to which are added a Speech on Tax Bills,* 1861, *and on Charities,* 1863. By W. E. GLADSTONE. London (Murray). 1863. Pp. 462.

Twenty Years of Financial Policy: A Summary of the Chief Financial Measures passed between 1842 and 1861; with a Table of Budgets. By Sir STAFFORD H. NORTHCOTE, Bart. London (Saunders, Otley and Co.). 1862. Pp. xvi., 399.

National Finance: A Review of the Policy of the last Two Parliaments. By JOHN NOBLE. London (Longmans). 1875. Pp. 368.

A book which has not been superseded is

The History of the Public Revenue of the British Empire. By Sir JOHN SINCLAIR. Third Edition. Three vols. 1803. Pp. xvi., 532; viii., 411, 63; viii., 320, 196.

The third volume contains a valuable bibliography of works on Finance.

On Free Trade the best treatise is—

Free Trade and Protection. New and Cheaper Edition. By the Right Hon.

HENRY FAWCETT. London (Macmillan). 1882.

The following works by AUGUSTUS MONGREDIEN are published by Cassells, or by the Cobden Club:—

Free Trade and English Commerce. History of the Free Trade Movement in England. 5th Ed.

Pleas for Protection Examined.

Among a multitude of works relating to labour and capital, the following only can be mentioned here:—

The Labour Laws. By JAMES EDWARD DAVIS. London (Butterworths). 1875. Pp. xv., 335.

The Conflicts of Capital and Labour. Being a History and Review of the Trades Unions of Great Britain. By GEORGE HOWELL. London (Chatto and Windus). 1878. Pp. xviii., 520.

An excellent cheap little work or primer, giving the elements of the labour question, is—

Political Economy for the People. By JOHN LANCELOT SHADWELL. Reprinted from the *Labour News*. London (Trübner). 1880. 12mo. Pp. v., 154.

The most compendious French text book of the science is—

Traité d'Economie Politique, exposé didactique . . . Par JOSEPH GARNIER. 5me Ed. Paris (Guillaumin). 1863. Pp. xii., 748.

The theory of the science, partly according to the recent French views, may be well studied in

Plutology; or, The Theory of Efforts to satisfy Human Wants. By W. E. HEARN, Professor of Political Economy in the University of Melbourne. London (Macmillan). 1864. Pp. xii, 475.

Having specified some of the more indispensable works, the following are added as books which may safely be purchased when they are met with at reasonable prices.

Henry Thornton's *Inquiry into the Nature and Effects of Paper Credit,* 1802.

Thoughts and Details of the High and Low Prices. By THOMAS TOOKE, and the other minor writings of the same author. Tooke and Newmarch's *History of Prices,* in 6 vols. is sold at absurdly high prices.

Torrens' *On the Production of Wealth.*

Whately's *Introductory Lectures on Political Economy.*

Nicholls' *History of the Poor Law.*

Eden's *State of the Poor.* 3 vols. 4to. 1797.

The last is an invaluable work, and contains a bibliography of books on the subject. Unfortunately it is scarce and expensive.

XIV THE SOLAR-COMMERCIAL CYCLE

Nature, vol. xxvi, pp. 226–8, 6 July 1882.

This article, typical of Jevons's work on his 'sun-spot' theory of the trade cycle, is in fact an addendum to two articles on 'Commercial Crises and Sun-Spots' which had appeared in *Nature* in November 1878 and April 1879, and were reprinted as item VIII in *Investigations in Currency and Finance*. The reasons for excluding the present paper from the set in *Investigations* are not clear: it is possible that Jevons, who selected the papers for that volume himself, had completed the collection before this paper was published. It was in fact his last completed publication on an economic subject.

In an article printed in NATURE (vol. xix., pp. 588–90) I gave a table of the prices of wheat at Delhi, from 1763 to 1835, quoted, or rather calculated from data given in a brief paper of the Rev. Robert Everest, contained in the *Journal* of the (London) Statistical Society for 1843, vol. vi. pp. 246–8. Between the years 1763 and 1803 there was evidence of wonderful periodicity in the recurrent famine and abundance at that part of India. When recently engaged in examining more minutely the relation between these prices and the variations of solar activity, as indicated by Prof. Wolf's numbers, it has occurred to me that an inference may be drawn which I overlooked on the previous occasion.

In the accompanying diagram[1] I have exhibited the prices in question together with Wolf's numbers as stated in the *Monthly Notices* of the Royal Ast. Soc. vol. xxi. pp. 77, 78. I have also indicated the dates of the Commercial Crises of the time according to the article on the subject in Mr. H. D. Macleod's "Dictionary of Political Economy," vol. i. pp. 627–8. It need hardly be said that the coincidence between the three classes of recurrent phenomena is of a very remarkable character, and goes far in supporting the relation of cause and effect which I had inferred to exist, both on empirical grounds and from the well-known fact that it is the cheapness of food in India, which to a great extent governs the export trade from England to India. But although the coincidence of commercial Crises in Western Europe with high corn prices at Delhi is almost perfect, it will be noticed that after 1790, the correspondence of the solar curve with that of prices is broken. Wolf does not recognise the existence of any sun-spot maximum between 1788 and 1804, and he believes that

[1] See below, p. 112.

there was a minimum at 1798. According to Wolf's later researches (*Memoirs* Roy. Ast. Soc., vol. xliii. p. 302), these dates are respectively, maximum 1788·1, minimum 1798·3, and maximum, 1804·2.

But now arises the question to which I wish to draw attention. If the eleven-year solar periodicity was really interrupted in this long interval of 16·1 years, how comes it that the meteorological periodicity, as manifested in the corn prices at Delhi, was not interrupted. It is true that the price maximum of 1803 was a comparatively small one; but this was quite to be expected, considering that if there were an intervening solar maximum, it must have been a small one. May we not reverse the argument and infer that the evident relation between the previous sun-spot maxima and the succeeding scarcities at Delhi, would lead us to expect a minor solar maximum about the year 1797?

Standing alone, the presumption thus created would, doubtless, be of a somewhat slight character. But it is in the first place well known, that the data upon which Wolf based his numbers about this time, are less conclusive than in other parts of his series. His results, too, from 1801 to 1807 are expressly marked as doubtful, so that extrinsic information which might have little weight where there was abundance of reliable solar or magnetic observations may come in very usefully where doubts already exist. Now it happens that the late Mr. J. A. Broun inquired very carefully into the facts known about the solar variation at this time, his results being given in the *Transactions* of the Royal Society of Edinburgh, vol. xxvii. pp. 563 - 594, and in his article printed in NATURE (vol. xvi. pp. 62--64). Broun inferred from the observations of Gilpin, and from other data, that there was a small maximum about 1797, and that there were grounds for believing that the subsequent maximum "may really have occurred after 1806, when Gilpin's series terminated." Now, what Broun deduced from totally different data, is exactly what we should infer from the Delhi prices. If we are to believe that Indian meteorology depends upon solar variations, then it almost follows that there was a solar maximum about 1797. The consequence of this inference, however, is very important, because it goes to support the views of Lamont, Broun and others, that the solar period is about $10\frac{1}{2}$ (10·45) years and not 11·1 as calculated by Wolf. It should also be pointed out that the temperature observations of Prof. Piazzi Smyth lead to a like result. The epochs of the heat waves are, according to him (NATURE, vol. xxi., p. 248), 1826·5, 1834·5, 1846·4, 1857·9, and 1868·8, giving an average interval of 10·57 years.

I may take this opportunity of asserting that the progress of events confirms belief in the eastern origin of the great commercial Crises.* In

* As it is impossible to reproduce the explanations and qualifications contained in the article

his important work, the "Précis du Cours d'Economie Politique" (vol. i. pp. 604–5), M. Cauwès while partially accepting the doctrine of periodicity criticises the particular views here advocated. He says:—

"Depuis longtemps les économistes ont signalé la périodicité de ces évolutions: MM. Juglar et Jevons prétendent même pouvoir la calculer d'une manière précise. Selon M. Jevons, l'ensemble des phénomènes serait renfermé dans un cycle de dix années et demie. De fait, les grandes crises économiques du siècle (1806, 1817, 1825–7, 1836–37, 1847, 1857,) s'échelonnent à dix années d'intervalle ou à peu près, mais les dernières, 1866 et 1873, seraient venues un peu avant l'heure, et celle de 1873 s'est prolongée au delà de toute attente." M. Cauwès in short accepts the six earliest crises of this century as sufficiently agreeing with the theory. The crisis of 1866 no doubt came about a year before it would be expected, which is a divergence of reasonable amount. The year 1873, however, is one which it would be impossible to introduce into the series. Now there doubtless were both in America and England in that year, a state of commercial stringency, a relapse of prices and other disturbances which might be mistaken for the signs of a true crisis. But such as it was, this crisis turned out to be just one of those exceptions which prove the rule. The following statistics of bankruptcy in the United Kingdom, as collected by Messrs. Kemp, and published in the *Mercantile Gazette*, show conclusively that the real collapse came in exact accordance with the decennial theory in the autumn of 1878 or early in 1879:—

Year.	Number of bankruptcies.	Year.	Number of bankruptcies.
1870	8,151	1876	10,848
1871	8,164	1877	11,247
1872	8,112	1878	13,630
1873	9,064	1879	15,732
1874	9,250	1880	12,471
1875	9,194	1881	11,632

It will be remembered that the crisis of 1878 was precipitated by the failure of the City of Glasgow Bank owing to great losses of their customers in the Indian trade, the depression of that trade being caused by the recent famine in India.

As a good deal of misapprehension has arisen concerning the American

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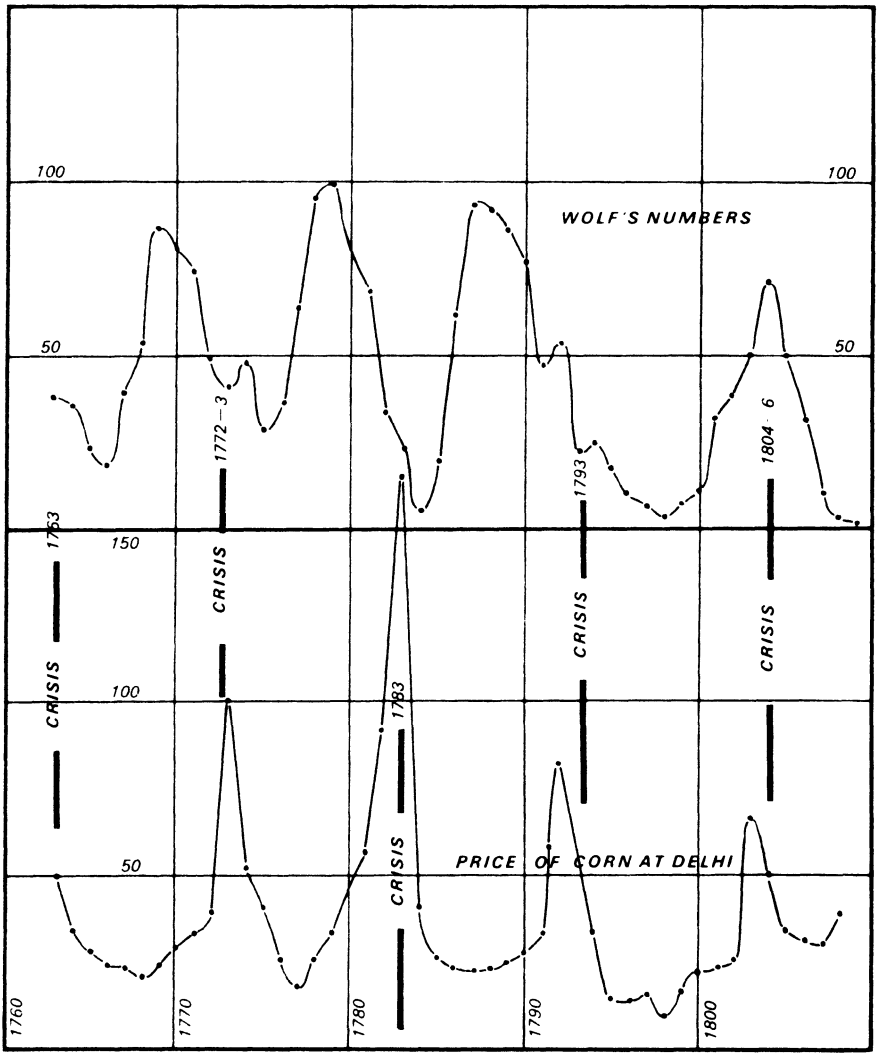
quoted above, or that at pp. 33–37 of the same volume of NATURE (vol. xix.), it is assumed that this article is read subject to those qualifications and explanations. In p. 588 col. *b* of the same volume, a *seer* of wheat was by a typographical oversight stated to be equal to 21 lbs. instead of the true weight 2 lbs.

