COMMON KNOWLEDGE: THE VICTORIAN WORKING CLASS AND THE LOW ROAD TO SCIENCE, 1870-1900

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A thesis submitted to the Faculty of Graduate Studies in
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ABSTRACT

For late-century Victorians, science was everywhere part of the culture, but current studies have mainly been concerned with the cultural elite. This dissertation looks beyond prosperous Victorians by examining working-class interests in science and the availability of scientific information for working men and women. Though no clear framework for this kind of analysis existed, uncovering scientific activity in working-class communities was not so much a matter of constructing an entirely new framework, as it was of recognizing working-class alternatives to middle-class methods and sources. This shift in focus emphasizes local opportunities created within working-class communities for the acquisition and study of scientific knowledge, allowing for varying degrees of difficulty and affordability. The formal middle-class "high road" of official schooling, expensive reading materials, and memberships in prestigious societies corresponds to what I have designated as "the low road." The low road consisted of informal adult education, shared skills within families

and communities, the working-class press, borrowed or used reading materials, cheap pamphlets, free lectures, mutual aid and reading groups, local science clubs, political groups, and the challenging pursuit of autodidactic studies.

In the final analysis, two questions needed to be answered. How did impoverished workers with little formal education obtain and comprehend scientific ideas, and what did workers want with science? This was the central task of this study, and its completion opens up the borders of the history of science as much as it adds new dimension to working-class history. Based largely on autobiographical testimony, organizational records, and the commercial and political press, evidence demonstrates that scientific ideas and practices were widely available as both common knowledge and serious pursuit. Science was, for many working-class Victorians, a fundamental component of leisure, self-improvement, and class emancipation through increased participation in the cultural, intellectual, and sometimes political, life of the nation.

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This dissertation has benefited from the helpful suggestions of David Vincent, Adrian Desmond, James R. Moore, Anne Secord, John Laurent, Suzanne Lemay-Sheffield, Mary McRoberts, Stuart Macintyre, and Jim Paradis. I would also like to extend my appreciation to my committee members, William D. Irvine and Craig Heron for their insightful comments, and to Diane Jenner, who served as the heart of the Graduate History Programme at York for many years. My research was assisted greatly by the archivists at Bishopsgate Institute, The Co-operative Archive in Manchester, the National Museum of Labour History, and the London School of Economics. I am also indebted to York University's efficient and congenial staff at the Faculty of Graduate Studies and the Resource Sharing department. I would especially like to thank my supervisor, Bernard Lightman, who has been both teacher and inspiration throughout my graduate studies. Finally, I wish to thank my son, Kealan, for sharing his youth with my dissertation.

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Chapter 1: Introduction - Mapping the Terrain

Frank Hodges grew up in late Victorian England and worked as a pit-boy at the age of thirteen. In his autobiography, he recalled sneaking a copy of Shakespeare into the pit so that he could keep his mind occupied during his "lonely vigil" and read to his fellow workmen during breaks. Hodges' next book, after having read several of Shakespeare's plays, was Charles Darwin's The Origin of Species. The question is: what use did a coalminer have for Shakespeare or Charles Darwin? Even allowing for his interest in Shakespeare, how would a pit-boy have understood evolutionary theory and why did he describe the encounter as a "mental revolution"?[1] There is, at the moment, no historical framework for answering these questions.

Working-class intellectual history is not exactly virgin territory, but it is still inexperienced. In the history of science, Victorian workers have received some

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[1] Frank Hodges, My Adventures as a Labour Leader (London: George Newnes, 1924) 13-16. Frank Hodges (1887-1947), son of a farmer/miner, was born in Gloucestershire.

attention in the last twenty years, but these are localized studies of artisan culture and are not seen as representing the broader working-class community. In nineteenth-century social and cultural history, working-class politics, living conditions, religion, trade unionism, education, and leisure have been documented, debated, and revised; yet, the intellectual life of the worker is often neglected. Intellectual studies are reserved for the middle-class leaders of working-class organizations, although the occasional proletarian qualifies. In the history of education, a similar story is told: the majority of working-class children did not become full-time participants in the school system until the twentieth century and so expectations of intellectual pursuits are confined to exceptional individuals. No doubt, the history of science has taken its cue from social and cultural history. Uneducated, overworked, impoverished, and surrounded by ignorance, what could labourers possibly want with science? Even if they had heard about it, how would they obtain and comprehend scientific ideas? Answering these questions requires a re-evaluation of working-class

intellectual activity through an amalgamation of social and cultural history and the history of science.

There are several compelling reasons for marking the years between 1870 and 1900 as an historical turning point for Britain's workers in the context of dramatic changes in both society and science.[2] Though many local customs and traditional features of British society and culture survived, changes in population, occupational composition, politics, urbanization, class relations, communication, and transportation were significantly altering the cultural, social, and intellectual life of the nation. Between 1871 and 1901, the population of Great Britain rose from approximately 26 million to 37 million.[3] The number of

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[2] For the main issues in the period 1870-1914, see Eric Hobsbawm, Workers: World of Labour (New York: Pantheon, 1984) and The Age of Empire, 1875-1914 (London: Weidenfeld and Nicolson, 1987); José Harris, Private Lives, Public Spirit: Britain, 1870-1914 (London: Penguin, 1994); Peter Mathias, The First Industrial Nation: An Economic History of Britain, 1700-1914 (New York: Charles Scribner's Sons, 1969) Chapter 15, especially 404-17. The issue of empire in relation to nationalism, foreign trade, and research and development is an important one. Hobsbawm's Age of Empire is useful for trade and nationalism, and for technology, see Bruce J. Hunt, "Doing Science in a Global Empire: Cable Telegraphy and Electrical Physics in Victorian Britain," Victorian Science in Context, ed. Bernard Lightman (London and Chicago: University of Chicago Press, 1997) 312-33. For Edwardian studies calling for a demarcation between 1870-1900 and 1900-1914, see Paul Thompson, The Edwardians: The Remaking of a Society (London: Weidenfeld and Nicolson, 1975); Alan O'Day, The Edwardian Age: Conflict & Stabilty, 1900-1914 (London: Macmillan, 1979).

[3] Mathias, The First Industrial Nation, 449.

cities with more than 100,000 inhabitants grew from ten in 1851 to thirty-six in 1911.[4] The Reform Bills of 1867 and 1884 extended the franchise to the majority of the adult male population, opening the way for the rise of mass politics, organized labour, and a multitude of lobby groups at the municipal and national levels.[5] In addition, this period experienced a contraction in the agricultural and textile workforce and an expansion in the construction trades, transport, mining, steel production, engineering, and shipbuilding, thereby generating important changes in the occupational composition of the workforce.[6] During the economic crises of 1873-96, profits fell but real wages increased due to falling prices.[7] As a result, in "modest, patchy, but plainly undeniable" ways, the standard of living rose for many Britons, even though the most vulnerable sectors continued to struggle.[8] At the same time, the domestic mass market improved as cheaper consumer

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[4] Hobsbawm, Workers, 196.
[5] Hobsbawm, Workers, 178, 198-99.
[6] Edward Royle, Modern Britain: A Social History, 1750-1997, 2nd ed. (London: Arnold, 1997) 4, 90, 94-95; Mathias, The First Industrial Nation, 263-73, 347-49, 404-13.
[7] Mathias, The First Industrial Nation, 395-97.
[8] Hobsbawm, Workers, 201-202; Mathias, The First Industrial Nation, 213,377

goods became available. The foundation for a consumer society was being laid.[9]

In communication and transportation, the popular press and the railway begin to expand after mid-century, and by the final quarter, significant reductions in production and consumer costs, improved technology, and expanded facilities allowed for greater movement of information, goods, and people, leading to "national integration."[10] Previously isolated regions were increasingly linked to the larger national network of ideas, debates, organizations, and special interest groups, fostering the growth of popular culture and public awareness of national issues.[11] Moreover, in the context of an expanding democracy, national integration prompted an escalation in state intervention.[12] Proliferation of legislation in areas of health and safety, education, labour relations, and social welfare attempted to cope with and contain the pace of urban growth, the threat of working-class mobilization and

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[9] Royle, Modern Britain, 282-86.
[10] Hobsbawm, Workers, 196-99; David Vincent, Literacy and Popular Culture, England 1750-1914 (Cambridge: Cambridge University Press, 1989) 32-48, 242-58.
[11] Hobsbawm, Workers, 198-201.
[12] Hobsbawm, Workers, 198; Henry Pelling, A History of British Trade Unionism, 5th ed. (London: Penguin, 1992) Chapter 6.

nation-wide industrial conflict, and the escalating demands for social and economic reform.[13] Democracy opened the door to diverse voices, and the state responded with countermeasures designed to settle or prevent inevitable disputes. This escalation of state intervention, combined with improved communications and increased mobility, helped to transform the "conditions of industrial conflict" and the political organization of the working class.[14]

The late Victorian working class was both the recipient and instigator of societal changes. The "new and broadened industrial economy" created shifts in the occupational composition and urban concentration of the workforce, significantly altering the social and cultural contexts of labour. Eric Hobsbawm contends that the "aggregate of microcosms which constituted the British world of labour, that collection of often strictly self-contained little worlds, [transformed] itself into a national phenomenon."[15] Smaller unions grew in membership and, at times, merged with other unions to form larger,

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[13] Royle, Modern Britain, 108-113.
[14] Pelling, 100-104, 113-17; Hobsbawm, Workers, 198.
[15] Hobsbawm, Workers, 152-75, 197.

amalgamated organizations such as the Amalgamated Engineers and the Operative Stonemasons, the Amalgamated Carpenters and Joiners, and after 1889, the National Union of Gas Workers and General Labourers. With nationally organized unions, an expanded franchise, and a national press, the labour movement was ready to take on "a political dimension it had not had since Chartism."[16] During the 1880s and 1890s, socialists, radicals, and labour activists agitated and lobbied for improved working and living conditions for the labouring sector, and the creation of the Labour Representation Committee (1900) and the Labour Party (1906) signified a new phase in labour politics that was to have important ramifications for British democracy and social reform.

Furthermore, indications of a growing sense of class-consciousness can be observed in this period, and Hobsbawm argues that 1870-1914 was a more pertinent phase in the formation of a British working class than the earlier stage described by E. P. Thompson in The Making of the English Working Class (1963). Hobsbawm noted in particular the

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[16] Hobsbawm, Workers, 198-99; Pelling, A History of British Trade Unionism, 59, 65-74, 83-95.

"profound sense of the separateness of manual labour, an unformulated but powerful moral code based on solidarity, 'fairness', mutual aid and cooperation, and the readiness to fight for just treatment."[17] Class solidarity within the new industrial context extended beyond working hours into culture, and Hobsbawm particularly noted the growing popularity of fish and chips, football, and the flat-peaked cap.[18] The connection between class-consciousness and popular working-class culture in the context of a consumer society has generated much debate as historians attempt to discover trends that will shed light on the changing nature of class relations during the Victorian period.