Crisis of 1873, it is well to quote the following valuable statistics from the Annual Circulars of Messrs. R. G. Dun's mercantile agency:—

Year.	Number of failures	Amount of liabilities in dollars.
1873	5,163	228,589,000
1874	5,830	155,239,000
1875	7,740	201,060,353
1876	9,092	191,117,786
1877	8,872	190,669,936
1878	10,478	234,383,132
1879	6,658	98,149,053
1880	4,735	65,752,000
1881	5,582	81,155,932

Although the amount of liabilities involved in the failures of 1873 was larger than in any subsequent year except 1878, the number of failures was less than in any year named except 1880. The average liability of each failure in 1873 was $44,274 compared with 22,369 in 1878. It is thus apparent that the crises differed entirely in character, and I believe that the collapse of 1873 was mainly due to the breakdown of values of properties necessarily following sooner or later upon the contraction of the paper currency. In any case there was a very distinct maximum of failures in 1878, succeeded by a sudden reduction, and it occurred at a time differing by less than a year from the corresponding collapse in England. In the Dominion of Canada there was a very strongly marked maximum of failures at the same time as in England, namely, in 1879.

The theory of the solar-commercial cycle and of the partially oriental origin of decennial crises has received such confirmation as time yet admits of. I am, however, fully alive to the weight of some of the difficulties and objections which have been brought forward against the theory. These objections are far from being conclusive, and I may hope to give them in due time a satisfactory answer. But such answer must involve more detail than can be put into a brief article.


100
100
WOLF'S NUMBERS
50
50
1763
1772–3
1793
1804·6
150
CRISIS
CRISIS
CRISIS
CRISIS
100
1783
50
PRICE OF CORN AT DELHI
1760
1770
1780
1790
1800

EXTRACTS FROM THE PERSONAL DIARIES
1856–60

EXTRACTS FROM THE PERSONAL DIARIES

1856

6th January

In town during middle of day, where fairly began "Smith's Wealth of Nations".

21 January

Had a day's work at Mint, but read a little of Smith's Wealth of Nations, on "value".

18 February

Sat up till 3 a.m. writing letter to Lucy consisting of two sheets letter paper, which I finished.[1] Recommenced reading Smith's Wealth of Nations at the Mint.

22 February

Reading Wealth of Nations at Mint regularly. In evening did some work at Meteorological Reports.[2]

25 March

Recommenced work at Mint. Read Smith's Wealth of Nations.

25 April

In evening worked at German writing etc. etc. Commenced British Empire by MacCulloch.[3]

27 May

Had a long discussion with F. B. M[iller][4] on Taxes. I am for the total abolition of all indirect taxation by Customs, excise &c &c.

1 June

Did little in morning but commenced letter concerning the Governors lecture on Railways.[5]

18 July

I have lately become much interested in a discussion on the introduction of railways into this colony; this evening it increased to the point of writing a short letter to the Herald on it.

26 July

[Jevons's account of his weekly expenses for this date includes an entry 'Chambers Pol. Econ. 2/6'.[6]]

[1] See Vol. II, Letter 81, pp. 208–11.

[2] See Vol. II, Letter 79, n. 6, p. 198; Letter 92, n. 2, p. 239.

[3] J. R. McCulloch, *A Descriptive and Statistical Account of the British Empire . . .* 2 vols (1837) and other editions to 1854.

[4] Assayer to the Branch Royal Mint, Sydney, 1854–65. See Vol. II, Letter 27, n. 6, p. 49.

[5] See Vol. II, Letter 90, pp. 235–7 and notes thereto; cf. Diary entry below.

[6] William and Robert Chambers, *Chambers's Information for the People*, published in 100 parts, 2 vols (Edinburgh and London, 1848–9).

31 July

Commenced reading Mayhews "Great World of London"[7] in which my idea of a science of Poliography or a *Topographical* Description of the districts of a city seems to have been anticipated.

6 September

Commenced reading Whewells Philosophy of the Inductive Sciences.[8]

11 September 1856

Subscribed for "Empire" £1. Subscribed for Waugh and Coxes New Sydney Directory[9] from which I intend to make up my "social maps of Sydney".[10]

19 November

Occupied during evening with a letter to Herald concerning Debentures & terminable annuities, which however I did not complete or send.

24 November

London Directory 15/- which I bought with the intention of commencing the study of towns and preparing myself for the study of Sydney in particular.

28 November

In evening copied music & commenced catalogue & statistic of trades of London in which I am in hopes of doing something.[11]

[At the end of the diary for 1856 is a page headed 'Work to be done 1856'. Among the entries on this page are the following:

Letter on railways.
Social map of Sydney &c
Social statistics of London.
Write work on "Formal Economics"

Only the first of the entries has been checked off by Jevons as completed, and at the beginning of his diary for 1857 a page headed 'Work to be done during 1857' repeats the last three entries given above; again these have not been checked off as completed.]

1857

4 February

Drew from Library Mill's Political Economy Vol. II.

7 February

Not doing much, except commencing a letter to "Empire" on the

[7] Henry Mayhew, *The Great World of London*, parts 1–9 (1856).

[8] William Whewell, *The Philosophy of the Inductive Sciences founded upon their history*, 2 vols (1840).

[9] *Waugh and Cox's Directory of Sydney and its Suburbs, 1855* (Sydney, 1855), continued as *Cox and Co.'s Sydney Post Office Directory, 1857* (Sydney, 1857).

[10] See Vol. II, Letter 107, n. 10, pp. 297–8.

[11] See Vol. I, p. 17.

"Western Railwayline, & the general policy of government railway extension".[12]

9 February

Engaged at Mint during afternoon in finishing and writing out letter on Railways which I sent to Empire office, finding it published in $2\frac{1}{2}$ columns of large type next day.

13 February

Bought MacCulloch's Account of the British Empire; in getting this as well as other expensive books, I wish to turn my attention to statistics and other similar subjects and the ultimate value to me of every scrap of knowledge of this kind obtained now will amply repay the few pounds I spend somewhat freely. Besides, on returning to England these books will be available there and are therefore a perfectly good investment.

15 February

In the evening music and Political Economy.

3 March

[An account of purchases made on this date includes the entry 'Heeren's Political System 15/-'.[13]]

6 March

Finished reading Mills Economy; many parts but carelessly and rapidly read but not without some advantage I think.

12 March

Returned Mill's Economy to School of Arts.

22 March

In evening continued letter upon Land and Railway Policy, with some success.

27 March

Whewells lec[rs] on Political Economy 10/-.[14]

28 March

Wrote and sent letter to Empire with view of shutting up writers about Protective Humbug.[15]

31 March

In evening wrote an article on the regulation of public houses, inns, etc. & the sale of spirituous liquors with the view to the prevention of habitual drunkenness.

[12] See Vol. II, Letter 98, pp. 262–8.

[13] Arnold Hermann Ludwig Heeren (1760–1842), *A Manual of the history of the political system of Europe and its colonies, from its formation at the close of the fifteenth century to its re-establishment upon the fall of Napoleon*. Translated from the fifth edition by D. A. Talboys (1846).

[14] Jevons definitely wrote '*Whewell's* lec[rs] on Political Economy' but no work with such a title had been published by Whewell at this date. It seems probable that Jevons, who had been reading Whewell's *Philosophy of the Inductive Sciences*, wrote 'Whewell' in mistake for 'Whately' since the diary entry for 5 April and a special entry in his Journal (Vol. I, pp. 157–9) show that he had been reading the latter's *Introductory Lectures*. Cf. below, n. 16.

[15] See Vol. II, Letter 102, p. 281.

5 April

Read a good deal of Shakespeare and Whateley.[16]

Writing etc. Proceeded with letter upon Land & Railway Policies.[17] Much engaged.

22 April

A list of purchases made on this date includes the following entries: "Lardner's Railway Economy 14/-[18]
Census tables of N S W 3/6"

29 April

Commenced reading Malthus essay on population.

Busy considering the subject of Roads & Internal communication in a financial point of view.

1 May

Commenced writing article on resolutions of meeting in favour of protection.

2 May

Finished writing out an Article on the absurd resolutions passed at a Protection Meeting. Delivered at office.

7 May

Read Malthus. Afterwards through town.

18 May

In evening commenced reading Mills Pol. Economy Vol. I. Introductory remarks not very remarkable or useful as far as I see.

21 May

In evening proceeded with the Introduction of my book on Anthropology or the general consideration of Man in the concrete, comprising Political & Social Economy, Moral Philosophy, & parts of ethics & metaphysics.

22 May

In evening reading Mills & writing on Economy.

26 May

Reading Mill, Thackeray. Also account of Dr. Livingstone's Explorations in Central Africa.[19]

6 June

[A list of purchases at this date includes the entry: 'Dr. Chalmers Work 7/6'.[20]]

[16] Richard Whately, *Introductory Lectures on Political Economy* (1831). See Vol. VI, Lecture 1, p. 4.

[17] See Vol. II, Letter 103, pp. 282–7.

[18] Dionysius Lardner, *Railway Economy: A Treatise on the New Art of Transport* (1850).

[19] Possibly *Sketches of Dr. Livingstone's missionary journeys and discoveries in Central South Africa* 1857.

[20] Thomas Chalmers, *Political Economy in connexion with the Moral State and Prospects of Society*, 2 vols (Glasgow, 1832). Presumably this is the 'Work' referred to, although it could also have been Chalmers's *Bridgewater Treatises* of 1833.

9 June

Finished 1 Vol of Malthus which is certainly a great & useful work if it was really the first exposition of so important a principle of human nature as that of over population.

In evening alone & much reading of Thackeray's Newcomes[21] etc.

Wrote part of a letter on Land regulations.[22]

14 June

Chiefly during morning. "Newcomes" Mill etc.

Evening. Well on with my most comprehensive work on Man in Society which on the most moderate estimate would take two lifetimes to finish.

20 June

Finished Mill Political Economy Vol. I.

21 June

Reading Mill's Logic.

23 June

[A list of purchases made on this date includes the entry: 'Census of Great Britain 10/6']

6 July

Commenced working again at Industrial Statistics.

14 July

Very busy every evening with classification of occupations as returned in Census of 1851 in Great Britain.

2 August

[A list of purchases made on this date includes the following: 'Quetelet's Treatise on Man[23] Philosophy of the working classes.']

16 August

Worked at *Division of Labour.*

30 August

Wrote a good deal of article on Division of labour in morning.