In examinations of working-class recreation, education, and political ideology, the central concern has been to determine the limits of working-class autonomy within a predominantly bourgeois capitalist consumer society. In the final analysis, studies indicate that a complex negotiation between available lifestyle choices occurred, and that variations existed among individuals, groups, and regions. In broad terms, workers took

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[17] Hobsbawm, Workers, 191.
[18] Hobsbawm, Workers, 200-201

advantage of affordable leisure and pleasures regardless of their middle-class or traditional working-class origins according to particular needs or interests, but that despite this, the working class as a whole was "impregnated" with a "sense of difference and conflict between 'us' and 'them'."[19] Some areas of popular culture were negotiable while others were not, and the fundamental defence of working-class rights continued to segregate working-class interests from the interests of capitalists and bourgeois reformers. As a result, cultural imports brought across class boundaries were frequently reconstituted to reflect a distinctly working-class culture.[20] How much this is the case for working-class

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[19] Hobsbawm, Workers, 190. See also Hugh Cunningham's "Class and Leisure in Mid-Victorian England," Popular Culture: Past and Present, eds. Bernard Waites, Tony Bennett, and Graham Martin (Kent: Croom Helm, 1982); Peter Bailey, Leisure and Class in Victorian England: Rational Recreation and the Contest for Control, 1830-1885 (London: Methuen, 1978); Peter Bailey, "Will the Real Bill Banks Please Stand Up," Journal of Social History 12 (1979) 336-53; Tony Mason, Association Football and English Society, 1863-1915 (Brighton: Harvester Press, 1980); Bread, Knowledge, and Freedom: A Study of Nineteenth-Century Working Class Autobiography (London: Europa Publications Ltd., 1981) Chapters 6-8.

[20] Hobsbawm, Workers, Chapters 11 and 13. See also, Gareth Stedman Jones, "Working-class Culture and Working-class Politics in London, 1870-1900," Popular Culture: Past and Present, eds. Bernard Waites, Tony Bennett, and Graham Martin (Kent: Croom Helm, 1982). Jones argues that class conciliation was part of a working-class capitulation to consumerism, and he bases his thesis on a shift in London club activity away from politics and education to recreation. Jones' strict division

intellectual culture in the late nineteenth century has yet to be determined, as is the role of science as a factor in the larger societal transformation of late Victorian Britain with respect to working-class organization. These omissions are particularly problematic because, as will be demonstrated, late Victorian working-class interest in science is connected to several definitive areas of research including leisure, education, political ideology, and class relations.

In late Victorian science, as in society, major transformations were underway in theory, production, and public participation. In biology, physics, chemistry, and psychology, the pace of scientific research was accelerating and its cultural authority expanding. Science affected industry, empire, medicine, technology, and foreign competition. Science was at the center of public

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of political autonomy or capitulation is not supported by my research. Also see, Chris Waters, British Socialists and the Politics of Popular Culture, 1884-1914 (Stanford: Stanford University Press, 1991), in which he argues that socialists feared the lure of capitalist entertainments and so tried, where possible, to counter its seductive appeal with collectivist recreation such as the Clarion's cycling clubs and choirs. Waters suggests that the expectations of socialist organizers were fairly rigid and as a result, workers who wanted simply to defend the rights of labour within a capitalist economy while taking advantage of commercial pleasures were a constant disappointment to the Left's intelligentsia.

debates over the origin of humanity, racial degeneration, metaphysics, and the nature of the mind. No serious argument can be made for neglecting the crucial role of science in the late Victorian experience, yet few social and cultural historians recognize this fact. An exception to this is Eric Hobsbawm, who acknowledged that the decades preceding the First World War constituted one of the brief periods of time in which "man's entire way of apprehending and structuring the universe is transformed."[21] In a chapter devoted to old "certainties undermined" by new developments in science and technology, Hobsbawm noted the essential link between society, politics, and science in the late Victorian period, most obviously, but not exclusively, detected in the social sciences and "those natural sciences which appeared to be directly relevant to society and its concerns."[22] In his brief survey of physics, mathematics, and biological theories such as Darwinism and eugenics, Hobsbawm concluded that the transformation in physics was likely perceived by "exiguous

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[21] Eric Hobsbawm, The Age of Empire (New York: Pantheon Books, 1987), 243.
[22] Hobsbawm, Age of Empire, 252-56.

numbers of men and women" but that evolution and its corollaries were central to bourgeois theories of class inequality and racism.[23] In so doing, he became one of the few social historians to treat science as more than a mere cultural appendage, although he did not extend his study of science beyond bourgeois culture.[24] Until the 1970s, a similar omission occurred in the history of science in that the social context of scientific ideas was treated as peripheral. The first historian of science to challenge significantly this omission was Robert M. Young, who pioneered the introduction of social and political thought to science studies.

In 1973, Young asserted that compartmentalized historical approaches inadequately explain the "common context of biological and social theory." In its place, he suggested that an approach be developed which would consider "social and political factors in scientific research and scientific factors in social, economic, and

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[23] Hobsbawm, Age of Empire, 243, 252-53.

[24] With the exception of a few social and intellectual historians such as Eric Hobsbawm, Stuart Macintyre, Logie Barrows, and Mark Pittenger, scholars from outside the history of science continue to be reluctant to acknowledge the relevance of naturalistic models and scientific theory in social and political development.

political history."[25] Young's Marxist deconstruction of the liberal capitalist theodicy implicit in the various articulations of evolutionary theory associated with the Darwinians, redirected science and society studies towards a more refined cross-disciplinary amalgam of the ideological links between social and scientific theories. Young, like Hobsbawm, concentrated on elite science and bourgeois culture, but his assessment of the role of class-related ideology in the articulation of scientific theories provided a foundation for a social history of science.

During the 1970s and 1980s, historians of Victorian science dismantled the social process of scientific practice and theory, and they have situated science within changing cultural contexts. Science is seen as both product and producer of culture, influenced by a wide range of consumers and makers of scientific ideas. In a seminal analysis of Victorian scientific naturalism, Frank Turner has situated science in the centre of the "contest for cultural authority" by demonstrating that the shift from

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[25] Robert Young, Darwin's Metaphor: Nature's Place in Victorian Culture (Cambridge: Cambridge University Press, 1985) 23, 164-71. This is a collection of essays written in the 1970s.

natural theology to evolutionism was about more than rival cosmologies: it was at the heart of the extension of economic and political authority to the ascending middle class.[26] A scientific worldview of progress and change was seized upon by liberal middle-class evolutionists, geologists, intellectuals, economists, political theorists, and social reformers in opposition to the fixed, hierarchical natural world of the Anglican-Tory elite that represented old ideas and old money. Turner's work constructed an intellectual foundation for evaluating the Victorian contest for ownership of science in the context of religious controversy, professional ambitions, and institutional elitism. Turner does not extend this to the late-century struggle for cultural authority between capital and labour that put the scientific naturalists in a defensive position, but he has provided a useful framework for this kind of analysis.

For nineteenth-century Britain, the intersection of science and society is particularly fertile for a comprehensive historical approach that incorporates social,

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[26] Frank Turner, Contesting Cultural Authority: Essays in Victorian Intellectual Life (Cambridge: Cambridge University Press, 1993).

cultural, intellectual, and political analysis. Ownership of Victorian science was part of a contest between the newly professionalizing scientific naturalists, amateurs, clerics, intellectuals, popularizers, and radical political groups.[27] The assorted agendas of these groups drew upon complex sets of factors that cannot be defined by restricted historical categories. In the geological and biological communities, among medical practitioners, and in the broadly defined category of naturalism, guidelines for what constituted real science and real scientists were subject to ostensibly extrinsic criteria such as class and political affiliation, personal and professional goals, and patronage.[28] These territorial disputes were directly

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[27] See for example James R. Moore, "Geologists and Interpreters of Genesis in the Nineteenth Century," God and Nature: Historical Essays on the Encounter Between Christianity and Science, eds. David C. Lindberg and Ronald L. Numbers (Berkeley: University of California Press, 1986); Anne Secord, "Corresponding interests: artisans and gentlemen in nineteenth-century natural history," British Journal for the History of Science 27 (1994): 383-408; Bernard Lightman, "Ideology, Evolution and Late-Victorian Agnostic Popularizers," History, Humanity, and Evolution: Essays for John C. Greene, ed. James R. Moore (Cambridge: Cambridge University Press, 1989) 285-309; Turner, Contesting Cultural Authority, Chapter 7.

[28] See for example, Martin Rudwick, The Great Devonian Controversy: The Shaping of Scientific Knowledge among Gentlemanly Specialists (Chicago and London: University of Chicago Press, 1985); Adrian Desmond, The Politics of Evolution: Morphology, Medicine, and Reform in Radical London (Chicago and London: University of Chicago Press, 1989); Peter Altar, The Reluctant Patron: Science and the State in Britain, 1850-1920 (New York: St. Martin's Press, 1986).

related to cultural authority and to job security and funding. Science, far from being confined to the laboratory, was deeply embedded in the larger social and cultural debates of the nineteenth century.

Like so much of nineteenth-century society and culture, science was one of the acquired possessions in the middle-class bid for institutional control. This intellectual and professional coup followed a three-pronged campaign that included manipulation of public support by presenting scientists as benevolent, demonstration of the utility of science for industry and empire, and lastly by infiltrating the offices of power such as the universities and government commissions on public schooling, the prestigious and popular journals, and the scientific societies.[29] This campaign was perhaps typified by two of the most famous popularizers of science, T.H. Huxley (1825-1895) and Herbert Spencer (1820-1903), but a survey of Victorian publications and public lectures demonstrates

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[29] A. J. Meadows, "Access to the Results of Scientific Research: Developments in Victorian Britain," The Development of Science Publishing in Europe, ed. A. J. Meadows (Amsterdam: Elsevier Science Publishing, 1980), 43-62: 61. See also William H. Brock, "The Development of Commercial Science Journals in Victorian Britain," Development of Science Publishing, ed. A. J. Meadows, 95-122; Alter, The Reluctant Patron; Turner, Contesting Cultural Authority, Chapter 8.

that a large assortment of popularizers was engaged in educating, persuading, and entertaining Victorians with the wonders of science.[30] Scientific ideas were associated with religious, social, and political debates on topics such as morality, faith, secularization, education, health, poverty, economics, and class and gender relations made their way into the press, literature, and recreational activities.[31] The campaign was successful: for much of the

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[30] Bernard Lightman, "'The Voices of Nature': Popularizing Victorian Science," Victorian Science in Context, ed. Bernard Lightman (Chicago and London: University of Chicago Press, 1997), 187-211: 191. See also Frank Turner, Between Science and Religion: The Reaction to Scientific Naturalism in Late Victorian England (New Haven: Yale University Press, 1974); Roger Cooter, The Cultural Meaning of Popular Science: Phrenology and the Organization of Consent in Nineteenth-Century Britain (Cambridge: Cambridge University Press, 1984); David Layton, Science for the People: the origins of the school science curriculum in England (New York: Science History, 1973); Edward Royle, Radicals, Secularists, and Republicans (Manchester: Manchester University Press, 1980); Warren S. Smith, The London Heretics (London: Constable, 1967); Evelleen Richards, "Redrawing the Boundaries: Darwinian Science and Victorian Women Intellectuals," Victorian Science in Context, ed. Bernard Lightman, 119-142.

[31] See for example, Jonathan Topham, "Scientific Publishing and the Reading of Science in Nineteenth-Century Britain: A Historiographical Survey and Guide to Sources," Studies in History and Philosophy of Science, vol. 31, no. 4 (2000) 559-612. See also studies by Meadows, William H. Brock, and Roy MacLeod in Development of Science Publishing, ed. A. J. Meadows; George Levine, Darwin and the Novelists: Patterns of Science in Victorian Fiction (Chicago and London: University of Chicago Press, 1988); Paul Fayter, "Strange New Worlds of Space and Time: Late Victorian Science and Science Fiction," Victorian Science in Context, ed. Bernard Lightman, 256-282; Bernard Lightman, "Constructing Victorian Heavens: Agnes Clerke and the "New Astronomy," Natural Eloquence: Women Reinscribe Science, eds. Barbara T. Gates and Ann B. Shteir (Madison: University of Wisconsin Press, 1997) 61-78; Barbara Black, On Exhibit: Victorians and Their Museums (University Press of Virginia, 2000).