13 October

Working hard at the "Division of labour" and engaged adding up totals of returns of employment from the British Census. These total results when finished will be quite complete giving the number of persons of, male and female separate, for every order of every section and class. The trouble however is very great.

[21] William Makepeace Thackeray, *The Newcomes. Memoirs of a most respectable family* . . . 2 vols (1854–5).

[22] See 'Contributions to the Sydney *Empire*' above, p. 3.

[23] Lambert Adolphe Jacques Quetelet, *A Treatise on Man and the Development of his faculties* . . ., first English translation (Edinburgh, 1842).

1858

Jevons's diary from 1 January to 4 February 1858 contains no entries relating specifically to political economy. At this point there is an entry reading 'after this diary discontinued but again used in London for the year 1860'.

1860

February 3rd – 5th including Sat. & Sun. – was almost entirely engaged in commencing a work on Pol. Econ to be established on a demonstrative basis, in the form of connected & distinct propositions. Value to be established on the basis of labour and the problems of rent wages interest etc. to be solved as mathematical functions. Am very sanguine of its success.

11 February

A short walk in Kensington Gardens. Some work at Latin, Greek and Pol Econ.

16 February

Math. & Pol. Econ.

18 February

Geometry, Econ. etc

19 February

At home all day & working chiefly at Economy, arriving as I suppose at a true comprehension of *Value* regarding which I have lately very much blundered.

25 February

Drill in the morning for 13th time.
Platoon exercise as in square.
De Morgan.
Latin, & Pol. Econ. rest of day.

LIST OF WRITINGS ADDITIONAL TO THOSE INCLUDED IN APPENDIX B TO THE *LETTERS AND JOURNAL*

ADDITIONAL WRITINGS

Appendix B to *Letters and Journal* is entitled 'Mr. Jevons' Writings', but in fact the list given there is not complete; neither is that given in Appendix IV to the *Theory of Political Economy* (fourth edition), which extends only to 'Works and Papers upon Economical Subjects'.

Jevons did, however, keep a notebook in which he entered details of all his publications. In his early years he appears to have been scrupulous in making all the entries fully, but in later life he does not seem to have kept the notebook regularly. However since the bibliographies mentioned above are mainly deficient with respect to Jevons's earlier writings, the notebook provides a valuable supplement to previously published lists. All the entries in it which are not to be found in those lists are therefore reproduced here, in the order in which Jevons made them.

1856

July 19 'The Railway Discussion', letter in *Sydney M. Herald.*

Oct. 2 'Lead poison in the Sydney Water, vindicating Dr. Smith' *Empire*

Nov. 20 'Red tapeism & the Newcastle Lifeboat.' *Empire*

1857

March 28 'Observations on the Total Eclipse' *Empire*

May 1 On the 'Resolutions passed at the Protection Meeting', Sydney *Empire*

Aug. 1 'Remarks on the Barometer & on Meteorology generally' *Empire*

,, 8 'On a Sungauge' *Empire*
Reprinted in the Summary for England.

1857

September	Meteorology of Australia	*Empire*
,,	Letter on a local subject	,,
,,	'Gunpowder and lightning'	,,
,,	'Railway Economy'	,,
,,	'Cure for the Revenue'	,,
,,	'The Royal Prerogative of Mercy'	,,
	'New Facts concerning the interior of Australia, viz Copper coloured Races and Gregory's Expedition.	
	'On the Philosophical Society of N.S.W.'	,,

1858

June 23 Letter concerning Mr. Scott's criticisms *Sydney Magazine*

October Review of the *Sydney Magazine of Science and Art* – In the *Sydney Morning Herald.*

'The Social Cesspools of Sydney' *S. M. Herald*

Oct. 'Canoona Diggings in a Scientific Aspect' *S. M. Herald*

1859

February 'Meteorological Observations in Australia' supplementary to those in Waugh's Almanack

March do. continued *Sydney Magazine*

1861 Notice of a work on Indian Whirlwinds – *Economist*

[Note to December entry for 'On the Deficiency of Rain in an elevated Rain-gauge' – 'See *Athenaeum* No 1770 Sept. p. 412']

December 9 Note on Sunspots 'Standard'.

[Note to entry on Watt's Dictionary articles – 'Arts. in Watts Chemical Dictionary noticed in the Philosophical Mag. vol. xxvi p. 309 Oct. 1863']

1862

May 3 *Chemical News* Letter pointing out Thomas Melvill as first discoverer in the subject of spectrum analysis.

1862

September. The following papers were forwarded to the meeting of the British Association at Cambridge. I was informed by the Secretary that they were read before the F Section, and that the second was approved of.

" 1. Notice of a *General Mathematical Theory of Political Economy* (p. 158.

" 2. On the study of Periodic Commercial Fluctuations with five diagrams (p. 157

" Brief abstracts are contained in the Report of the Proceedings, 1862, pp. 157–8.

" A fuller explanation and publication of the above-mentioned theory is deferred until a more suitable period for establishing a matter of such difficulty.

1862

Sept. 13. 'Clerk of the Weather Office' in *Spectator*

Statistical diagrams are noticed in Spectator of August 1862.

1863 Review of Dove's Law of Storms
Economist
[Note to April 16 entry "A Serious Fall . . . . ."
Edw. Stanford, 6, Charing Cross S. W. London.
Noticed in *National Review* October 1863
Noticed in *Westminster Review* Jan 1864.
"Serious Fall" noticed by Dr. Farr in Reports of the English Delegates to the International Statistical Congress, Berlin.
Journal Stat. Soc., Dec. 1863 p. 415
"Prices have been investigated by Mr. Jevons . ."
quote continues down to "from the best authorities".
Discussed by Dr. E. Laspeyres, Prof. in Basel in Essay – "Hamburger Waarenpreise 1851–63".]

1863 Dec. 18 – [following entry on *Pure Logic*:]
Noticed by Prof. de Morgan – *Athenaeum*.
Spectator – March 12, 1864
Reader?

1864

March 5 Notice of Hearn's Plutology
Spectator – March 5

March Statistics of Shakespearean Literature
No 1898 *Athenaeum* 12 March 1864 p 373–374.

March 11th *Spectator*
Notice of Robertson's 'Laws of Thought' 1864.

1865 The Coal Question
First attention given to subject in 1861 or 1862. Inquiry commenced in January 1864. Chiefly carried out at Museum Library June and July 1864. Writing completed before Christmas. Transmitted to Mr. Macmillan about Dec. 28. Accepted Jan. 6th 1865. Printing commenced Jan. First proof Jan. 27.
Announced in *Macmillan's Mag.* Febr. 1.
Athenaeum Febr. 4th.
copied into *Examiner* (Manchester)
Inquirer
April Coal Question published during the week April 24th – 30th
May 1 Publisher's Circular } Cuttings pasted
Cty News (London) June 3rd 1865 } in.
Quarterly Review April 1866 p. 435
Art "Coal and Smoke"
(quote from p. 464).

Review *London Quarterly Review* April 1874
No. LXXXIII, p. 121
News cutting dated "Liverpool, 19 March 1866" and headed "Literary and Philosophical Society" recording that "Professor Jevons then gave a "Preliminary Account of certain Logical Inventions", the *Logical Abacus* and *Logical Machine*"

1867

December 11th 1867. Diagrams in paper of Mr. John Mills on Credit Cycles
Manchester Statistical Society

1868

November 3rd 1868 Remarks on Mr. Baxendell's Laws of atmospheric ozone
Manchester Lit & Phil Society
Proceedings, p. 33.

1867 27 April. Article in *Spectator* newspaper on "Early Presentiments of the Electric Telegraph"
pp. 475–6 as Review of George Dodds Railways, Steamers & Telegraphs.

1869 Nov 18th *Nature* – Letter on the Personal Error in astronomical observations Vol. I. p. 85 See answer 27 Jan 1870 p. 337.

1869 Dec 30th Nature – Article – p. 231
A Deduction from Darwin's Theory

1870 [After entry on Mechanical Perf. of Logical Inference] see Proceedings Nature 27 January 1870 p. 343
Printed in the Philosophical Transactions for 1870 pp. 497–518 Plates 32–34.

1870 Feb 10th 'Oversight by Faraday' Nature vol. I p. 384.

1870 Glasgow Herald – Notice of Mrs. Fawcett's "Political economy for beginners"

1870 Nature – Notice of Whitworth's Choice & Chance.

1870 [After note of Pres. Address to Section F.] –
Statistical Journal Vol. XXXIII p. 309
Nature Vol. II p. 428 Sept 22, 1870.
see Pall Mall Gazette 16 Sept 70 p. 10
27 Sept 70.

1871 14 October 1871 – The Theory of Political Economy
New Editions
Review in Westr Rev[iew] Jan 1880
New series Vol. VII pp 226–7.

1875

[After cutting from Publisher's Circular announcing *Money and the Mechanism of Exchange:*]
"Geld und Geldverkehr" von W. Stanley Jevons Leipzig – F. A. Brockhaus 1876 (May.).

1874

[Above cutting from Publisher's Circular of 2 February announcing the *Principles of Science*] "Title chosen in April 1868"
British Quarterly Review April 1874 No. CXVIII p. 546.
The above by James Collier.
Hull Criterion 4th July 1874, No. 27 p. 3.
Letter concerning Mill's Logic and the Principles of Science.

1876

Bonamy Price on Currency and Banking
Notice in Manchester Guardian 24 March 1876.
Letter in Spectator June 1876 on the alleged Poisoning of the Natives of Queensland.
"The Prospects of the Telegraph Department"
Letter dated March 20, 1876, published in Manchester Guardian.
After the entry for the *Primer of Logic* (1876) the entries are few and scattered. The next entry relates to *Studies in Deductive Logic* under date 26 October 1880 and the next again to Cossa's *Guide* (both publisher's announcements).
The final entry (in W. S. J.'s handwriting) is –
The Silver Question
Banker's Magazine Dec 1877
vol XXXVII pp 989–996.

JEVONS AS EXAMINEE AND EXAMINER

I PAPER SAT BY JEVONS AT UNIVERSITY COLLEGE LONDON, 1860[1]

POLITICAL ECONOMY.

1. How is wealth defined by political economists?

2. Discuss the proposition that "all men desire wealth", and the mode in which, and extent to which, its habitual assumption by political economists affects the soundness and generality of their conclusions.

3. Mention the general causes in operation which tend to elevate wages, and those which tend to depress wages.

4. Mention some of the circumstances which give rise to difference of wages in different occupations.

5. Show that profits have a minimum limit; and discuss the circumstances which, in wealthy and industrious communities, influence their approximation to and recession from that limit.

6. State and reply to the arguments for the proposition, that improvements in machinery are often injurious to the interests of the working classes.

7. Show that the natural tendency of manufacturing industry is to concentration at a few points, and of agricultural industry to diffusion.

8. Describe the system of gold, silver, and copper coinage in this country, with particular reference to the mode in which it ensures the joint circulation of gold and silver coin.

9. Mention some of the leading forms of credit in use in commercial countries.

10. Show that in general the exchanges must be unfavourable to the mining countries and those carrying on a transit trade in the precious metals.

11. What were the objects aimed at in the Bank Charter Act of 1844?

12. State your views as to the working of that Act.

13. "These different movements in the distribution of the precious metals to the points to which the exchanges of the world direct them, are all determined by broad general principles, which are self-acting, and which any artificial attempt to disturb or control can only tend to derange."

Give a sketch of the principles referred to as determining the distribution of the precious metals, and indicate the circumstances which regulate local prices.

14. State Adam Smith's four maxims of taxation.

15. Sketch the arguments for and against levying an income tax by an

[1] *Calendar of University College, London, 1860–61*, p. 167.

equal per-centage on permanent and temporary incomes; and on incomes earned in a business or profession, and those derived from realized property.