"educated middle class," science was seen as a reliable source of "insight into the truth of things" on "crucial issues of the day."[32] In fact, the public culture of science was so successful that, at times, it turned defiantly towards trends in popular culture and against the strictures of the self-appointed professional spokesmen of science, veering off into unofficial and, for some, unsavory pursuits such as mesmerism, phrenology, and spiritualism.[33]

Clearly there was ample infatuation with scientific ideas in the Victorian middle class, and studies have gone a long way towards elaborating the social and cultural context of a widespread mania for facts, although detailed quantification of serious students and casual dabblers is still lacking.[34] Nevertheless, it is generally agreed that by the latter part of the century, science had passed from

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[32] Lightman, "Voices of Nature," 191.
[33] Alison Winter, "Mesmerism and Popular Culture in Early Victorian England," History of Science xxxii (1994) 317-43; Roger Cooter, The Cultural Meaning of Popular Science: Phrenology and the Organization of Consent in Nineteenth-Century Britain (Cambridge: Cambridge University Press, 1984); Janet Oppenheim, The Other World: Spiritualism and Psychical Research in England, 1850-1914 (Cambridge: Cambridge University Press, 1985).
[34] Stuart Macintyre, A Proletarian Science: Marxism in Britain, 1917-1933 (Cambridge: Cambridge University Press, 1980) 70. See also Susan Budd, Varieties of Unbelief: Atheists and Agnostics in English Society, 1850-1960 (London: Heinemann, 1977) Chapter 6.

being the preserve of a select community of elite practitioners along the professional and academic high roads into public culture through the middle road of secondary education, the popular press, leisure, and inexpensive books. Studies of this transfer of science to popular culture have been fruitful in that they have mapped out the contested boundaries of Victorian science, but if they have one major flaw, it is that they rarely step outside middle-class culture.

Popular science and the popularization of science remain attuned to the middle-class pocketbook and corresponding educational opportunities largely because it makes sense that science was too difficult to understand without proper education and scientific literature was too expensive for the impoverished working class. For the prosperous, better-educated artisans, these limitations are seen as less onerous, and there is now a growing attention to the intellectual pursuits of this sector of society with important studies done on radical artisan politics and evolutionary theory, scientific activity among local

artisan naturalists, and the artisan press.[35] Nevertheless, the idea of a popular culture of science continues to be associated with the Victorian middle class.

Defining precisely what constitutes a popular audience has proven difficult because, in the history of science, the term "popular" was originally intended to distinguish a lay audience from professional scientists. As studies have added depth to breadth, this simple division has become more confusing than helpful.[36] Now the main obstacle is that "few historians [in the history of science] have training in social and cultural history."[37] In a field "bereft of master narratives," Roger Cooter's and Stephen Pumfrey's seminal article on popular science disparages "our ignorance of both the low drama and high art of

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[35] See for example, Adrian Desmond, "Artisan Resistance and Evolution in Britain, 1819-1848," Osiris, 3 (1987) 77-110; Anne Secord, "Science in the Pub: Artisan Botanists in Early Nineteenth-Century Lancashire," History of Science xxxii, 1994, 269-315; Susan Sheets-Pyenson, "Low Scientific Culture in London and Paris, 1820-1875," diss., University of Pennsylvania, 1976; Ruth Barton, "Just Before Nature: The Purposes of Science and the Purposes of Popularization in some English Popular Science Journals of the 1860s," Annals of Science 55 (1998) 1-33; Ian Inkster and Jack Morrell, Metropolis and Province: Science in British Culture 1780-1850 (Philadelphia: Pennsylvania University Press, 1983).

[36] Stephen Pumfrey and Roger Cooter, "Separate Spheres and Public Places: Reflections on the History of Science Popularization and Science in Popular Culture," History of Science xxxii (1994), 237-67.

[37] Pumfrey and Cooter, "Separate Spheres," 245.

science's diffusion and modes of popular production and reproduction."[38]

Summarizing the complexities involved in defining a public culture of science, Pumfrey and Cooter outlined the ambiguous historical subcategories that broadly describe the social relations of scientific production and communication such as "public science," "popular science," "popularization of science," and "proletarian science." Whether "proletarian science" is ultimately the most useful category in which to situate ordinary working Victorians depends on the perspective of the historian: is a middle-class audience properly defined as elite or popular? Is working-class science popular or proletarian? As Pumfrey and Cooter indicate, there are more questions at this point than answers.[39] The task now is to determine whether or not the breadth of studies in middle-class culture and science can be extended vertically to include groups regularly considered to be on the fringe of the history of science, namely the non-artisan working class, which in quantitative

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[38] Pumfrey and Cooter, "Separate Spheres," 253.
[39] Pumfrey and Cooter, "Separate Spheres," 239.

terms is better suited to the designation "popular" than the middle class.

Following E.P. Thompson's The Making of the English Working Class (1963), labour and working-class studies tackled a broad and rich assortment of social and cultural issues; however, the intellectual life of ordinary Victorians remains largely an unknown quantity.[40] The rationale is similar to that of the history of science. In working-class history, intellectual studies have been mainly confined to the "intelligent artisans," focusing on their reading habits, self-improvement strategies, and hobbies.[41] More prosperous, artisans could afford reading materials and leisure time. The "labour elite" purchased books and periodicals, made use of libraries, mechanics institutes, and cooperative societies, and had local

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[40] E.P. Thompson, The Making of the English Working Class (London: Penguin, 1991). Exceptions to this are David Vincent, Peter Bailey, and Jonathan Rose's forthcoming book The Intellectual Life of the British Working Class (New Haven: Yale University Press, July 2001).

[41] Alastair Reid rejects the utility of analytical segregation of the artisans for the working class as whole in an excellent article on Thomas Wright, "Intelligent Artisans and aristocrats of labour: the essays of Thomas Wright," The Working Class in Modern British History, ed. Jay Winter (Cambridge: Cambridge University Press, 1983) 171-86. General accounts of artisan intellectual life, library use, book purchasing, and adult education can be found in Richard Altick, The English Common Reader: A Social History of the Mass Reading Public, 1800-1900, 2nd ed. (Columbus: Ohio State Univerity Press, 1998); Alec Ellis, Educating Our Masters (Hampshire: Gower, 1985).

discussion groups that debated the merits of political ideas, literary classics, and a wide assortment of scientific topics, although the latter receives little attention from social and cultural historians.[42] Below this upper stratum, financial struggles are held accountable for the "vicious and depraved" condition of the uneducated masses that presumably did not have the time or money for the education or leisure necessary to the pursuit of knowledge in general and science in particular.[43]

At the heart, then, of this broad exclusion from intellectual history is the issue of education, and debates involve three distinct but related subjects: schooling, literacy, and reading habits. Historians such as Richard Altick, Lawrence Stone, and Neil Smelser have advocated an education-from-above thesis, asserting that where formal education is lacking, there can be little reading of any significance despite the presence of basic literacy.[44]

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[42] A notable exception is David Vincent whose work contains significant discussion of science and the working class. See for example, Bread, Knowledge, and Freedom: A Study of Nineteenth-Century Working Class Autobiography (London: Europa Publications Ltd., 1981).

[43] Alec Ellis, Educating Our Masters (Hampshire: Gower Publishing, 1985), 1.

[44] Richard Altick, English Common Reader; Lawrence Stone, "Literacy and Education in England 1640-1900," Past and Present, 42 (1969) 69-139;

Alternatively, historians such as David Vincent, Gretchen Galbraith, and John Burnett have enlisted working-class autobiography in conjunction with other forms of evidence in working-class history and cultural studies as part of an education-from-below supplement to the obvious achievements of official schooling.[45] Their research suggests that literacy statistics and evidence of wide-ranging reading habits downplay the role of formal education in the working-class pursuit of knowledge.

The education-from-above thesis focuses on children's education, and equates schooling with formal institutions such as day schools and Sunday schools. These institutions fostered literacy and reading under the benevolent direction of middle-class reformers; this includes the

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Neil Smelser, Social Paralysis and Social Change: British Working-Class Education in the Nineteenth Century (University of California Press, 1991). See also, Alec Ellis, Educating Our Masters Chapters 1 and 2; Dorothy Entwistle, "Children's Reward Books in Nonconformist Sunday Schools, 1870-1914: Occurrence, Nature, and Purpose," diss., University of Lancaster, 1990.

[45] David Vincent, Literacy and Popular Culture, England 1750-1914 (Cambridge: Cambridge University Press, 1989); Gretchen Galbraith, Reading Lives: Reconstructing Childhood, Books, and Schools in Britain, 1870-1920 (New York: St. Martin's Press, 1997; John Burnett, Destiny Obscure: Autobiographies of Childhood, Education and Family from the 1820s to the 1920s (London: Allen Lane, 1982). David Vincent's contribution has been acknowledged by Altick whose updated bibliographic annotations describe Vincent's Literacy and Popular Culture as "the best overall study of the subject"(426).

state-funded "Board" schools and the religious elementary schools run by the National Society for Promoting the Education of the Poor in the Principles of the Established Church (Anglican, founded 1811) and the British and Foreign School Society (Nonconformist, founded 1814).[46] These official educators not only provided reading skills but the moral instruction necessary in the selection of suitable reading materials; thus cultivated, the working class was brought into Victorian culture at a class-appropriate level.

In this view, the 1870 Education Act, which inaugurated partial funding for schools in regions where little formal education existed, is seen as a turning point in the education of the poor.[47] By creating a system that extended the efforts of the religious schools to remote areas, elementary schooling took its first steps towards standardization, guaranteeing that the literacy rate would continue to rise by reaching those who were "the hardest to

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[46] For a general survey of education, see Anne Digby and Pete Searby, Children, School, and Society in Nineteenth-Century England (London, Macmillan, 1981),

[47] Altick, English Common Reader, 90.

provide for under the voluntary system of education."[48] Moreover, with the 1870 Education Act highlighted as the turning point in working-class education, this view implies that little significant progress was made before state intervention attempted to compensate for working-class absenteeism and indifference to intellectual development. The only exception is in the treatment of the artisans and their families who could more easily afford books and formal schooling throughout the century; however, no general pattern is deduced from artisan studies because they are considered anomalies within the working-class community.[49] Typical of this type of analysis is a pessimistic view of non-artisan working-class families and education, claiming that apathetic parents "willingly" exploited their children by taking them out of school to

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[48] Altick, English Common Reader, 171-2.

[49] See for example, Altick, English Common Reader, Chapters 10 and 11; Ellis, Educating Our Masters, Chapter 1; Neil Smelser, "The Contest Between Family and Schooling in Nineteenth-Century Britain," Differentiation Theory: Problems and Prospects (New York: Columbia Press, 1990), 171; Edward Royle, Modern Britain: A Social History 1750-1997 2nd ed. (London: Arnold, 1997) 356-57; Altick, English Common Reader, 208-21, 237, 244-45; Thomas Kelly, A History of Adult Education in Great Britain From the Middle Ages to the Twentieth Century (Liverpool: Liverpool University Press, 1962) 147-48.

supplement the family income rather than provide for their moral and intellectual training.[50]

Linked to the education debate is the issue of literacy. Literacy statistics provide one of the measurements used to evaluate Victorian educational reform, but conclusions are contradictory and inconsistent. Literacy rates—based on signatures in the Marriage Register—indicate that the majority of Victorians were literate before the onset of compulsory education with approximately 75-80% literacy by 1870 and nearly full literacy by 1900.[51] However, due to the difficulties in extrapolating reading skills from signatures, interpretations of the data have required supplementary evidence and this has in turn opened the way for disagreements. At its most basic level, evidence of literacy allows only for the possibility of reading but it in no way guarantees it.[52]

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[50] Smelser, "Contest," 173. Lawrence makes a similar claim for the first half of the century, "Literacy and Education," 118.
[51] Altick, English Common Reader, 171-72; Stone, "Literacy and Education," 119-122.
[52] Altick, English Common Reader, 86-95; Stone, "Literacy and Education," 98-99; Vincent, Literacy and Popular Culture, England 1750-1914 (Cambridge: Cambridge University Press, 1989), 5-12, 22-32; Digby and Searby, Children, 3-5.

Conventional assessments read these statistics partially in conjunction with the apparent indifference to education shown by the working class and partially in reaction to the general presumption that leisure time, when there was any, was rarely devoted to reading. Supplemented by contemporary middle-class accounts of the working-class apathy with respect to libraries, book ownership, serious literature, and newspaper items beyond sports and romantic fiction, reading habits are assigned simple descriptive categories of serious and depraved, with the bulk of the working class falling within the latter.[53] The better-educated artisans are considered serious readers, but for the remainder of the working class, little distinction is

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[53] Altick, English Common Reader, 85-90; Ellis, Educating, 136-37. Outside the history of the press, historians concerned with reading habits treat newspapers as only moderately significant light reading that often catered to the degraded reading tastes of the worker. As a result, content, distribution, and shifting developments that affected working-class culture are undervalued and misunderstood. For challenges to this view, see Patricia Anderson, The Printed Image and the Transformation of Popular Culture, 1790-1860 (Oxford: Clarendon, 1994). Anderson challenges the middle-class Victorian "myth" that the reading habits of the "lower orders" were "impure, corrupt, vulgar, prurient, low, ignorant," and argues that with respect to both the general labouring population and the individual reader, a wide range of literary and cultural levels can be found at any given time (179-80). Anderson also implies that this may have been true for the middle-class reading public as well (ff.242). On the centrality of the press in working-class culture, see Virginia Berridge, "Content Analysis and Historical Research on Newspapers," The Press in English Society from the Seventeenth to Nineteenth Centuries, eds. Michael Harris and Alan J. Lee (London: Associated University Presses, 1986).

made between the economic, geographic, or industrial variations that may have influenced readers, despite evidence of a complex reading demography. The conclusion has been that pre-1870 literacy was, for what it was worth, a product of the middle-class voluntary schools that struggled to enforce consistent attendance until legislated reforms set Victorian children on the proper path to knowledge. The 1870 Education Act remains the turning point, with achievements in working-class literacy and reading habits mainly attributed to this and subsequent educational reforms.[54]

Several problems undermine these conclusions. To begin with, many of these studies rely uncritically on middle-class sources and government records for their data, ignoring the possibility that religious reformers and

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[54] One of the problems with this assumption is that legislation did not always translate into action, and before reforms were uniformly adopted near the turn of the century, working-class intellectual culture was already well underway, having more to do with availability of cheap newspapers and books. In 1876, English literature was added officially to the school curriculum, but that does not mean it was taught in the schools. By 1880, elementary school was officially considered compulsory between the ages of seven and ten, but enforcement was inconsistent. Throughout the 1880s and 1890s, reforms were added with the intention of creating a universal, standardized, compulsory system of education suitable for working-class children. See Vincent for a survey of reforms and the fragmented nature of elementary education, Literacy, Chapter 3.

state-appointed commissioners may have acted from preconceived notions rather than investigate working-class culture personally and objectively.[55] A history of the working class, or any group for that matter, that makes little or no contact with the targeted group is bound to contain some important oversights by setting up an imposed set of standards.[56] In the absence of working class records, this is understandable, but with the growing availability of direct testimony and refined working-class studies, it is no longer necessary to see workers wholly through the eyes of reformers.

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[55] Altick's use of sources provides a good example. In his optimistic review of the anomalous autodidacts, he lists autobiographies by Benjamin Tillett, Alexander Somerville, Thomas Burt, Thomas Cooper, Joseph Arch and Samuel Bamford, along with references to many more. Yet, when Altick generalizes about working-class reading habits, he fails to consider the constant references in autobiographies to working-class reading. Instead, he relies on external observations such as the Select Committee on Public Libraries or the Select Committee on the State of Education, and articles appearing in The Library, The Bookseller, or Chamber's Journal which carried the observation that the working class had "as much use for learning as a cow has for clogs"(237). Similarly, Smelser's preface to his bibliography in Social Paralysis states that the "research for this book included a reading of all parliamentary debates on working-class education, 1807-80," along with reports of parliamentary commissions, minutes and reports of the Department of Education, and various contemporary advocates and observers. While this may seem exhaustive, it really reflects variations on the same point of view, and as such only provides readers with the intended structure and goal of educators, not the actual experiencing of it.

[56] Peter Bailey, Leisure and Class in Victorian England: Rational Recreation and the Contest for Control, 1830-1885 (London: Methuen, 1978) 114-15.

Historians critical of the education-from-above thesis have been especially wary of the designation of 1870 as the turning point in working-class literacy and intellectual pursuits. While it is clear that from the 1860s onward, educational reforms expanded access to schooling, increased the length of compulsory attendance, and towards the turn of the century, added topics to the curriculum beyond basic literacy and arithmetic, it is not clear that this was the sole means to knowledge. An examination of working-class sources reveals that labourers pursued education outside the formal schools. Middle-class accusations of widespread working-class apathy may have resulted from a lack of deference and gratitude towards the Trojan horse of formal schooling provided by condescending bourgeois reformers.[57]

Acknowledging that education was frequently interrupted for work-related reasons, David Vincent, Anne Digby, and Peter Searby found that, when possible, families supported education for their children and negotiated for the best deal. Vincent described parents as "consumers" of

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[57] Digby and Searby, Children, 5, 24; Vincent, Literacy, 87. On adult disenchantment with middle-class educational strategies, see Adrian Desmond, Huxley: Evolution's High Priest (London: Michael Joseph, 1997), 256-61.

education who did not necessarily follow the directives of either the state or religious educators, often making private arrangements with local schoolteachers.[58] Digby and Searby make a similar claim with respect to local options in private and voluntary schools that charged a small fee, stating that "in spite of the economic pressures…working-class parents were prepared to make the requisite financial sacrifices if the character of the available schooling was congenial to them."[59] Thomas Laqueur, in his monograph on late eighteenth- and early nineteenth-century Sunday Schools, found that working-class communities worked together to provide education for local children.[60] Furthermore, in a study of education for the poor at the Kennington National Schools, Pamela Silver and Harold Silver examined school records, discovering that typical excuses for absenteeism were weather conditions, celebrations, and leisure, not economic conflicts.[61] Is

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[58] Vincent, Literacy, 54.
[59] Digby and Searby, Children, 5.
[60] Thomas Laqueur, Religion and Respectability: Sunday Schools and Working-Class Culture, 1780-1850 (New Haven: Yale University Press, 1976), 3-19, 61; Vincent, Bread, 99-102.
[61] Pamela Silver and Harold Silver, The Education of the Poor: The History of a National School, 1824-1974 (London: Routledge & Kegan Paul, 1974) 103-106.

this indifference to education or does it indicate that formal schooling was only one approach in the pursuit of knowledge? According to David Vincent, reading skills, trade skills, and natural knowledge were often part of the general knowledge passed on to children by family and community; formal schooling was only one source among many.[62] With due respect for the economic necessities of working-class families and the fact of child labour, it is evident that the stereotypical portrait of children driven from school to the fields and factories by their coarse, exploitive parents may be a bit overstated, reflecting Victorian middle-class snobbery more so than it does Victorian working-class realities.

Similarly, recent revisions on the history of literacy focus on the determination of working-class families to read and write. If, in fact, by 1870 literacy had reached approximately 75-80%, and by the time "the full consequences of compulsion" were felt in the 1890s, "less than 5 per cent of the task remained," then it is worth

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[62] Vincent, Literacy, 54-87. This section provides a neat overview of family attitudes to education and community resources.

revisiting working-class habits in learning and reading.[63] Setting aside middle-class descriptions of working-class culture, attention is being directed towards a growing collection of working-class autobiographies and diaries.[64] Added to studies on working-class leisure, political culture, the penny press, and traditions of self-improvement, autobiographical information makes it possible to map out a distinctly working-class cultural terrain of cheap and secondhand reading materials, book sharing, family and community reading, local discussion groups and

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[63] Vincent Literacy, 53-54, 68; Burnett, Destiny, 135-37.

[64] In 1984, John Burnett, David Vincent, and David Mayall published their first volume of The Autobiography of the Working-Class: An Annotated, Critical Bibliography, v. 1, 1790-1900 (New York: New York University Press, 1984). It contained listings for 804 autobiographies for the period 1790-1900 and many other autobiographical fragments, diaries, and memoirs. Representing an enormous potential to open up working-class history, it has influenced such studies as Anne Secord's research on artisan naturalists and the pub as a site for scientific activity, Gretchen Galbraith's analysis of childhood reading, Regenia Gagnier's discussion of stylistic shifts in Victorian working-class self-representation, and Nan Hackett's evaluation of autobiography as a literary document. No longer does Samuel Smiles represent working-class autobiography. See Anne Secord, "Science in the Pub: Artisan Botanists in Early Nineteenth-Century Lancashire," History of Science xxxii, 1994, 269-315; Galbraith, Reading Lives; Regenia Gagnier, "Social Atoms: Working-Class Autobiography, Subjectivity, and Gender," Victorian Studies, 30, no. 3, Spring 1987, 335-63; Nan Hackett, XIX Century British Working-Class Autobiographies, An Annotated Bibliography (New York: AMS Press, 1985). The importance of working-class autobiography for science has been acknowledged by David Layton in Science for the People (30), and the pursuit of scientific knowledge is a prominent theme in much of David Vincent's research. In fact, he would make a very good historian of science.

clubs, and informal schooling hosted by cooperative societies, local educators, and political groups.[65]

What has emerged is a complex reading and learning demography that rejects the restriction of serious reading to the labour aristocracy, questions uniformity among artisans, and establishes a general or popular interest in what is normally considered the intellectual property of the elite, namely the arts and sciences.[66] David Vincent continues to differentiate between a minority of serious readers and a larger group of general readers, but he does not see this strictly as a class or economic issue, and he has not detected any significant working-class divergence

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[65] See for example, David Vincent, Bread, passim, which examines the reading habits of variously employed workman based on 144 autobiographies; Peter Bailey, Leisure, in which Bailey argues for diverse contours in working-class intellectual, recreational, and political culture that moved increasingly away from middle-class patronage toward working-class autonomy (Chapter 5). Also, see Hugh Cunningham's "Class and Leisure in Mid-Victorian England," Popular Culture: Past and Present, eds. Bernard Waites, Tony Bennett, and Graham Martin (Kent: Croom Helm, 1982), which argues that middle-class attempts to achieve class conciliation through leisure ultimately failed, although economic hegemony was preserved. For a multi-textured account of the working-class press that rejects the simple division of working-class reading tastes as either lofty or degraded, see Patricia Anderson, The Printed Image and the Transformation of Popular Culture, 1790-1860 (Oxford: Clarendon, 1994).

[66] See in particular, Alastair Reid, "Intelligent Artisans and aristocrats of labour: the essays of Thomas Wright," The Working Class in Modern British History, ed. Jay Winter, 171-86.

from this general pattern in Victorian reading habits.[67] In the final analysis, reading was a matter of personal taste and determination. From this perspective, the 1870 Education Act is seen as having provided an energizing boost to an already existing infrastructure of local and informal education. Counterpoised to the high road of university education and the middle road of extended formal schooling, the informal 'low road' of community organizations, part-time education, inexpensive reading materials, and creative responses to economic hardship provides the route to a more precise elaboration of the contours of working-class intellectual culture. It is along this low road that evidence of contact between workers and scientific ideas is found.