16. Describe the warehousing system, and point out its advantages.

N.B. *Where the answer is matter of opinion, it should be accompanied by a statement of reasons.*

JACOB WALEY, *Professor.*

II PAPERS SET BY JEVONS AS EXTERNAL EXAMINER AT CAMBRIDGE UNIVERSITY[2]

MORAL SCIENCES TRIPOS.

TUESDAY, *Dec.* 1, 1874. 1 to 4.

POLITICAL ECONOMY.

1. EXPLAIN briefly but precisely the relations between the sciences of Ethics, Economics and Politics. Illustrate your answer by discussing the action of the Government of India in saving a part of the population from famine, which has been described as "a setting aside of the laws of political economy." In giving your opinion upon this subject, take into account the assertion of some eminent authorities that the population of the famine districts is becoming excessive, and that a recurrence of such famines appears to be inevitable.

2. Give a very brief account of the origin of Trades-Unions. Point out the conditions of their successful action on the rate of wages: and examine how far this action can be legitimate and permanent.

3. It has been said that the difficulty of preventing a commercial crisis lies more in moral than in physical or commercial forces.

Describe the different stages of a commercial crisis, and the effects produced by the 1844 Bank Act, so as to illustrate this remark.

4. What are the chief circumstances affecting the value in England of a bill of exchange on France?

5. "As a physical fact, capital will consist chiefly of gold." A. Musgrave. Examine this statement.

6. What are the conditions of an effective monopoly? The character of the demand being given, show upon what principles the price should be fixed, in order that the greatest gross profit may be made by the sale of the commodity.

[2] *Cambridge University Calendar for the year 1875*, pp. 156–62, and *for the year 1876*, pp. 154–60.

What modifications are required in the cases (*a*) of a limitation in the monopoly - e.g. railways. (*b*) Of a limitation in the commodity - e.g. coal?

7. Investigate the principles which should govern a banker in the investment of his funds. In what respects, and why, is the case of the Bank of England a peculiar one?

8. It is stated that the clauses of the Irish Land Act facilitating the purchase by tenants of the freehold of their farms have proved nearly inoperative. Analyse the probable causes of this failure and the difficulties which stand in the way of the spread of peasant proprietorship.

9. Because wages are lower and the hours of labour longer in Mulhouse or other continental towns, it is asserted that continental manufacturers can undersell English manufacturers. Examine the truth of this inference.

10. It has been adopted almost as an axiom by many recent writers on political economy that no taxes should be laid upon the necessaries of life. Examine this question; and give all the reasons which occur to you for or against such a fiscal rule; taking as instances of necessaries of life, corn, salt, and coal.

MORAL SCIENCES TRIPOS.

THURSDAY, *Dec.* 3, 1874. 9 to 12.

POLITICAL ECONOMY.

1. WHAT are the chief practical axioms or principles of action upon which our present economical intercourse is based? Show how far these differ from the principles hypothetically assumed by the scientific economist: and contrast them, on the one hand, with those of any previous historical state with which you may be acquainted, and, on the other, with those of any ideal economic state.

2. "Capitalists can never exact from labourers the whole advantage which their capital confers."

Explain this position; and show the form in which it is proved by Adam Smith and Bastiat.

3. "The quantity of money must in every country naturally increase as the value of the annual produce increases. The value of the consumable goods annually circulated within the society being greater, will require a greater quantity of money to circulate them."

Comment upon this passage from the Wealth of Nations.

4. Give a concise statement of the wage-fund theory; and examine

any objections to the theory which have been brought against it in recent years.

5. How far, and why, are the principles which apply to international trade different from those which hold true of the internal trade of a country?

Is the trade between London and Melbourne, or between London and Dublin international?

6. What are the principal new theories or additions to economical doctrine due to Ricardo? How far have such novel doctrines been countenanced by subsequent leading writers?

7. Give your opinion in detail as to how far the present revenue of the United Kingdom is raised in conformity with the views enunciated by Adam Smith one century ago.

8. Investigate minutely the action of the system of metallic currency known as *the double standard system,* and give your opinion as to its effects upon the values of gold and silver relatively to each other and also relatively to commodities in general. State the time at which such a system was in operation in England; and describe how it came to exist and to terminate, and what effects followed from it.

9. Give Adam Smith's account of the manner in which the public debt of Great Britain was contracted. What are the economical reasons for and against a rapid reduction of the debt by increased taxation? and how is the reduction effected at present?

10. It has been said that the *vocabulary* of commerce is framed almost wholly from the capitalists' stand point. Show, by illustrations, how far this is true of economic science as usually expounded: and how far this was the *real point of view* of the following economic writers:— Adam Smith, Ricardo, Bastiat.

MORAL SCIENCES TRIPOS.

FRIDAY, *Dec.* 4, 1874. 1 to 4.

POLITICAL ECONOMY.

1. DESCRIBE and contrast the methods of Adam Smith, Ricardo and Bastiat. What are the chief advantages to be derived by the use of the Historical and Comparative methods in Political Economy?

Give examples showing what parts of the science admit of treatment by Mathematical methods; and point out the nature and limits of the advantage gained by this treatment.

2. MacCulloch and some other English writers have asserted or

implied that Political Economy is entirely a modern science, and was quite unknown to the Greeks and Romans. Give your opinion upon this point, supporting it by adequate statements of the doctrines of classical authors.

3. Form a classification of the principal theories which have been held concerning the mutual relations of *utility, labour* and *value*. Give the names of some of the principal writers who have upheld each distinct theory: and criticise them from your own point of view.

4. What are the chief economical and social consequences which might be expected to result from the considerable increase of industrial partnerships, or co-operative *producing* societies?

5. Wages and profits in different employments and neighbourhoods are not uniformly proportional to the efforts of labour and abstinence of which they are the respective rewards.

Classify the circumstances which prevent this uniform proportionality; and show (a) how far their effect is likely to be reduced by economical progress, (b) how far they occasion the differences of value of the same commodity in different markets.

6. If it were required to suddenly double the revenue of this country, upon what principles should the new Budget be framed, and from what sources chiefly would it be best to derive the additional revenue?

7. State as precisely as possible the general principles upon which poor-law relief is at present administered in England: describe as far as may happen to be known to you the difference between the classes of paupers who are allowed to have indoor and outdoor relief, and discuss the expediency and probable effect of altogether prohibiting outdoor relief.

8. Adam Smith generally maintains that it is best to leave individuals perfectly free in their economical relations. What are the precise assumptions on which this conclusion depends? how far do they require qualification? and how far is their truth affected by the increasing solidarity of society?

What exceptions to his general principle are recommended by Adam Smith? Would you extend the list?

MORAL SCIENCES TRIPOS.

TUESDAY, *Nov.* 30, 1875. 1 to 4.

POLITICAL ECONOMY.

1. ADAM SMITH enumerates among the kinds of fixed capital, "the

acquired and useful abilities of all the inhabitants or members of the society." Discuss this statement in connection with the common saying that "Labour is capital".

2. "In proportion to the increase of capital, the absolute share of the total product falling to the capitalist is augmented, and his relative share is diminished; while, on the contrary, the labourer's share is increased both absolutely and relatively".

Give Bastiat's "demonstration" of both parts of this theorem, and examine its validity.

3. It has been held that the demand for labour can be increased and the rate of wages consequently raised by the trades-union expedient called "making work". Examine the soundness of this doctrine, and indicate some of the consequences to which its adoption would logically lead. Point out some of the various forms which the process of "making work" may assume.

4. What is the doctrine summed up in the expression *laissez-faire?* State your opinion as to the limits, if any, within which its application should be restricted.

5. Examine the grounds upon which the government or the municipal authorities in many places regulate the charges of cabmen, boatmen, porters, guides, &c., instead of leaving them to the action of free competition.

6. Give an abstract of Smith's account of the Bank of Amsterdam, and explain how far, or in what way, similar functions are performed by the English banking system at the present day.

7. What are the four principles of taxation laid down by Adam Smith? How far do they lead us to a preference of direct for indirect taxation?

8. Explain the assertion that "an *ad valorem* tax on commodities generally would be amongst the most unequal and mischievous duties that could be imposed," causing "a change in the values of most descriptions of commodities".

MORAL SCIENCES TRIPOS.

THURSDAY, *Dec.* 2, 1875. 9 to 12.

POLITICAL ECONOMY.

1. ADAM SMITH commonly describes wealth as "the annual produce of land and labour". In what respects must this definition be regarded as faulty?

2. Give Mill's analysis of Cost of Production and the purport of Cairnes' criticism upon it. Explain how the transfer of labour and capital from one trade to another, so frequently assumed by economists, is affected by actual experience.

3. Analyse the circumstances upon which depends the amount of difference between the wholesale and retail prices of a commodity.

4. It has been held by some that exchange can produce no benefit, because the values of the goods exchanged are equal. Others have argued that what one gains the other must necessarily lose. What is really the nature of the gain which a country derives from its foreign trade? Is it possible to determine the amount of such gain?

5. Point out the connection which exists between the business of banking and the doctrine of probability, and investigate precisely the nature of the principal risks and difficulties to which bankers are subject.

6. What are the chief provisions of the Bank Act of 1844? Discuss the dictum that "the business of the banking department of the Bank of England should be conducted on precisely the same principles as that of any other bank".

7. Examine the advantages and drawbacks of the Funding System as compared with the plan of raising the supplies within the year. On what grounds has the National Debt been sometimes represented as a source of benefit to the community?

8. What was the Sinking Fund of Price and Pitt? Describe some of the other principal schemes by which it has been proposed or is actually attempted to reduce or eventually complete the payment of the National Debt.

9. Give an outline of Professor Cairnes' views as to the logical method of political economy.

MORAL SCIENCES TRIPOS

Friday, *Dec.* 3, 1875. 1 to 4.

POLITICAL ECONOMY.

1. WRITE a brief article in which the editor of an American newspaper is supposed to advocate the policy of protection to native industry.

2. Supposing the price of a commodity within a country be high, inquire under what circumstances, if any, the prohibition of its exportation would tend to lower the price. Among other instances of commodities consider corn and horses.

3. In what manner can you explain the high level of wages and prices in the United States or England as compared with that in Switzerland, Norway, Russia or Bengal?

4. Specify the objections which have been urged against the so-called Ricardian theory of rent by Dr. Whewell and Professor Rogers. "Shew me in any part of the world land which has not been subjected directly or indirectly to human action, and I will shew you land destitute of value." How does Bastiat endeavour to reconcile the existence of different degrees of fertility of land, and of a consequent residual value of the superior qualities not resolvable into remuneration of anterior labour, with the doctrine implied in the above quotation?

5. What is a coin? It has been urged that the supply of coinage, like that of other commodities, should be left to the free action of competition, instead of being a government monopoly. Point out any grave objections which in your opinion attach to such a proposal.

6. Mention some of the popular explanations of the rise in general prices which has occurred during the last twenty-five years, and discuss their force.

7. The fact that the silver price of gold has remained comparatively unaltered has been regarded by some writers as a proof that no fall in the value of the metal has taken place. Consider the validity of this reasoning, and state what are, in your opinion, the means by which the question, whether depreciation has or has not occurred, may be decided.

8. Is a government justified under any circumstances in maintaining roads, telegraphs, railways, or other means of communication, which cannot be made to pay the ordinary return to labour and capital? If so, under what circumstances?