One of the exclusionary objections to a history of working-class science is the question of whether science can have been accessible in the absence of formal training. From the perspective of the twenty-first century,

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[67] Dr. Vincent describes the general pattern in middle-class Victorian reading as a minority of serious readers and a majority of casual readers. This was communicated to me in personal correspondence with Dr. Vincent, July 1999. I wish to thank Dr. Vincent for his help in refining my understanding of working-class strategies in the pursuit of knowledge. See also, Bread, 111-118.

scientific literacy would seem a nearly insurmountable obstacle. Science was not part of the school curriculum in the Victorian period unless individual teachers took the initiative, and so understanding complex scientific theories would seem unlikely.[68] An exception has been made for the mechanics, the ambitious autodidacts, and artisan naturalists who are seen as having benefited from mechanics magazines and institutes, and were better able to afford books.[69] Similarly, studies on working-class science periodicals have established that a thriving market existed for mechanics' magazines and journals, but the audience for these publications is vaguely categorized as the artisan sector, as distinct from presumably the unskilled workers; where the semi-skilled worker fits in is unclear.[70] Important and useful as they are, these studies leave science at the level of uncommon knowledge, while the majority of the working class is lost to modern assumptions

[68] David Layton, Science for the People; Thomas Laqueur, Religion and Respectability, 99-113.

[69] Steven Shapin and Barry Barnes, "Science, Nature and Control: Interpreting Mechanics' Institutes," Social Studies of Science, 7 (1977), 31-74; John Laurent, "Science Education, Evolution Theory, and the British Labour Movement, 1860-1910, diss., Griffith University, 1984.

[70] Susan Sheets-Pyenson, "Popular Science Periodicals in Paris and London: the Emergence of a Low Scientific Culture, 1820-1875," Annals of Science, 42 (1985), 549-572; Ruth Barton, "Just Before Nature."

regarding formal education and scientific literacy. There are several grounds for rejecting this assumption based on a reexamination of nineteenth-century science texts, practices, and popularization.

In the twenty-first century, we think of professional science as infinitely complicated and beyond the grasp of average readers, and popular science as less rigorous but comprehensible to the interested reader. How far was this the case in late Victorian England? The classic scientific texts of Charles Darwin (1809-1882), Charles Lyell (1797-1875), T.H. Huxley, and Herbert Spencer, or the popular scientific publications and lectures of Richard Proctor (1837-1888) and Robert Ball (1840-1913) did not require high levels of scientific literacy; conversely, thermodynamics, a difficult topic, was not the most popular hobby for working-class or middle-class enthusiasts.[11] At the most basic level, science was presented to working-class readers in rudimentary form, in simple language,

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[11] Bernard Lightman, "Marketing Knowledge for the General Reader: Victorian Popularizers of Science," Endeavour 24 (3), 2000, 100-106; Bernard Lightman, "The Story of Nature: Victorian Popularizers and Scientific Narrative," Victorian Review 25, No.2 (1999) 1-29. For women popularizers, see Suzanne Lemay-Sheffield, "Revealing New Worlds: Three Victorian Women Naturalists," Women & Science Series (London: Harwood Academic Publishers, 2001).

often dwelling on the observational sciences of geology, natural history, and astronomy. Autobiographical testimony repeatedly lists texts and lectures on astronomy, biology, and geology as among the typical choices of working-class readers. Written before science became the highly specialized property of a scientific elite, these books were intended for a popular audience, although authors may have correctly assumed that the general reader would have been challenged, though not overwhelmed, by the demands of the material. Darwin's The Origin of Species (1859) contains several sections written in narrative style.[72] Moreover, many of Darwin's arguments would have been familiar to local working-class naturalists and breeders, thereby forging an agreeable link between a traditional understanding of the natural world and the new biology.[73]

Scientific practice in the nineteenth century is similarly misrepresented by modern assumptions. Victorian science was not confined to the laboratory or scholarly

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[72] See Gillian Beer, Darwin's Plots: Evolutionary Narrative in Darwin, George Eliot, and Nineteenth-Century Fiction (London: Routledge and Kegan Paul, 1983).

[73] See especially Origin's introduction, final section, and chapters 1-4, all of which are written in a familiar prose style and would have been familiar to local naturalists and breeders.

halls but was carried on in the surrounding fields and homes of amateur naturalists.[74] Local cooperative societies held classes in science, and gave lectures and demonstrations on botany, geology, and astronomy.[75] Additionally, some working-class men occasionally pursued science with the intent of establishing a career in science education or research.[76] Science practice at this level involved artisans, miners, labourers, and even schoolchildren.[77] Scientific literacy would not have been an obstacle for informal scientific practice in the fields

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[74] The Bolton Co-operative Record (c. 1889-n.d.) reported regularly on local ramblings and the activities of the Field Naturalists Club, and The Young Socialist (c. 1900-20) encouraged a similar interest in children. John Laurent's thesis describes many similar local clubs, see "Science Education," Chapters 4 and 8; and numerous autobiographical examples are cited by David Vincent in Literacy, 156-64 and Bread, Chapters 6-8.

[75] The Rochdale Cooperative Society provided a variety of classes, lectures, books, and scientific instruments. See A. Greenwood, "The Educational Department of the Rochdale Equitable Pioneers' Society Limited," a paper given at the Co-operative Hall, Toad Lane, Rochdale, 14 July 1877 (Cooperative Union Archive, Manchester).

[76] James Croll, John Buckley, Joseph Gutteridge, Alfred Cox, and Abel Jones all achieved some measure of success in science research, medicine, or science education during the period under analysis. Details of their careers in science are found in Chapter 3 of this study.

[77] For personal testimony, see, Frank Hodges, My Adventures as a Labour Leader (London, George Newnes, 1924) Chapter 2. Hodges provides one example of a young miner who developed an early interest in Darwin's theories.

of botany or geology because knowledge of the natural world belonged to the community.[78]

This view of science as it was understood and practiced in the nineteenth century calls into question the historical partitioning of scientific literacy from other types of literacy in that science was not restricted to the abstract or esoteric texts of professionals. Victorian science was embedded in traditions of natural history that pre-dated modern professional classifications, and a great deal of latitude existed in definitions of what constituted scientific activity. Science was not always difficult, nor did it always demand formal training, though this was less true in physics than in botany. The breadth and depth of Victorian science allowed for a basic engagement of science at the popular level or the more ambitious study of geology, physiology, or chemistry; for the truly dedicated, there was always mathematics and physics. This diversity is evident in working-class publications, lectures, and evening classes, and an examination of these sources

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[78] David Vincent cites a generational link in Joseph Gutteridge's autobiography. As a boy, Gutteridge was fascinated by natural knowledge, prompting his father to give him an "ancient" copy of Culpeper. See Literacy, 161.

establishes that Victorian science had a broad popular base for which scientific literacy was not an issue.

A.J. Meadows' study of the commercial science press found that the most popular sciences were biology, geology, and astronomy, and that these were considered suitable topics for the general reader.[79] This is confirmed by the working-class press in which articles on the physical sciences appear frequently and with simple explanations. Biology, geology, and astronomy articles were more frequent, due to the relative ease with which these topics could be engaged. Periodicals in the twopence to fourpence range establish that scientific literacy was not a barrier for the more prosperous workingmen, and that a lively discourse on science and technology can be found in popular science journals. These publications contained material of interest for both the serious and general reader, but availability would have been restricted by the price: journals costing more than twopence would have been less accessible to a large portion of working-class readers, though this does not preclude borrowing or sharing.

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[79] Meadows, "Access to Results," 59.

Moreover, this price restriction need not narrow the popular base for science if similar analysis is applied to the penny press.

In 1888, The Star reported that the new library in the east-end slum Bethnal Green was doing a lively business, with readers showing literary tastes "as varied as those of a higher social grade."[82] The Star noted that general readers were "mainly satisfied" with journals and newspapers "as is the case with all classes everywhere," and that some readers delved into serious topics ranging from Carlyle to mathematics; in both groups, science had "many votaries." Moreover, The Star noted that general readers often took their book recommendations from their journals, and an investigation of texts recommended by working-class periodicals indicates that science was a consistent choice.

This article directs attention to the important distinction between serious and general readers, but it simultaneously rejects the assignment of scientific

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[82] The Star, 31 January 1888, 4. The editor of The Star from 1888 to 1891 was T.P. O'Connor, a supporter of radical, even socialist, ideas. The Star is taken up in detail in Chapter 4 of this study.

interests to one group. Moreover, it supports the view that science took on different forms according to reading levels and personal inclination, with some readers preferring periodicals and newspapers to books. For those who preferred their science in small doses, science was available and comprehensible. Added to other sources of scientific information such as pamphlets and the secularist and political lecture circuit, and in combination with the informal education available in working-class communities, the low road to science emerges as more complex than historians have allowed. Upon closer inspection, it becomes evident that, for the late nineteenth century, scientific literacy at the popular level was not distinct from general literacy to any significant degree and that both working-class literacy and the popularization of science were partially achieved within the working-class community.

The distinction between artisans and labourers and between serious and general readers brings up the important issue of identity. What kind of worker was interested in science? Who traveled the low road? This is difficult to

say because intellectual artifacts and their makers are easier to research than are consumers who rarely leave records of their reactions. Newspaper and periodical historians have made use of correspondence, and autobiographical testimony offers commentary on books, magazines, lecturers, and political organizers, but for the most part, the consumers of culture are only partially known. Product-based artisan studies have been able to identify publications, political movements, and sites of learning such as the Mechanics Institutes that appealed to this sector, but claims to knowledge of the audience suffer from ambiguous social and economic identification. Drawing on a comment by Stephen Pumfrey and Roger Cooter, social history and economic history have yet to make an impact on intellectual and cultural studies of science.[81] This can be remedied by re-examining the sources and methods used in social and cultural history in conjunction with the textured perspective gained by extensive use of working-class autobiography.

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[81] Pumfrey and Cooter, "Separate Spheres," 245.

In the history of science, uncritical perceptions of social and economic divisions have led to oversimplified cultural categories. The artisans, for example, as a social unit are assumed to have had sufficient income to generate disposable income directed towards study and leisure whereas labourers did not have these advantages. Based on these broad social descriptions, a self-referential pattern determines research guidelines that connect artisans to intellectual material—and intellectual material to artisans--while excluding the non-artisan sectors from intellectual culture. This pattern of analysis fails to acknowledge the complex demography of the working sector whose livelihood was influenced by trade fluctuations, family circumstances, health, geographical discrepancies, and personal taste. Assigning a particular product exclusively to artisans and another to labourers ignores these factors.[82] Skilled labour and semi-skilled labour were fluid categories that merged and shifted

[82] Royle, Modern Britain, 88, 100-105. Royle cites Charles Booth's categories from Life and Labour of the People of London (1889-1903) in which Booth noted the difficulties of defining "a working man," and the widespread cultural mingling of unskilled and skilled labour.

according to time, region, and industry.[83] The deciding factor, in matters of purchased goods, was disposable income and this cannot be discerned from a simple social category, with the exception of the destitute poor.

A second problem occurs with the assumption that intellectual materials were purchased rather than shared or borrowed. With the free lecture circuit and the placement of libraries and reading rooms at the disposal of all sectors of the working class, items of interest could be enjoyed without cost. Taking into account working-class reliance on free lectures and reading material, the restrictive correlation between artisan-level wages and intellectual interests breaks down. Instead, I begin by recognizing the pay-what-you can attitude along the low road and the fluid social and economic divisions of the members who traveled its cultural highways and byways. Still drawing on price as a limiting factor, the main question concerns availability: what was there for workers at an affordable level that brought scientific information into their lives? To that end, the cheap press, penny

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[83] Alastair Reid, "Intelligent Artisans," 171-73.

lectures, used books, shared materials, community resources, and free education form the core of the consumer goods analyzed in relation to the low road to science.