I MR JEVONS' THEORY OF POLITICAL ECONOMY

by Alfred Marshall, *The Academy*, 1 April 1872

THIS book claims to "call in question not a few of the favourite doctrines of economists." Its main purpose is to substitute for Mill's Theory of Value the doctrine that "value depends entirely upon utility." The rate of exchange of two commodities will, when the equilibrium has been attained, be such that the utility to each individual of the last portion of the commodity which he obtains is only just equal to that of the last portion of the other commodity which at this rate he gives in exchange for it. The utility of a commodity is in part "prospective," that is, dependent on the benefit which will at a future time accrue from its possession: and this depends partly upon the difficulty that there might be in obtaining something before that time to supply its place. Though "labour is often found to determine value," it yet does so "only in an indirect manner by varying the degree of the utility of the commodity through an increase in the supply." Bearing in mind what has been said about prospective utility, it is almost startling to find that the author regards the Ricardian theory as maintaining labour to be the origin of value in a sense inconsistent with this last position. But the language of Ricardo on this point was loose with system: and that of many of his more prominent followers differs from his only in that its looseness is not systematic. By a natural reaction, attempts have been made by a series of able men to found the theory of value exclusively upon the neglected truth.

Although the difference between the two sets of theories is of great importance, it is mainly a difference in form. We may, for instance, read far into the present book without finding any important proposition which is new in substance. But at length he definitely commits himself: at the end of his Theory of Exchange we read—

> Labour affects supply, and supply affects the degree of utility which governs value, or the ratio of exchange. But it is easy to go too far in considering labour as the regulator of value; it is equally to be remembered that labour is itself of unequal value . . . I hold labour to be essentially variable, so that its value must be determined by the value of the produce, not the value of the produce by that of the labour.

The confusion here implied is not merely one of words. He returns again in his concluding remarks to his attack upon the ordinary theory of the variation of wages in different employments, and says "the wages of a working man are ultimately coincident with what he produces after the deduction of rent, taxes, and the interest on capital." He does not see that, since rent, taxes, etc. are not paid in kind, we must have before us a

complete theory of value in order that we may perform this subtraction. He does not speak of the amount of the wages, and the exchange value of the products as varying elements, the variations of each of which affect those of the other. He considers that value is determined absolutely and independently, and that wages are determined afterwards. He goes on:

> I think that in the equation,
>
> Produce = profit + wages,
>
> the quantity of produce is essentially variable, and that profit is the part to be first determined. If we resolve profit into wages of superintendence, insurance against risk, and interest, the first part is really wages itself; the second equalises the result in different employments; and the interest is, I believe, determined as stated in the last chapter.

The attempt, here referred to, to give an account of interest independent of any theory of wages or value, is bold and subtle. The reasoning is mathematical; but the argument may be expressed by the following example. Suppose that A and B employ the same capital in producing hats by different processes. If A's process occupies a week longer than B's, the number of hats he obtains in excess of the number obtained by B must be the interest for a week on the latter number. Thus the rate of interest is expressed as the ratio of two numbers without the aid of any theory of value – expressed, but not determined – yet in the passage quoted it is spoken of as determined. The relative productiveness of slow and rapid processes of manufacture is but one of the determining causes of the rate of interest: if any other cause made this fall, B's process would be abandoned. The rate of interest affects the duration of the remunerative processes of manufacture no less than it is affected by it. Just as the motion of every body in the solar system affects and is affected by the motion of every other, so it is with the elements of the problem of political economy. It is right and necessary to break up the problem; to neglect for the time the influence of some elements; to investigate the variations of any one element which must, *caeteris paribus*, accompany certain assumed variations in one or more others. Such investigations give results which, even as they stand, are roughly applicable to certain special cases. But this does not justify us in speaking, in general, of one element as determined by another; as, for instance, of value as determined by cost of production, or of wages as determined by value. It is difficult to remember a prominent Ricardian writer who has not attained brevity at the expense of accuracy by employing the former of these expressions. Professor Jevons' use of the latter of them will have done good service if it calls attention to the danger of such parsimony.

The main value of the book, however, does not lie in its more

prominent theories, but in its original treatment of a number of minor points, its suggestive remarks and careful analyses. We continually meet with old friends in new dresses; the treatment is occasionally cumbrous, but the style is always vigorous, and there are few books on the subject which are less open to the charge of being tedious. Thus it is a familiar truth that the total utility of any commodity is not proportional to "its final degree of utility," *i.e.* the utility of that portion of it which we are only just induced to part with, or to put ourselves to the trouble of procuring, as the case may be. But Professor Jevons has made this the leading idea of the costume in which he has displayed a large number of economic facts. In estimating, for instance, the benefit of foreign trade, we must pay attention to the total utility of what we obtain by it, as much as to its final utility, which alone is indicated by the rate of exchange. His attack on Mill on this point is worth reading, though it is in parts open to criticism; and though, while Mill pleads the difficulty of the subject in excuse of his neglect of the total utility of international trade, Jevons does not overcome the difficulty. Again, the whole advantage of capital to industry – its total utility – cannot be measured by the rate of interest, which corresponds only to its final degree of utility. Again, the final degree of utility to a labourer of his wages diminishes as their amount increases, while the final degree of pain resulting from the labour, at all events after a certain time, increases as the amount becomes greater: consequently, the artisan as soon as his real wages have ceased to be barely sufficient for his support, strikes for shorter times, rather than for the further increase in wages.

Among his more interesting incidental discussions are those on the difficulties Thornton has found in the theory of value, and on the economy of muscular effort. He contributes to the definition of the terms "market," "labour," "capital," "circulating capital," but he does not keep sufficiently distinct the various connections in which each of them is employed. His lucidity serves to render darkness visible; to make us conscious of the absence of a specialised economic vocabulary, perhaps, on the whole, the severest penalty that the science has paid for its popularity. He supplies, indeed, one expression which, with a little more care, might be rendered a useful one. Capital which "consists of a suitable assortment of all kinds of food, clothing, utensils, furniture, and other articles which a community requires for its ordinary sustenance," he calls "free capital," because it "can be indifferently employed in any branch or kind of industry." The term "value," indeed, he considers as hopeless, and he expresses an intention, to which he does not adhere, of avoiding its use.

Value in exchange expresses nothing but a ratio, and the term

should not be used in any other sense. To speak simply of the value of an ounce of gold is as absurd as to speak of the ratio of the number seventeen.

There does not seem to be any greater absurdity in speaking of the value of an ounce of gold, or of a cubic inch of gold, than there is in speaking of the weight of a cubic inch of gold. In each case reference is made to some unit conventionally adopted at some particular place and time. He complains that "persons are led to speak of such a nonentity as intrinsic value": but the examiner, who has asked for a definition of specific gravity, is fortunate if he has not heard of "intrinsic weight." The abuse of a term is not a sufficient cause for its rejection. We cannot afford to dispense with the phrase "the rate of wages," though Ricardo has employed it in a forced sense, which Professor Jevons himself has failed to catch.

He has done good service, moreover, in protesting against Mill's saying:—"Happily there is nothing in the laws of value which remains for the present or any future writer to clear up; the theory of the subject is complete." It is probable that Mill intended this to be interpreted in a very narrow sense; but anyhow, it is unfortunate. As Jevons says, it would be rash to make such a statement about any science. It would be very rash to make it about the law of gravitation. Mill would probably have been more correct if he had stated that, taking into account only questions which have already occurred, there is no one side of the theory of value which does not require for its completion a greater amount of scientific investigation than has, up to the present time, been applied to the whole of political economy - that there is scarcely any question which can be asked with regard to value to which a complete answer is forthcoming. Take, for instance, a question which Professor Jevons has made prominent - What is the influence which a rise in price of hats, owing to an increased demand, has on the wages of hat-makers? Of course one element to be considered is the facilities which exist for introducing new workmen into the trade. How far, then, is this dependent on the number of parents occupied in this and other employments who have been able to give their sons an education sufficiently good to fit them to become hat-makers, but not a much better one. What is the relation between the cost of production of an average skilled labourer and his remuneration? This is but one question out of many. We know, perhaps, in what direction to look for the answers: but the point is that they are not yet formulated. And who can tell what difficulties will have to be overcome before they are formulated?

Professor Jevons has expressed almost all of his reasonings in the English language, but he has also expressed almost all of them in the

mathematical. He argues at great length and with much force the applicability of mathematical method to political economy:

> If there be any science which determines merely whether a thing be, or be not — whether an event will happen, or will not happen — it must be a purely logical science; but if the thing may be greater or less, or the event may happen sooner or later, nearer or farther, then quantitative notions enter, and the science must be mathematical in nature, by whatever name we call it.

He insists that mathematics have been successfully employed in physical sciences of which the data are very inexact: and what innumerable possibilities of economical statistics exist already half tabulated in the books of mercantile houses great and small. His remarks on these and some similar points are singularly good. In general, indeed, he makes but little use of mathematical methods of reasoning. And he has not even fully availed himself of the accuracy which he might have derived from the use of the language. He does not always point out what are the variables as a function of which his quantities are expressed. It is often necessary to understand independently the whole of his reasoning, in order to know whether he means his differential co-efficients to be total or partial; and in several cases he seems almost to have himself forgotten that they are total. He has expressed the fact that "the last increments in an act of exchange must be exchanged in the same ratio as the whole quantities exchanged" by the equation

$$\frac{dy}{dx} = \frac{y}{x}.$$

He does not indicate the existence of any relation the $\triangle y$ and $\triangle x$, of which he considers dy and dx to be the limits, which can constitute $\frac{dy}{dx}$ a differential co-efficient: the mathematical phrase merely confuses. Some amusement has been derived from the absurd result which is obtained by integrating the equation. But this implies a misapprehension. A point on a locus may be determined by an equation with a differential co-efficient in it. If we integrate the equation, we get, not this locus, but some other intersecting it at the point to be determined. An instance of a different kind of inaccuracy, for which his making use of mathematical language leaves him without excuse, occurs in his investigation of the influence on the rate of international exchange exerted by a tax on imports. He tacitly assumes that the government levies the tax in kind, and destroys it, or, at all events, consumes it in such a way as not to interfere with the demand there would otherwise have been in the country for it.

We owe several valuable suggestions to the many investigations in which skilled mathematicians, English and continental, have applied their favourite method to the treatment of economical problems. But all that has been important in their reasonings and results has, with scarcely an exception, been capable of being described in ordinary language: while the language of diagrams, or, as Professor Fleeming Jenkin calls it, of graphic representation, could have expressed them as tersely and as clearly as that of the mathematics. The latter method, moreover, is not well adapted for registering statistics until the laws of which they are instances have been at least approximately determined: and it is not intelligible to all readers. The book before us would be improved if the mathematics were omitted, but the diagrams retained.

ALFRED MARSHALL.

II NEW THEORIES IN POLITICAL ECONOMY

by John Elliott Cairnes, *Fortnightly Review*, n.s., XI (January 1872) pp. 71–6.