Veering away from publications priced higher than twopence, Chapters 4 and 5 draw upon material associated with penny press such as Reynolds's Newspaper, The Star, and The Clarion, all mass circulation publications designed for the general reader. This sets up a large foundation of accessible material for artisans, skilled workers, semi-skilled, and even unskilled labour in some situations, and by no means excludes purchases above the penny level for those with the spare money and the interest.[84] In contrast, periodicals such as Justice would have appealed to a narrower audience, though this would not necessarily be defined by social and economic restrictions as much as intellectual and political preferences. With supplementary material from autobiographical testimony, the scientific interests of a diverse group of Victorian workers emerge as defined less by social and economic boundaries and more by the determination and personal inclinations of men and

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[84] I am not dealing with white-collar workers or servants because their influences were not the same as manual labourers.

women with a hunger for knowledge. Finally, both specialized and general readers are accounted for by establishing a broad product base that allowed for both common and uncommon pursuits in scientific trivia or detailed knowledge.

One of the main sources for working-class intellectual history is autobiography. With the discovery of several hundred working class autobiographies and additional memoirs and diaries, reliance on middle-class observers has diminished as the missing "voice of the workers" becomes increasingly audible. Nevertheless, despite the din of voices now added to the idealized Samuel Smiles model and the from-poverty-to-parliament model, working-class autobiography as an historical source remains shackled by charges of subjectivity and inaccuracy linked to hindsight life-writing and ideological bias.[85]

In 1984, John Burnett, David Vincent, and David Mayall produced a bibliography of nineteenth-century working-class

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[85] For a discussion of this, see the papers by Michael Shortland and David Vincent in Hugh Miller and the Controversies of Victorian Science, ed. Michael Shortland (Oxford: Clarendon, 1996). This problem was also discussed by Vincent in an unpublished paper delivered at Warwick University in 1995 on "Provisional Voices, Form, and Variation in Nineteenth-Century Working-Class Life History."

autobiography that included just over 800 entries with dissimilar geographic and employment backgrounds.[86] This influential collection addresses many of the uncertainties connected to the authenticity and reliability of autobiographical text, and while "there is no single formula which will resolve these difficulties," the authors emphasized that with proper caution "no other source material will bring historians as close to the meaning of the past for those who made and were made by it."[87] With due attention to the "characteristics of the genre" and simple checking of facts, the subjectivity of autobiography need not be seen as misrepresentation. The authors claimed that in studies of individual texts, they found "little deliberate misrepresentation" beyond easily verifiable facts such as dates or the size of a crowd.[88] Exaggeration and concealment are potential problems but this is true of all historical records, and, where relevant, discrepancies

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[86] Burnett, et al., The Autobiography of the Working Class, xxxiii. Subsequent to the first volume, a second volume is available covering the years 1900-1945. There was an overrepresentation of journalists and writers, and geographically, there was notable concentration in London and in large industrial centers (xviii). This volume also included additional abstracts of diaries and memoirs, which are treated as distinct forms of personal testimony because neither form offered attempts at a comprehensive life-history (xxxiii).

[87] Burnett, et al., Autobiography, xxi.

[88] Burnett, et al., Autobiography, xxi.

can be corrected with additional research and comparison with other autobiographies.[89] With the limitations of the genre noted, David Vincent and John Burnett have used working-class autobiography extensively in their social and cultural studies, and they have helped create a mural of self-portraits that reflect the life-experiences of ordinary Victorians.

A great deal of literature has been occupied with analysis of autobiography in relation to history, literary criticism, gender studies, and ethnic studies, and in each category the tension between self and society is a central issue. In all fields, subjectivity is viewed as both an asset and a liability. Mary Jo Maynes has challenged the historical empiricism of church records and census data, stating that "Luisa Passerini puts it best…[that] 'All autobiographical memory is true. It is up to the interpreter to discover in which sense, where, for which purpose.'" Subjectivity is both the limiting factor and the most valuable aspect of personal testimony, and she

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[89] John Burnett, Destiny Obscure: Autobiographies of Childhood, Education, and Family from the 1820s to the 1920s (London: Allen Lane, 1982) 12, and Burnett, Useful Toil: Autobiographies of Working People from the 1820s to the 1920s (London: Allen Lane, 1974) 13. See also David Vincent, Bread, 4-5.

described the "line between lived experience and memory of experience" as "for many purposes, not relevant."[90]

Positive emphasis on the value of experience over empirical data is further supported by Laura Marcus. In a recent analysis of autobiographical and biographical discourse, Marcus affirmed that the "self is more complex than fact."[91] Marcus praised the subjective self in autobiography for its provision of an "insider quality" that forms a balanced view if placed in relation to the public context.[92] Similarly, Gretchen Galbraith and Nan Hackett, both influenced by David Vincent and John Burnett, have concluded that autobiographies record what was relevant in the experience of the authors, and it is these choices that most reflect the times in which they lived.[93] In other words, the time in which a person lives shape the person as much as the genre in which the life is recorded:

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[90] Mary Jo Maynes, "Autobiography and Class Formation in Nineteenth-Century Europe: Methodological Considerations," Social Science History, v.16, n.3, Fall 1992 (517-37) 522-23.
[91] Laura Marcus, Auto/Biographical Discourses: Criticism, Theory, Practice (Manchester: Manchester University Press, 1994) 3.
[92] Marcus, Auto/Biographical Discourses, 5-9, 283.
[93] Gretchen Galbraith, Reading Lives, Chapter 1; Nan Hackett, XIX Century British Working-Class Autobiographies, 1-7, 23.

the person, the genre, and the text are reflections of their cultural context.

This leaves the historian with the task of resisting the urge to be condescending while also maintaining a critical distance. Michael Shortland's introduction to Hugh Miller's memoir falls short on the first count due to his emphasis on the second.[94] While acknowledging the "direct and honest" writing of Miller, Shortland continually undermined the authenticity of Miller's self-portrait, describing him as "self-fashioning," "not always truthful," and an "unstable" individual looking for and re-inventing himself continually.[95] However, in the supplementary biographical information on Miller, Shortland revealed that Miller was suffering from psychological instability. This suggests that Miller was painfully honest in his self-portrait, but not at the simple level. Moreover, there were few historical corrections in Shortland's notes, suggesting that the public record

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[94] Hugh Miller, From Stonemason to Geologist, ed. Michael Shortland (Edinburgh: Edinburgh University Press, 1995).
[95] Shortland, introduction to Hugh Miller's Stonemason, 2-3, 28-29, 76. For Shortland's description of Vincent's Bread, as "brilliant," see 80n79.

offered by Miller passed inspection.[96] In the final analysis, the interplay between the subjective, experiential elements of personal testimony and the demand for a rigorous and broadly representative source falls into the same debate pattern as that of local and national studies: one is too close to be representative and the other is too far away to be accurate. Striking a balance between the individual and larger trends in working-class culture requires acknowledgement of the fact that individuals were both producers and products of their culture, and taken in conjunction with public forms of evidence directly relating to working-class communities, the subjectivity of autobiography becomes an asset.

Drawing on the methodology of Burnett, Vincent, and Mayall, along with evidence gathered from periodicals, a few additional restrictions apply with respect to which sector of the working class is represented in this study. Reference to workers indicates individuals engaged in manual labour for an extended period of their life and who, if otherwise occupied in adulthood, nevertheless continued

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[96] Shortland, introduction to Hugh Miller's Stonemason, 227-30.

to claim working class status. In both the autobiographical evidence and analysis of working-class organizations, there is some overrepresentation of the politicized working class, though I have tried to include a variety of partisan views and apolitical individuals. Women are underrepresented due to their lower representation in working class autobiography in general, their exclusion from many of the working-class institutes, and their subordinate position in the periodicals and newspapers.[97] There is, however, evidence of women engaged in science through Women's Guilds and the university extension courses, and so analysis of working-class women and science would be possible even if outside the range of this study.[98]

In terms of temporal and geographical distribution of the selected autobiographers, the main group was born between 1853 and 1887, leaving an equal margin of time with respect to the 1870 Education Act. This helps to assess

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[97] John Burnett, et al., The Autobiography of the Working-Class, xviii. The compilers of the bibliography noted with regret that the most underrepresented group in the collection is women, with only 70 entries.

[98] For more on the Women's Guilds and science, and women and night school, see Chapter 2 of this study.

the relevance of this legislation for intellectual and popular interest in science reading. Geographically, birthplaces included both rural and urban settings in England, Scotland, and Wales, though many of the autobiographers moved to London in their adult years.[99] Trade variations among autobiographers ranged from skilled to unskilled with some overrepresentation in journalism and pro-labour propagandists. Finally, this study is not concerned with that portion of the working class not interested in science, though it was likely substantial.

For late-century Victorians, science was everywhere part of the culture, but encounters with science varied according to available resources and personal inclination. This dissertation explores how and why a significant fraction of the working class participated in modern science. As such, it distinguishes itself from other

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[99] It would be useful in subsequent studies to undertake a detailed analysis of the kinds of materials available in remote rural villages compared with more densely populated areas, and to further compare data from before and after the publishing boom of the late century. Studies on improvement societies and reading clubs in small towns and villages, along with autobiographical descriptions such as those of John Buckley, Flora Thompson, Edwin Grey, and Abel Jones indicate that the acquisition of reading materials encountered greater obstacles in small communities but that these were not insurmountable. Family assistance, combined effort, and a little luck was sometimes enough to provide for the intellectual development of the determined labourer. See Chapters 2 and 3 of this study.

working-class studies in the history of science in that it is not confined to artisan culture but also includes less prosperous and less formally educated workers who obtained information where and when they were able. My research establishes that science was widely available as a recreational pursuit and topic of general interest. Furthermore, in a substantial sector of the community, scientific practice and theory were vigorously pursued by serious working-class intellectuals and naturalists from disparate backgrounds. I contend that science was, for many working-class Victorians, a fundamental component of self-improvement and class emancipation through increased participation in the intellectual, and sometimes political, life of the nation.

The following chapter examines the many opportunities created in working-class communities for the acquisition and study of scientific knowledge at varying degrees of difficulty and affordability. Beginning with the working-class family, and extending analysis to friends, neighbours, teachers, and institutions, I investigate the role of formal schooling, the development of basic skills,

and informal means for advanced studies. In the context of Victorian working-class self-help, workers formed "voluntary associations when faced by problems or difficulties which were beyond the abilities and resources of one person."[100] Typically, this meant taking the low road to science through local working-class science clubs, mechanics' institutes, occasional lectures, reading rooms, libraries, adult education, and the sharing of skills and information within families and neighbourhoods.

The term "low road" requires qualification. The main components of the low road were informal opportunities and resources available within the working-class community at affordable prices. For the purpose of this study, low refers not to lowly pursuits but differentiates the working-class acquisition of information from the formal, costly means available to the more advantaged sectors of Victorian society. The low road provided cheap access to scientific information, which was no less valuable for its low cost. In addition to inexpensive evening study and

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[100] Brian Graham, Nineteenth Century Self-Help in Education—Mutual Improvement Societies: The Carlisle Reading Rooms (Nottingham, Department of Adult Education, University of Nottingham, 1983) 1.

local discussion groups, scientific information was widely popularized through the working-class press, secularist lecturers, and political agitators. Basic science was entered into common knowledge, and the intellectual controversies involving scientists were known, if not completely understood. For serious students of science, the low road provided difficult books and advanced classes, but this path was long and arduous, requiring assistance from the community in one form or another. Only a minority of the working-class took this arduous intellectual journey, but they in turn popularized scientific ideas within the working-class community. Acknowledging that science could be pursued as a general or serious topic, and that locations of learning existed outside the halls of formal schooling, are prerequisites for understanding the low road on its own terms.