IN the concluding remarks of Professor Jevons's able and original work he enters a protest against "the too great influence of authoritative writers in political economy," urging, as a plea for the boldness of his own speculations, the existence of a "tendency of a most hurtful kind to allow opinions to crystallise into creeds." I should be inclined to deprecate quite as strongly as he does the tendency in question, could I perceive its existence; but I own I am quite unable to do so. So far from this, what strikes me as the most notable feature in recent economic publications – almost the only circumstance, indeed, which they have in common – is the entire freedom manifested by the writers from any such subserviency to authority as Mr. Jevons deprecates. With the single exception of Professor Fawcett's manual and Mrs. Fawcett's smaller treatise, I am unable to recall a single work published within the last twenty years in which principles, more or less fundamental in what Mr. Jevons would call the accepted system of political economy, have not been freely brought in question. In the writings, for example, of Mr. McLeod, of Professor Rickards, of Professor Rogers, of Mr. Thornton, of Mr. Longe, of Mr. Jennings, of Professor Hearne, and of Professor Jevons himself, not to mention French and American publications, I think it would be difficult to discover indications of that subservient and timid spirit against which we are warned. Indeed, I must frankly own that my apprehensions take an entirely different direction; and that what I should be disposed to deprecate in the treatment of economic questions is something the exact reverse of excessive deference for authority – an eagerness to rush into difficult speculations, and to propound crude

solutions of complicated problems, in entire disregard, or at all events without due study, of what has been done towards elucidating those subjects by previous thinkers. Not indeed, that I consider political economy to have spoken its last word – very far from this – or even to have received in any of its branches final and definite form; and still less that I desire to see a "despotic calm" in economic speculation, but that I think impatience of authority may in science be carried too far. What appears to be due to the great names in any province of thought is that their opinions should be candidly studied before being set aside, and that, so far as is consistent with scientific convenience, the new developments of doctrine, suggested by enlarged investigation, should be built upon the results of past thought, where these are found to be sound. It appears to me that no presumption can be greater than that of a writer who, dealing with problems of extreme difficulty, which have been the subject of the prolonged and intense meditation of some generations of able men, coolly thinks he may disregard all that has been done, and strike out at a heat, by his unassisted genius, solutions which they have failed to discover; and it is towards this extreme, as it seems to me, far rather than towards servile acquiescence in established doctrines, that the intellectual habit prevailing among those who engage in economic discussion tends at the present time. It is, indeed, true that we find abundant appeals on all hands to "the established principles of political economy;" but what is the value of such appeals? The dogmas appealed to are, in the great majority of cases, no more principles of political economy than they are principles of the black art, but, as Mr. Jevons would no doubt be the first to admit, the merest plausibilities – platitudes, for example, about supply and demand – either evolved at the moment from the moral consciousness of the reasoner, or which have somehow got current, possibly as having what is considered the proper scientific ring. I am, therefore, wholly unable to join in the present protest against the alleged servile spirit of modern economic speculation. It is anarchy, as it seems to me, rather than despotism, with which we are menaced. Mr. Jevons, indeed, thinks that in the "republic of the sciences sedition and even anarchy are commendable." But in this view I cannot concur. As I regard the matter, sedition is only commendable when preceded by knowledge of the principles against which the revolt is made, and perception of their inadequacy; nor can I think that anarchy is commendable at all; at best it is only preferable to absolute stagnation.

It would seem, therefore, that our author has no need to be apprehensive of his views failing to receive the attention they undoubtedly deserve from any indisposition on the part of economists to entertain novel doctrines. Every one will acknowledge the perfect competency of so able and accomplished a writer to challenge any

principle of political economy, it matters not by what names it may be endorsed; and he will, on his side, no doubt be prepared to find opinions, deviating so widely as some of his do from those which have been held by some very able men, severely and even jealously canvassed. Mr. Jevons has diverged from the beaten track in two directions – on the question of the method by which political economy ought to be cultivated, and also on some of its substantive doctrines. As regards method, he thinks that economic principles may be best developed by means of mathematics; while he has propounded, on the subject of value in exchange, as well as on some other doctrines of the science, some views of more or less novelty. A few remarks on his doctrine of value are all I shall venture on, on the present occasion.

The phenomena of exchange-value involve two perfectly distinct problems, which, one is surprised to find, Mr. Jevons does not discriminate – the problem as to normal or average, or (to use Adam Smith's phrase) "natural" values, and that as to fluctuations of value, or, as it is commonly expressed, "market values". Of course all exchanges whatever, at least all with which political economy is concerned, take place in a market, and therefore all values are in a sense "market values;" but the exchanges of the market may be considered either with a view to the law of their fluctuations, or with reference to that which governs them as average or normal phenomena, when taken over periods long enough to allow disturbing causes to neutralize each other. It is one thing to inquire why the price of wheat is higher to-day than yesterday, this year than last; it is an entirely different inquiry why its price is *on an average* higher than that of oats, or why gold is *on an average* of higher value than silver, silver than copper, copper than iron. These two problems I say are distinct. It is of course conceivable that a solution may be found which shall embrace both; and, as Mr. Jevons has ignored the distinction, this, I presume, is what we are to understand his theory as undertaking to do.

That theory is not absolutely new; at least it seems to me that I perceive in it a conception of the law of value at bottom the same with that propounded by Bastiat in his "Harmonies Economiques."* But in form, and in the exposition, the doctrine now advanced appears, so far as I know, for the first time. It is briefly as follows:— Exchange-value, or, as Mr. Jevons prefers to call it, "the ratio of exchange," depends upon utility – that is to say, corresponds with, and expresses the relative utility of, the commodities exchanged; but "utility" is here to be taken, not as ordinarily understood, as expressing the capacity in general of a commodity to satisfy a human desire, but in a sense which will be gathered from the following passage:—

* Examined in the *Fortnightly Review*, October 1870.

"We can never say absolutely," says Mr. Jevons, "that some objects have utility and others have not. The ore lying in the mine, the diamond escaping the eye of the searcher, the wheat lying unreaped, the fruit ungathered for want of consumers, have not utility at all. The most wholesome and necessary kinds of food are useless unless there are hands to collect and mouths to eat them. Nor, when we consider the matter closely, can we say that all portions of the same commodity possess equal utility. Water, for instance, may be roughly described as the most useful of all substances. A quart of water per day has the high utility of saving a person from dying in a most distressing manner. Several gallons a day may possess much utility for such purposes as cooking and washing; but after an adequate supply is secured for these uses, any additional quantity is a matter of indifference. All that we can say, then, is, that water, up to a certain quantity, is indispensable; that further quantities will have various degrees of utility; but that beyond a certain point the utility appears to cease.

"Exactly the same considerations apply more or less clearly to every other article. A pound of bread per day supplied to a person saves him from starvation, and has the highest conceivable utility. A second pound per day has also no slight utility: it keeps him in a state of comparative plenty, though it be not altogether indispensable. A third pound would begin to be superfluous. It is clear, then, that *utility is not proportional to commodity*: the very same articles vary in utility according as we already possess more or less of the same article. The like may be said of other things. One suit of clothes per annum is necessary, a second convenient, a third desirable, a fourth not unacceptable; but we, sooner or later, reach a point at which further supplies are not desired with any perceptible force, unless it be for subsequent use."

In conformity with this view as to the varying degrees of utility incident to each commodity, the doctrine of exchange-value is thus laid down:— "The ratio of exchange of any two commodities will be inversely as the final degrees of utility of the quantities of commodity available for consumption after the exchange is effected;" in other words, the greater "the final degree of utility" in the case described, the smaller will be the quantity of the commodity which will be given in exchange for others, or the higher will be its exchange-value. Such is the theory, which may be considered from either of two points of view; either, 1, with reference to its truth as an expression of fact; or, 2, with reference to its importance as a means of elucidating the phenomena of wealth.

As regards the question of fact, our decision must evidently depend on the criterion which we adopt for estimating utility. "Utility," Mr. Jevons tells us, "corresponds to and is measured by pleasure." This seems

sufficiently clear; but in truth it leaves the whole question open; for how are we to measure pleasure? Most people would, I think, say that the pleasure which a man derives from, let us say, the last drop of water that satisfies his thirst – in Mr. Jevons's language, the "terminal utility" of water – is substantially the same in all times and places. A man's capacity for enjoying a drink of water does not change with his change of locality. Or, again, I think it would be generally agreed that the pleasure derived from wearing a shirt or coat – given the constitution of the man and the climate – is not sensibly different now from what it was a century ago. The satisfaction would be regarded as depending upon the constitution of the human being in conjunction with the nature of the commodity. But, estimating utility by this method, Mr. Jevons's theory is manifestly untenable, since it is matter of fact that the exchange-value of water is not the same for all times and places, and it is equally certain that the price of all articles made of cloth or calico has greatly fallen within a century. Another measure of utility, therefore, must be found if the doctrine is to be accepted. For example, this view may be taken. It may be contended that the pleasure or utility which a man derives from the use of a commodity is not properly represented by the satisfaction arising from the action of the commodity upon his sensitive frame, but depends upon his estimate of the commodity as indicated by the things which he is disposed to give in exchange for it. In other words, we may take exchange-value as the criterion of utility; and this in fact is the test which Mr. Jevons ultimately adopts. "The price of a commodity," he says (p. 140), "is the only test we have of the utility of the commodity to the purchaser." So that what we come to is this – exchange-value depends upon utility, and utility is measured and can only be known by exchange-value. With these explanations the theory may perhaps be saved, but what is the value of the doctrine thus emasculated? I own it seems to me to come so close to an identical proposition, that I am unable to distinguish it from that species of announcement. I fail to perceive in what way it throws light on any problem of economic science. What is the purpose of a theory of value? As I understand the matter, to inform us of the conditions on which this phenomenon depends. But, if the conditions the theory announces are something undistinguishable from the phenomenon itself, if their statement is merely another mode of expressing the fact, what is the importance of the information it conveys? We desire to know, for example, the course which exchange-value will take with the progress of society, or in consequence of changes in the modes and sources of production, in the case of such articles, suppose, as corn, meat, iron, coal, gold, and silver; and we are told it will correspond in each case with the "terminal utility" of the commodity. But of what avail is it to know this, unless we have some means of determining the "terminal utility,"

independent of the phenomenon in question? If the "terminal utility" can only be known by the exchange-value, how are we helped to a knowledge of the latter by being referred to the former? The importance of knowing the laws of Nature is that we may overcome Nature by obeying her - as Professor Huxley has put it, to avoid the boxes on the ear which Nature administers to those who neglect her warnings. But if the only intimation we can have of the law is the experience of the box, how are we bettered by our scientific knowledge?

The purely formal character of Mr. Jevons's doctrine is still more clearly brought into view in the following development of it:—

> "What is the utility of one penny to a poor family earning fifty pounds a year? As a penny is an inconsiderable portion of their income, it may represent one of the indefinitely small increments, and its utility is equal to the utility of the quantity of bread, tea, sugar, or other articles which they could purchase with it, this utility depending upon the extent to which they were already provided with those articles. To a family possessing one thousand pounds a year, the utility of a penny may be measured in an exactly similar manner; but it will be found to be much less, because their want of any given commodity will be satiated or satisfied to a much greater extent, so that the urgency of need for a pennyworth more of any article is much reduced." (P. 133.)

Thus the "terminal utility" of a commodity will vary with the circumstances of each purchaser. The "terminal utility" of a pound of tea will be greater to a washerwoman than to a fine lady; from which some readers might be disposed to infer that, according to Mr. Jevons's theory, the washerwoman ought to pay more for her tea. But this would be a wrong inference; because the "terminal utility" of the money paid for the tea would, according to the standard adopted, be also different in the two cases, since it was to be measured by that of the tea itself. If the pound of tea be more useful to the washerwoman than to her rich neighbour, so also is the money paid for it; and thus, according to the theory, the price for each purchaser ought to be, as it is, the same. The theory thus may be saved by the simple process of depriving it of meaning. It cannot be said to be at variance with fact, since it merely asserts that the fact agrees with itself; but something more than this, I apprehend, is required of a scientific doctrine.

Besides the doctrine of value, there is much in Mr. Jevons's volume that will attract the attention of economists. In particular his view as to the amenability of economic problems to mathematical treatment is well deserving of consideration. Into this question, however, I do not now enter. I shall merely say that, while not denying that some of the doctrines of political economy may be exhibited mathematically, and may possibly

thus be made clearer to some minds, my own belief is that this mode of presenting economic truths admits of but very limited application. When mathematics are carried further than this in the moral or social sciences, and used for conducting processes of reasoning, without constant reference to the concrete meaning of the terms for which the mathematical symbols are employed, I own I regard the practice with profound distrust. I must, however, defer to another occasion any attempt to vindicate my objections on this score.