Having documented the existing sites of learning in working-class communities, the third chapter outlines the ways in which twenty-four serious working-class

intellectuals pursued and utilized scientific ideas.[101] It focuses on their quest for intellectual enlightenment, political and social emancipation, and occasionally, scientific careers. Making use of community resources, these uncommon labourers began their quests as young readers and relied on used books, self-teaching, likeminded neighbours, and family when money and schooling were in short supply. Grappling with science, religion, philosophy, politics, and personal goals, they read Darwin, Huxley, Tolstoy, Zola, Tyndall, Lyell, Dickens, Blatchford, Kropotkin, and sometimes, Karl Marx. For some, socialism was the outcome of their intellectual quest, but it was a political view they believed to be grounded in scientific reasoning. Rejecting the sociology of T.H. Huxley, they preferred the social science of Prince Kropotkin (1842-

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[101] These twenty-four representatives of late Victorian working-class intellectual culture were selected from the autobiography abstracts available in Burnett, et al., Autobiography. In total, I examined forty autobiographies. Ten of these mentioned science very briefly, preferring to dwell on political issues or family and community histories. The remaining thirty made significant comments about or directly engaged Victorian science. Of the thirty, several became redundant once general patterns were deduced. Three are discussed very briefly because they were born early in the century, although they remain useful in that they lived through the late Victorian period and demonstrate enduring patterns. The main group of twenty-one individuals represents a cross-section of serious Victorian proletarian intellectuals as they engaged scientific ideas. The patterns that emerged from this group are examined in Chapter 3 of this study.

1921), socialist and natural scientist, Edward Aveling (1849-1898), prominent socialist and science lecturer, and Alfred Russel Wallace (1823-1913), socialist and co-discoverer with Charles Darwin of the theory of evolution by natural selection, presented jointly to the Linnean Society in London (1858). For others, scientific study and hobbies earned them certificates in chemistry, physiology, or biology, making them the intellectual equals of those with education and economic advantage. Curious about nature, society, and God, their intellectual hunger showed little respect for class and poverty. Fortunately, the low road had something for everyone.

Moving beyond the individual and community, the fourth chapter situates the pursuit of scientific knowledge in the larger context of the working-class press, bringing science into working-class culture as part of common knowledge, with appeal for both serious and general readers. This chapter explains how science was linked to several facets of working-class culture including recreation, self-improvement, and social reform. Whatever the ultimate absorption rate of science through tit-bits and science

gossip, the fact is that the popular working-class press carried items and announcements on scientific ideas and events on a regular basis. Mass circulation newspapers such as Reynolds's Newspaper, The Star, and The Clarion brought science into popular consciousness. If we suspend judgment on the depth of working-class engagement with science and restrict enquiry to popular contact, then common knowledge seems a less outrageous claim. After all, historians of science and the Victorian middle class have yet to demonstrate the comprehension levels and intellectual depth of ordinary middle-class readers, yet who doubts that they participated in the popularization of Victorian science?

The final chapter links the general and serious pursuit of scientific knowledge to the broader working-class movement through the activities of left-wing propagandists and organizations. Science was at the centre of the mid-century contest for cultural authority between the middle class and the Anglican-Tory elite, but by late-century, the struggle was between labour and capital. The Victorian Left perceived the importance of scientific

authority in social reform, and served as popularizers of science in the articulation of scientific socialism and evolutionary socialism in its press, pamphlets, and lectures. Science was recruited and reconstituted to serve ideological goals just as liberal capitalism was naturalized by middle-class scientific naturalists such as T.H. Huxley and Herbert Spencer.

This contest over late-century cultural authority involved several battles over intellectual territory as socialists and pro-labour advocates rejected the biased sociology of middle-class scientists, and middle-class scientists rejected left-wing interpretations of scientific ideas. Huxley, a dedicated advocate of working-class education and technical training in the 1860s and 1870s, was by the 1880s and 1890s losing some of his inter-class panache.[102] A regular target of left-wing scorn and ridicule, Huxley was opposed in the socialist press by Prince Kropotkin, and Edward Aveling. Moreover, Huxley was attacked on a personal level: letters arrived questioning his right to speak on behalf of the working class and

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[102] Desmond, Huxley, v.2, 256-61.

asking for clarification of his views on socialism. In 1887, a letter to The English Mechanic stated that while Huxley's knowledge of frog anatomy was incomparable, his authority on "trade matters or commercial questions…is not worth more than that of the Llama of Thibet or the Archbishop of York."[103] Additional letters were sent directly to Huxley charging him with pointlessly promoting class over mass as part of his increasingly inflexible "social philosophy," and asking him if socialist agitators had been correct in quoting him as saying that he would rather live as a "savage in the centre of Africa" than as a "Labourer in the East End of London."[104] This last query was sent on behalf of "a body of Working Men" from the community. Huxley's promotion of working-class education as part of class conciliation was increasingly identified with anti-labour social reform, and territorial disputes over the boundary between scientific expertise and socioeconomic expertise were engaged as much by politically active workers as by Huxley. The contest between

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[103] The English Mechanic, v.45 (1887), 575-77.
[104] Imperial College of Science, Technology and Medicine, Huxley Papers: Gaskell, G.A. to Huxley 17:20 1891 January 23; Jeffery, Edward to Huxley 19:42 1890 September 29.

scientific capitalism and scientific socialism was prominently featured in left-wing lectures, pamphlets, and journals, and it spread beyond London to the provinces through the left-wing propaganda network.

In the final analysis, two questions need to be answered. How did impoverished workers with little education obtain and comprehend scientific ideas, and what did workers want with science? This is the central task of this study, and its completion opens up the borders of the history of science as much as it adds new dimension to working-class history. The short answer is that workers wanted fun, diversion, one-upmanship, self-improvement, class elevation, and class emancipation, depending upon the individual and the cultural context. Science was, in a scientific age, a natural choice. By accounting for the variations in the types and levels of science pursued, and by looking to the creative opportunities and resources devised within working-class communities, the highways and byways of working-class culture emerge, offering a much-needed revision of the intellectual flatland portrayed in current histories of the Victorian working class.

Chapter 2: Taking the Low Road to Science

Alfred Cox (1866-1954), son of an ironworker, wrote in his autobiography that we "are largely creatures of our environment."[1] Cox worked his way from pupil-teacher to a dispensing assistant earning only room and board. Finally, in the 1890s, after years of hard work, Cox became a medical practitioner and organizer of the British Medical Association.[2] What was available in Cox's environment that helped him to formulate and achieve these goals? Were there affordable opportunities for obtaining skills that facilitated interest in scientific information during the final decades of the nineteenth century? This chapter examines locations and resources available within working-class communities that provided the types of skills and material necessary to the pursuit of scientific knowledge. Defining what constitutes scientific pursuits necessarily includes a wide range of topics because ruling out casual hobbies in favour of advanced undertakings would inadequately reflect the diverse interests of nineteenth-

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[1] Alfred Cox, Among the Doctors (London: Christopher Johnson, 1950) 18.
[2] Cox, Among the Doctors, 16, 22, 71.

century workers. Allowing for popular science in conjunction with the more serious study of scientific theories provides the most accurate indication of the full range of science available in working-class communities.

The history of working-class participation in the Victorian age of information has been pursued not within the context of intellectual history but as a facet of the history of education. These studies concentrate on formal education and the problematic development of the British school system from an essentially philanthropic religious foundation to the state-controlled system of the twentieth century.[3] Documenting working-class reluctance to sacrifice income for knowledge in a competitive capitalist economy, the history of Victorian schooling is presented as a battle between parental intransigence and well-meaning educators backed by progressive state legislation. The decisive moments in the battle were the educational reforms of the 1870s and 1880s, which made education more necessary and less avoidable. Thereafter, improvements in working-class

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[3] Pamela Silvers and Harold Silvers, The Education of the Poor: The History of a National School, 1824-1974 (London: Routledge & Kegan Paul, 1974) 113.

literacy and intellectual development can be documented with increasing optimism, and by the 1880s, it is generally agreed that parents were beginning to comply and the school curriculum was expanding to include geography, history, and natural science.[4] Even so, because the formal curriculum did not include much beyond basic literacy and numeracy at the lower standards and many working-class children were withdrawn before they reached the upper standards, lack of advanced education precludes discussion of working-class interest in subjects as specialized and complex as science. Popular science, therefore, is rarely discussed with reference to the labouring sector. Alternative schooling such as that provided by village teachers and Sunday schools is appended to this argument, although local curricula variations have been acknowledged on occasion.[5]

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[4] John Burnett, Destiny Obscure: Autobiographies of Childhood, Education and Family from the 1820s to the 1920s (London: Allen Lane, 1982) 151.

[5] P. Silver and H. Silver, Education of the Poor, 102-103. The authors state that some attention to history, geography, and human physiology once government grants could be obtained to support these subjects as of the late 1860s, but they were not uniformly taught and were confined to senior students. Teaching science became more a part of the curriculum in the twentieth century (147-49). See also Richard Altick, The English Common Reader: A Social History of the Mass Reading Public, 1800-1900, 2nd ed. (Ohio State University Press, 1998) Chapter 7; Thomas Laqueur, Religion and Respectibility: Sunday Schools and Working Class Culture, 1780-1850 (Yale University Press, 1976) 103.

Assessing the accuracy of the educational approach demands a re-evaluation of how Victorian workers perceived education: formal schooling as offered by the state or by religious philanthropic societies was not necessarily the only, or most desirable, form of instruction, although many families found the necessary school fees whenever possible. David Vincent, whose study of literacy and popular culture is described by Richard Altick as "the best overall study of the subject," cautions against a too strict correlation between formal school attendance and working-class dedication to the pursuit of knowledge.[6] Parents, according to Vincent, must be seen as consumers negotiating with a variety of teachers over the education of children, not as passive recipients to outside influences.[7] Formal education was certainly limited by economic necessity, but the school system itself was "in its childhood," and with or without it, parents sought supplementary forms of education for their families.[8] This indicates that a rejection of formal schooling does not automatically translate to a rejection

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[6] Altick, English Common Reader, 426.
[7] David Vincent, Literacy and Popular Culture, England 1750-1914 (Cambridge: Cambridge University Press, 1989) 54.
[8] David Vincent, Bread, Knowledge, and Freedom: A Study of Nineteenth-Century Working-class Autobiography (London: Europa, 1981) 106

of learning, and Edward Royle defined the "great mistake of educational and moral reformers" as the failure to recognize the "resources of the working classes to educate themselves."[9] Autobiographical testimony supports these conclusions, and indicates that working-class communities continued to treat State education as one option among many until after 1914.[10] What, then, were the other options?

Alternative accounts to the educational approach have been offered by supplementing institutional records and parliamentary reports with analyses of community-based schools, evening study, shared resources, community resources, and family support. Autobiographical testimony has been particularly useful in locating common sites of learning for self-improving labourers and their families.[11] John Burnett's evaluation of working-class autobiographies has led him to the conclusion that the educational environment of working-class communities was dictated less by formal schooling than on self-improvement initiatives.

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[9] Edward Royle, Modern Britain: A Social History, 1750-1997, 2nd ed. (London: Arnold, 1997) 356.
[10] Vincent, Literacy, 93; Laqueur, Religion and Respectibility, 151.
[11] Vincent, Literacy, 54-58; Flora Thompson, Lark Rise to Candleford, A Trilogy (London: Penguin, 1973) 80. First published individually by Oxford University Press in 1939, 1943, and 1945.