J. E. CAIRNES.

III UNTITLED AND ANONYMOUS REVIEW[1]

Saturday Review, 11 November 1871, pp. 624–5

PROFESSOR STANLEY JEVONS remarks both in the preface and in the conclusion of this book that an exaggerated respect for authority has been very injurious to the progress of Political Economy. The names of Mill, Ricardo, and Adam Smith have been hurled at the head of any unfortunate heretic, and he has frequently been hooted out of Court without obtaining a hearing. Nothing, as Mr. Jevons truly urges, can be more opposed to the true spirit of scientific inquiry. We are therefore prepared to be rather grateful than otherwise to Mr. Jevons for attacking some of the accepted views. He will have, in the opinion of many, a better claim to be heard because his divergence from the old results is scarcely so great as he seems to imply. He accepts, for example, the orthodox theory of rent. He holds a doctrine as to the relation of profit and wages which to us seems to be substantially orthodox; and even in the theory of exchange, where he professes to introduce the greatest amount of novelty, he comes to many of the old conclusions. He believes in Mr. Mill's theory of international exchanges, with a slight exception; he admits, with Ricardo, that certain commodities are exchanged in the ratio of the cost of production; and he even accepts the general reasoning as to the laws of supply and demand. In fact, we have been struck by his general agreement with the writers to whose authority he declines, and rightly declines, to yield unreasoning obedience.

In what, then, does Mr. Jevons's originality consist? First, in the fact that he approaches the subject from a new point of view; and, secondly, that this method enables him to express his conclusions in mathematical symbols. To explain the first statement we may remark that, for scientific

[1] Possibly written by George Wirgman Hemming (1821–1905), mathematician, law reporter and fellow of St John's College, Cambridge. Cf. Merle M. Bevington, *The Saturday Review 1855–1868* (1941).

purposes, human society may be considered as a vast piece of machinery, in which the action of the various parts is determined by the various forces which affect the will. Each man is regarded as an instrument moved by pain and pleasure; and the arrangements of society at large are determined by the aggregate impulses of all its individual members. If, then, we could calculate the effects of given causes in producing pleasure and pain, we might determine such phenomena, for example, as those of the exchange of commodities. Just so, if we knew all the molecular forces by which the various parts of the human frame are combined, we could determine the mode of circulation of the blood. The apparently hopeless complexity of the problems thus suggested has induced economists, like anatomists, to renounce the attempt of thus analysing human society into its ultimate constituent forces, and to be content with tracing the consequences of certain highly general empirical laws. They assume, for example, that an increased supply will diminish the demand for a commodity; but they do not attempt to show from any consideration of human nature by what law the intensity of desire for the commodity will be regulated. If the time should ever come at which the actions of a man could be calculated like the orbit of a comet, political economy would reach its ideal perfection, and we might, no doubt, as Mr. Jevons urges, make it part of a Calculus of Pain and Pleasure. Meanwhile he thinks that he can detect some laws which will at least start us in the right direction; though, of course, we cannot as yet expect a mathematical accuracy of solution. We will try to see what he has made of it.

Let u, he says, represent the whole utility proceeding from the consumption of a quantity x of any given commodity. Then we may assume that u is a function of x, and he defines the "degree of utility" to be the differential coefficient of u with respect to x or $\frac{du}{dx}$. This is all very well, but so far we see no clearer. When a mathematician wishes to calculate the variations of a force, he begins by telling us distinctly what is the measure of force; when, for example, we know that g means the number of feet which a body will cover in a second with the velocity derived from gravitation acting for a second, our ideas are perfectly clear. But what is the measure of utility? To this we can discover no answer in Mr. Jevons's book. The obvious reply would be that utility is measured by the price paid for the object under given circumstances. But this would be, in fact, to give up Mr. Jevons's method, and to relapse into the old mode of empirical inquiry. We must suppose that a unit of pleasure is somehow discoverable. Mr. Jevons admits that we can "hardly form the conception" of such a unit; but thinks that we may somehow compare quantities of pleasure. Undoubtedly we can tell that one pleasure is greater or less than another; but that does not help us. To apply the

mathematical methods, pleasure must be in some way capable of numerical expression; we must be able to say, for example, that the pleasure of eating a beefsteak is to the pleasure of drinking a glass of beer as 5 to 4. The words convey no particular meaning to us; and Mr. Jevons, instead of helping us, seems to shirk the question. We must remind him that, to fit a subject for mathematical inquiry, it is not sufficient to represent some of the quantities concerned by letters. If we say that G represents the confidence of Liberals in Mr. Gladstone, and D the confidence of Conservatives in Mr. Disraeli, and x and y the numbers of those parties; and infer that Mr. Gladstone's tenure of office depends upon some equation involving $\frac{dG}{dx}$ and $\frac{dD}{dy}$, we have merely wrapped up a plain statement in a mysterious collection of letters. Let us, however, attempt to test the value of Mr. Jevons's conclusions by following out at some length an example which illustrates his chief principle. Perhaps we shall find that an array of symbols very terrible in appearance may be expressible in plain language when we examine them closely.

Mr. Jevons begins his inquiry by the assertion that if A. exchanges x of one commodity for y of another, the equation $\frac{y}{x} = \frac{dy}{dx}$ will necessarily be satisfied; and his reason is as follows:—"Suppose that two commodities are bartered in the ratio of x for y, then every mth part of x is given for every mth part of y, and it does not matter for which of the mth parts." Extending this to the case of indefinitely small parts, the above equation of course follows.

He then undertakes to solve the following problem. If A. has a [say] of corn and B. b of beef, and A. exchanges x of corn with B. for y of beef, what must be the values of x and y? He assumes the truth of the following principle – namely, that as the quantity of corn in A's possession diminishes, the utility of each unit will increase, although the utility of the whole may diminish. This is the equivalent of the ordinary proposition that the specific value of any commodity will increase as the supply diminishes, though the value of the whole amount will diminish. Hence the utility of the corn in A's possession will be some function of the total amount; or, if we use symbolical language, and remember that, after the exchange, he has $a-x$ of corn and y of beef, we may call the utilities of his corn and beef $\phi_1 (a-x)$, and $\psi_1 (y)$, where ϕ_1 and ψ_1 are some functions dependent upon the idiosyncrasies of A. Using similar symbols for B., the utility of his corn and beef will be expressed by $\phi_2 (x)$ and $\psi_2 (b-y)$; and Mr. Jevons proceeds to argue that, when each is satisfied, the following equation will hold good:—

$$\frac{\phi_1(a-x)}{\psi_1(y)} = \frac{dy}{ax} \text{ and } \frac{\phi_2(x)}{\psi_2(b-y)} = \frac{dy}{dx}$$

Or, since

$$\frac{dy}{dx} = \frac{y}{x},$$

$$\frac{\phi_1(a-x)}{\psi_1(y)} = \frac{y}{x} = \frac{\phi_2(x)}{\psi_2(b-y)}$$

Here are two equations to determine the two unknown quantities, x and y.

Let us now try to discover the meaning of these mysterious symbols. And, first, of that equation $\frac{y}{x} = \frac{dy}{dx}$, of which Mr. Jevons makes so much use. It follows immediately from the statement, as Mr. Jevons may learn from any book on differential equations, that $y = Cx$ where C is a constant; or, in words, that the quantities bought and exchanged have a fixed ratio. In short, he has simply put into a symbolical shape the very simple truth that, if three herrings are sold for a penny and a half, any number of herrings will be sold for the same number of halfpence. Or, to speak more generally, we may say that, if two commodities are exchanged at a given rate, any quantities exchanged will always be in the proportion so fixed. Rather an obvious truth to be expressed in so cumbrous a fashion!

When Mr. Jevons proceeds to apply this equation to the solution of his problem, he appears to us to fall into a palpable blunder. Translated into plain English, the equation $\frac{y}{x} = \frac{dy}{dx}$ means, as we see, simply that, however much corn A. gives to B., he will receive a proportionate quantity of beef in exchange. If he doubles the amount of corn, that is, he will receive twice as much beef. But the other equations are obtained on the contrary supposition, namely, that the rate of exchange will vary according to some complex law, determinable, if we could tell precisely what effect will be produced on the mind of the parties to the bargain, by the possession of varying quantities of beef and corn. In fact, x is now a function of y, as might easily be foreseen from Mr. Jevons's statement of the case, in quite a different sense from what it was before. The substitution, therefore, of $\frac{y}{x}$ for $\frac{dy}{dx}$ is a mistake, whilst even the equations

$$\frac{\phi_1(a-x)}{\psi_1(y)} = \frac{dy}{dx} = \frac{\phi_2(x)}{\psi_2(b-y)},$$

assuming them to be legitimate, seem to us to be simply useless so long as the functions are obviously indeterminable. They are merely a roundabout way of expressing what may be better said in words. In short, we

are compelled to regard Mr. Jevons's equations as altogether illusory.

We will, however, attempt to discuss the problem which he examines from a different point of view, and, as we would hope, in a plainer manner. Mr. Mill, in his *Political Economy* (Book III. Chap. XVIII.), puts the following case, which, as he thinks, illustrates the "elementary principle of international values." "Suppose," he says, "that 10 yards of cloth cost in England as much labour as 15 yards of linen, and in Germany as much as 20; at what rate will cloth and linen exchange, if the trade is thrown open?" We need not follow out his argument, remarking only that according to him the exchange will ultimately be made at some intermediate rate, depending upon the mode in which a rise or fall in price affects the demand in each market. Now Mr. Jevons's hypothetical case differs from Mr. Mill's in the following way; that A. and B., who may stand for England and Germany, are each supposed to have a strict monopoly of their respective commodities, and that moreover the production can be neither increased nor diminished. His problem is therefore equivalent to this; suppose that the British Museum had all the existing remains of Greek sculpture, and the Louvre all the existing remains of Roman sculpture; at what rate would they exchange collections, no other purchasers being in existence? The problem is so far removed from reality that it may be scarcely worth considering; and certainly it cannot be taken for a normal type of exchanges that actually take place. However, as extreme cases may very well illustrate principles, let us endeavour to follow out Mr. Jevons's example by his method, though without the use of his symbols. A. has 100 of corn and wishes to exchange it for some of B.'s beef. Suppose, for the moment, that a given rate of exchange is adopted. Let it be 5 of corn for 1 of beef. When A. has made one deal on these terms, he will have 95 of corn and 1 of beef. He may be willing to continue the process till, perhaps, he has 80 of corn and 4 of beef. We may suppose that he will now be unwilling to deal further on the same terms. If he parted with more corn for beef, the "utility" of his corn would rise and that of beef decline, and therefore the bargain of 5 for 1 would no longer be satisfactory to him. Meanwhile B. has 20 of corn and 6 of beef. If this happens to satisfy him, there will be equilibrium. We need hardly say, however, that the chances are much against it, and therefore some other rate of exchange must be found which will satisfy both parties to the bargain at the same level. It may be that no such rate is discoverable. Suppose, for example, that at the point just reached, B. having a surfeit of beef is willing to offer 2 of beef for 5 of corn, but that even this attraction will not induce A. to alter the composition of his sandwiches. Then A. will be content, but B. would still be willing to exchange at a moderate rate. Neither do we see why the rate which would content both of them should ever be hit upon. In short, all we can say is

that they will exchange beef and corn till one or both of them choose to leave off; but when that will be depends partly on the desire of A. and B. for beef and corn, and partly on their acuteness in higgling. This is the same result as that at which Mr. Jevons himself arrives in the case of a man wishing to sell a house to a single purchaser. If one would rather take 900*l.* than not sell the house, and the other would rather give 1,100*l.* than not buy it, there is, as he justly remarks, no way of determining from general considerations what the price will be. He thinks, however, that the difficulty is owing to the fact that the house cannot be sold by separate bricks, whereas it is really owing in our opinion to the assumed absence of competition. If any number of other houses can be built, the rate of exchange would at once be determinable, as Mr. Jevons admits, by a different set of considerations. But till that cause comes into play no rule can be given. In fact, to sum up our view of Mr. Jevons's conclusions, we should say that he wishes to determine the rate of exchange by the utility to the dealers, without introducing the ordinary play of supply and demand; he therefore imagines a case where supply and demand do not operate; he finds, as might be expected, that the only answer is, that the result depends in some way on personal peculiarities which evade examination; and he wraps up this mysterious conclusion in symbols which are mere verbiage, as they contain functions which neither are nor can be determined.

Without going further, we may conclude that, whether anything can or cannot be done in the direction indicated – and we by no means say that it cannot – Mr. Jevons has taken us a very short way.

IV UNTITLED REVIEW OF THE SECOND EDITION

by Thomas Edward Cliffe Leslie, *The Academy*, no. 377, n.s. (26 July 1879) pp. 59–60

The high reputation of the author, and the unsettled state of opinion with respect to both the limits and the method of political economy, make it the duty of every economist to master the doctrines of this work; and that can be done only by careful study of the book itself. A reviewer limited to a few dozen sentences can at best only assist a reader to form a judgment on some of its main topics. The principal questions it raises are whether political economy should be confined within the limits that Mr. Jevons assigns to it, and whether the method which he applies to the solution of the problems within those limits is legitimate and adequate. On both questions our own opinion differs from that of Mr. Jevons; but with respect to the first, the difference, though important, is one mainly of

classification and naming. For Mr. Jevons fully concurs in the necessity of historical induction to ascertain the economic phenomena of society and their laws, but would set it apart as a branch of the general science of society under the name of economic sociology, confining the term political economy - or, as he prefers to call it, economics - to a theory deduced from known facts, axioms, or assumptions respecting the conduct dictated by personal interest, such as "that every person will choose the greater apparent good, that human wants are more or less quickly satisfied, and that prolonged labour becomes more and more painful." The theory of population, accordingly, though pronounced by Mr. Jevons "as scientific in form as consonant with facts," forms, in his view, "no part of the direct problem of economics," and is not discussed in his present work. The majority of the most eminent economists of all schools – including Mr. Senior, who attempted to make political economy purely deductive, and whom Mr. Jevons estimates highly – are, it need hardly be said, against so narrow a limitation of the province of the science, and Mr. Jevons gives only the following reason for it:—

> "The problem of economics may be stated thus: 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 maximise the utility of the produce."

He adds that "it is an inversion of the problem to treat labour as a varying quantity when we originally start with labour as the first element of production, and aim at its most economical employment." The answer seems to be that land, like Labour, is a primary element of production, and the area in cultivation and the productiveness of that area are both varying quantities. Were labour, moreover, not a varying quantity - as it is, because population is so - inferior soils and costlier methods of cultivation would not have been resorted to, and rent, to which Mr. Jevons gives a high place in economics, would not have arisen. But if, for these reasons, the laws of population come properly within the pale, political economy is clearly not limited to an assemblage of deductions or calculations from self-interest. Nor can any other natural laws, directly and deeply affecting the amount and distribution of wealth, be in consistency excluded. Admit the theory of population, and all that Mr. Jevons classes apart under the name of economic sociology has a logical title to a place within the domain of political economy.

Since Mr. Jevons, however, is an advocate, not an opponent, of the most extensive historical and inductive investigation, it is, as we have said, mainly a question of naming and classification whether the term "political economy" or "economics" should be confined to a narrower

field. But the question follows – Within that narrower field can we proceed, as Mr. Jevons contends, not only by simple deduction, but by mathematical process? "There can be," he says, "but two classes of sciences – those which are simply logical, and those which, besides being logical, are also mathematical. If there be any science which determines merely whether a thing be or not, whether an event will or will not happen, it must be a purely logical science; but if the thing may be greater or less, or the event may happen sooner or later, nearer or farther, quantitative notions enter, and the science must be mathematical in nature, by whatever name we call it."

Nevertheless, it can hardly be contended that Adam Smith's reasoning respecting the nature and causes of the wealth of nations is in its essence, and ought to be in actual form, mathematical; or that the process by which his main propositions are established is anything more than logical. We might add that they rest in good part on inductive, and not simply on deductive, logic; but the question before us is whether mathematical methods could properly be applied to their demonstration. That wealth consists, not of money only, but of all the necessaries and conveniences of life supplied by labour, land, and capital; that man's natural wants are the strongest incentives to industry; that the best assistance a Government can give to the augmentation of national opulence is the maintenance of perfect liberty and security; that the division of labour is the great natural organisation for the multiplication of the products of industry; that it is limited by the extent of the market; and that the number of persons employed in production depends in a great measure upon the amount of capital, and the modes of its employment – these are the chief propositions worked out in *The Wealth of Nations*, and it can hardly be said that mathematical symbols or methods could fitly be used in their proof. We need not controvert Mr. Jevons' proposition that

> "pleasure, pain, labour, utility, value, wealth, money, capital, are all notions admitting of quantity; nay, the whole of our actions in industry and trade depend upon comparing quantities of advantage or disadvantage."

But the very reference which Mr. Jevons proceeds to make to morals militates against the assumption that "political economy must be mathematical simply because it deals with quantities," and that "wherever the things treated are capable of being greater or less, there the laws and relations must be mathematical." The author instances Bentham's utilitarian theory, according to which we are to sum up the pleasures on one side and the pains on the other, in order to determine whether an action is good or bad. Comparing the good and evil, the

pleasures and pains, consequent on two courses of conduct, we may form a rational judgment that the advantages of one of them preponderate, that its benefits are greater, its injurious results, if any, less; but it by no means follows that we can measure mathematically the greater or less, or that the application of the differential calculus would be appropriate or possible in the matter. We do not go the length of saying that there are no economic questions to which mathematical calculation may be fairly applied. The precious metals, for instance, move so easily between adjacent countries that the variations of the foreign exchanges might perhaps be mathematically treated. But the immense inequalities in wages and profits, and the extraordinary fluctuations of prices under the uncertain influences of credit and speculation, are enough to baffle any attempt to apply the calculus to questions of value in general.

Were the application of mathematical processes and symbols to all economic reasoning, however, possible, it does not follow that it would be expedient. Bastiat's conception of the main problem of political economy was not very different from that of Mr. Jevons, who says that "to satisfy our wants to the utmost with the least effort – to procure the greatest amount of what is desirable at the expense of the least that is undesirable – is the problem of economics." Suppose that Bastiat could have put his *Sophismes Economiques* into a mathematical form, with symbols for words and equations for syllogisms and epigrams, would not political economy and the world have suffered a heavy loss by his doing so? The *Times* might be printed in shorthand, and much ink and paper thereby saved, but would it conduce to the enlightenment of the public to make that economy? We regret that so much of Mr. Jevons' own reasoning is put into a mathematical form, because it is one unintelligible or unattractive to many students of considerable intellectual power and attainments. On the other hand, we not only concede that a mathematical shape might have been given to a great part of Ricardo's system, but we regret that it ever received any other, because his theory of value, wages, profits, and taxation is misleading and mischievous. Assume that the products of equal quantities of labour and abstinence are necessarily of equal value and price, and that exertions and sacrifices of different kinds are commensurable, and a number of mathematical equations and calculations can be based on those assumptions. But since the basis is false, the more the superstructure is hidden the better, and we should be glad to see it obscured in every treatise in which it is put forward by a liberal use of the calculus. Taking utility in the sense in which Mr. Jevons uses the word, we should acquiesce in his "general law that the degree of utility varies with the quantity of commodity, and ultimately decreases as that quantity increases." Yet in one case only are the variations of utility and value, consequent on variations in the quantity of commodity, suscep-

tible of mathematical measurement and calculation. The purchasing power or value of currency is inversely as its quantity, because there is an unlimited demand for it; but the variations in the value of other commodities bear no regular ratio to their quantity. Davenant's estimate, to which Mr. Jevons refers, that a defect of one-tenth in the harvest raises the price of corn three-tenths, and that a defect of one-half more than quadruples its price, is useful as an illustration, and made a rough, though only a rough, approximation to truth, so long as little corn came from abroad. Now the supply comes from the harvests of the world, and a defect of one-tenth in our own harvest might be followed by a fall instead of a rise in the price of grain. Could we even get accurate statistics of the harvests of the world, it would be found that its price is affected by so many other conditions that it bears no constant mathematical ratio to the amount of supply.

On the other hand, the stress which Mr. Jevons lays on the relation between value and quantity of supply seems to us to afford an answer to an objection which Mr. Cairnes has made to the proposition for which Mr. Jevons contends, that "value depends on utility." When Mr. Cairnes asks whether commodities are exchanged for each other simply in proportion as they are useful, we should reply in the affirmative, if by usefulness is meant, what Mr. Jevons and most other economists mean by it, the power of satisfying any human desire. If, in a siege or a famine, a loaf is refused in exchange for a large diamond, it is because the loaf is more desired or more useful; if, in ordinary times, a large diamond would not be given for a thousand loaves, the reason is that the diamond is preferred, or has greater utility in the economist's sense. It may, indeed, be urged that the comparative usefulness of diamonds and loaves in the two cases gives only the proximate cause of their relative value in exchange, and that the ulterior cause is comparative limitation of supply. A loaf contains as much nourishment in a time of plenty as in a famine; but in the former case no particular loaf is much wanted, or has any particular utility, while in a famine every loaf has a utility proportionate to the amount of food it contains. Mr. Jevons' proposition is in substantial accordance with the generally accepted doctrine that value depends mainly on limitation of supply. It depends, however, also on other conditions which defy all mathematical powers of calculation. Given the supply of a commodity, the urgency of the desire for it, and the amount of the funds in the hands of the persons desirous to purchase it, its price is still indeterminate. It will vary according as buyers and sellers combine or compete, according to the activity of credit and speculation, and according to other conditions which are subject to no ascertainable laws.

A proposition laid down by Mr. Jevons, in which we fully concur, is that "economics must be found on a full and accurate investigation of the

conditions of utility, and to understand this element we must examine the wants and desires of man." An urgent desideratum in political economy is certainly the substitution of a true theory of what Mr. Jevons terms "the laws of human wants" for vague abstractions, such as the love of wealth and the aversion to labour. But wide historical investigation must precede the construction of the true theory. The authors to whom Mr. Jevons refers have made some instructive suggestions respecting the subordination and successions of human wants, but they seem not to have perceived that these wants vary under different surrounding conditions and in different states of society. The order which the evolution of human wants follows is one of the enquiries that await a rising historical and inductive school of economists, which happily has no opposition to encounter from Mr. Jevons. But with respect to the deductive method, Mr. Jevons does not quite fairly represent the view of that school when he says, "I disagree altogether with my friend Mr. Leslie; he is in favour of simple deletion. I am for thorough reform and reconstruction." We are, it is true, for deletion of the deductive method of Ricardo; that is to say, of deduction from unverified assumptions respecting "natural values, natural wages, and natural profits." But we are not against deduction in the sense of inference from true generalisations and principles, though we regard the urgent work of the present as induction, and view long trains of deduction with suspicion.

We have been able to touch only a few of the problems discussed in Mr. Jevons' treatise. It is one which requires a considerable intellectual effort on the part of the reader, but the effort will bring its reward, even where it may not end in entire assent to the views of the eminent author.

T. E. C. LESLIE.