Labourers taught themselves even if it meant reading in the attic by candlelight while others were asleep. They tried mutual improvement societies, Mechanics Institutes, friends, family, local reading rooms, and whatever else they could find. The tradition of pursuing knowledge under difficulty is praised by Burnett as a "striking testimony to the force of the spirit of self-improvement."[12] Obstacles were plentiful but so were opportunities for the pursuit of knowledge, and as David Vincent's analysis of learning within the context of working-class communities has established, the sharing of skills among friends and neighbours was an important resource.[13]

The Family

The starting place for analysis of the working-class community is the family.[14] What strategies did working-

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[12] John Burnett, Destiny, 136.
[13] Vincent, Bread, 105-111.
[14] The autobiographies included in this study provide information on working-class communities as different as Birmingham, Yorkshire, and London, throughout the second half of the century. This provides the means to compare rural and town environments, and schooling before and after the wave of educational reforms in the 1870s and 1880s. The conclusion has been that working-class self-help was little affected by

class parents employ in the education of their children? What kinds of skills were developed in childhood that may have encouraged an interest in scientific ideas? Edwin Grey (1859-c.1935), son of farm labourer, insisted that many parents "denied themselves considerably" in order to keep children at school until age twelve or thirteen."[15] J. Millott Severn's father, a silk stocking weaver, felt the pinch in the family budget when Severn (1860-c.1938) was only ten year old, and so work became the priority. However, within the year, Severn's father reversed his decision and the boy returned to school until the officially recommended age of twelve.[16] Rowland Kenney (1882-c.1950), son of a cotton operative, remembered that many of the parents in his community wanted a better life for their children than the factory, and this was likely the case in the Kenney family because Rowland did not go into the factory. Tom Bell (1882-1944), son of a

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geographical and temporal variations with respect to the patterns and locations of self-help, but the quantity of available material increased towards the 1890s. Findings are supported by the research of David Vincent and John Burnett, as already noted, and also by Gretchen Galbraith's Reading Lives: Reconstructing Childhood, Books and Schools in Britain, 1870-1920 (New York: St. Martin's, 1997).

[15] Edwin Grey, Cottage Life in a Hertfordshire Village (St. Albans, Fisher, Knight and Company, 1935) 30.

[16] J. Millott Severn, The Life Story and Experiences of a Phrenologist (Brighton: the author, 1929) 29.

stonemason, recalled that parents would do whatever had to be done to find schoolpence, sometimes putting themselves in the awkward position of having to borrow money or share private family hardships with the local schoolmaster.[17] Additionally, Frank Hodges (1887-1947) recalled that:

> The Welsh miner's great family ambition is to bring up his children on a much more highly educated plane than he himself was brought up. Fathers work hard, making the greatest sacrifices; mothers will pinch and save to give their children the chance to attend the secondary school. This is the characteristic of the Welshman wherever he is to be found.[18]

Hodges' description of the Welsh miners and their children approximates middle-class family goals and suggests that setting high standards for children transcends Victorian class divisions. Conversely, some families succumbed to economic pressure. Will Thorne (1857-1946), son of a brick

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[17] Thomas Bell, Pioneering Days (London: Lawrence & Wishart, 1941) 16-17.

[18] Frank Hodges, My Adventures of a Labour Leader (London: George Newnes, 1924) 73.

maker, was forced to work from age six when his father died, and Ben Turner (1863-1942), son of a weaver and active unionist, became a half-timer at age ten. Early entrance into the workforce was common despite parental concern over their children's future, and the descriptions of tension between economic reality and education are confirmed in autobiographical accounts of childhood.[19]

Formal schooling was, however, only one option. David Vincent and John Burnett agree that self-reliance in working-class communities directed families to employ their own effort rather than rely solely on the elementary schools run by the State, churches, or charitable organizations. Working-class testimony confirms that parents and other family members were often readers and, in turn, taught children to read. Flora Thompson (1876-1947), daughter of a stonemason, recalled that reading was increasingly common in rural communities during the final decades of the century.[20] In Lark Rise, where Thompson's

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[19] Vincent, Literacy, 54, 71; Royle, Modern Britain, 354-5; Will Thorne, My Life's Battles (London: George Newnes, 1925) 15-20; Ben Turner About Myself (London: Humphrey Toulmin, 1929) 34-45. See also Bell, Pioneering Days, 16.

[20] Thompson, Lark Rise, 109-10.

self-styled protagonist Laura grew up, people learned to read in whatever way they could:

> It was surprising to find how many of the old people in the little hamlet who had had no regular schooling could yet read a little. A parent had taught some; others had attended a dame school or night school, and a few had made their own children teach them later in life.[21]

Thompson claimed that education was a combination of a "little at school, more from books, and some by dipping into the store of others."[22] As for Laura's parents, Thompson wrote that her mother was very intelligent with an education "above the average of her station in life," and that her father owned more books than most of their neighbours. Laura's father provided early instruction for his children in reading and writing.[23] Thompson's recollection draws attention to variations in book owning

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[21] Thompson, Lark Rise, 80.
[22] Thompson, Lark Rise, 44.
[23] Thompson, Lark Rise, 38, 43.

and in skill levels according to one's station in life; however, she does not indicate that reading and owning books were unusual in her small village.

The reading material of working-class homes varied widely.[24] For many, it meant a few religious books, especially Pilgrim's Progress, and some old newspapers; for others, book collections included fiction, history, and even science, and increasingly, secular and educational books and periodicals became common towards the end of the century.[25] Joseph Keating's father, a shipyard worker, regularly brought home "bags of books" that included Greek philosophy, grammar, and Euclid, all of which the children dutifully studied.[26] In some instances, families found opportunities to purchase or inherit books. For these families, an eclectic range of material existed, though not all family members cared to explore more than a few texts.

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[24] The following chapter examines the childhood reading habits of 22 working-class intellectuals born between 1852-1887.

[25] Vincent, Bread, 109-113; Literacy, 174-79, 200-27. Several of the autobiographers claimed exposure to secular material and they frequently noted the presence of religious books, most notably, Pilgrim's Progress. Thompson recalled that newspapers such as Reynolds's Newspaper were read regularly by the men and women preferred novelettes (109-111).

[26] Joseph Keating, My Struggle for Life (London: Simpkin, Marshall, Hamilton, Kent and Company, 1916) 65. Keating was born in 1871 and died in 1934.

Flora Thompson's autobiography is especially useful for understanding variations in reading habits in rural communities due to her detailed history of her childhood. Flora was the family bookworm, and to her delight, she had more books to choose from than most of her neighbours. The family owned religious and secular material, and Flora's father had his own collection, described with respect as "father's books," which included Grimm's Fairy Tales, and Gulliver's Travels.[27] Flora's uncle, also a "great reader," owned a massive selection of fictional, historical, and scientific works which he had the good fortune to purchase at a furniture sale for the mere price of carting away the books.[28] Stumbling onto this treasure of books was part of Flora's intellectual transformation from a young bookworm to a confident reader.

In Ben Turner's household, the father had a weekly subscription to Reynolds's Newspaper and Bradlaugh's National Reformer, both radical secular periodicals with ample scientific content. Ben Turner described his

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[27] Thompson, Lark Rise, 43.
[28] Thompson, Lark Rise, 43, 352.

father's acquisition of reading skills as typical of this period:

> My father was a very good reader, yet when he was twenty-one he couldn't read a line. He never went to school, he never could write more than his own name, but he learnt to read, and read excellently, at the old village cobbler's shop, where they took in radical and other papers.[29]

Turner recalled that his father's newspapers contained much more than political information, having articles on poetry, literature, art, and science.[30] Turner's experiences illustrate one of the crucial intersections in working-class history. Periodicals circulated in even the most remote villages bringing news of politics and national events, but these newspapers also brought information on culture and science on both the national and local levels.[31]

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[29] Turner, About Myself, 23.
[30] Turner, About Myself, 50.
[31] Thompson, Lark Rise, 111; George Lansbury, My Life (London: Constable and Co., 1928) 19, 30. Lansbury (1859-1940), son of a railway timekeeper, recalled that he learned to read using his grandmother's

Even for families that could not afford to own books, newspapers kept villagers talking, townspeople debating, and knowledge-seekers learning at the cobbler's shop and in the coffee houses, reading rooms, and pubs. Periodicals were a major component of community reading, and their function as a central feature of working-class networking is discussed in Chapters 4 and 5 of this study.

Friends and Neighbours

In addition to the skills learned within the family, friends and neighbours contributed to the education and training of local children. Praise for the working-class community was a common theme in the autobiographies, though some criticism of political apathy was expressed by Tom Barclay (1852-1933), son of a rag seller, and Will Thorne, both active campaigners for the socialist movement.[32] William Margrie (1877-c.1960), son of a carpenter, was critical of the working class in general. Margrie believed

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weekly copy of Reynolds's Newspaper, and that by eleven he was using newspapers to study world events and politics.

[32] Tom Barclay, Memoirs and Medleys: The Autobiography of a Bottle Washer, 2nd ed. (Leicestershire: Coalville, 1995) 73; Thorne, My Life's Battles, 54-55.

that the "average working man does not want education or culture. He wants plenty of betting and public-houses."[33] However, Margrie was critical of nearly everything and everyone with the exception of middle-class women and himself.[34] Nevertheless, Margrie's account is partially supported by T.A. Jackson (1879-1955), son of a printing house foreman, who recalled feeling isolated from other children because he preferred books to games and was taunted with insulting nicknames such as "Four Eyes." On the other hand, Jackson was referring to his childhood and did not intend a sweeping indictment of working-class intellectual culture. In his teen years, he found friends with similar interests and local mentors to guide him in his intellectual development. Similarly, Thompson recalled being called a "bookworm" as a young girl but she also found support for her interests within the community. Additional testimony indicates that it was no easier

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[33] William Margrie, A Cockney's Pilgrimage: In Search of Truth (London: Watts and Company, 1927) 9.
[34] William Margrie, The Invincible Smile: The Autobiography of a Bottom Dog (London: Watts and Company, 1924) 5-6.

growing up in Victorian working-class communities as an intellectually curious child than it is today.[35]

Tom Bell and Joseph Keating recalled the comfort they derived from working-class friends with whom they studied, attended lectures, discussed books, and talked out the problems of the universe. Bell offered this eloquent representation of working-class youth and the pursuit of knowledge:

> Politics, too, got a good share of our attention. It is a big mistake to think the corner boys spend all their time conspiring to attack old gentlemen and steal purses. There are many intelligent young workers in these crowds, and I have heard very fine political discussions, albeit amateurish and crude.[36]

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[35] T. A. Jackson, Solo Trumpet: Some Memories of a Socialist Agitator and Propagandist (London: Lawrence & Wishart, 1953) 13-15; Thompson, Lark Rise, 43-44. Jackson wore glasses as a child and Thompson's love of books made her a target of local gossip. See also Barclay, Memoirs and Medleys, 33, 55; Turner, About Myself, 49; Rowland Kenney, Westering: An Autobiography of Rowland Kenney (London: J.M. Dent & Sons, 1939) 9.

[36] Bell, Pioneering, 30.

Bell and his friends took an early interest in labour issues but were drawn irresistibly to the issue of religious authority:

> We planned to go to all the Labour meetings. But, as often happens, with young workers who begin thinking about political questions, we saw religion and the Church as the big enemy…. We took the road of secularism. In our simple way, we probed into religion, science, and sociology. It was some time before we ventured into an atheistic meeting, but it happened.[37]

Bell's representation of his peer group is an excellent example of the general discussion of science and social issues in the late Victorian period. Similarly, Percy Redfern (1875-1958) and his friends took a serious interest in secularism, politics, and philosophy, and Percy claimed that his intellectual friendships often provided the only

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[37] Bell, Pioneering, 30-31.

"consolation for alternations of overwork at the factory and hungry short-time."[38]

Joseph Keating's pals were "lively students of anything and everything within reach." Brought together by a "secret, hidden magnet," they met every evening after working in the pit during the day. They helped each other with grammar and ideas, and they had one very important rule: "no one was allowed to talk about himself."[39] Keating's community, like that of Frank Hodges, was a Welsh mining community. Just as Hodges, a reader of Darwin by age fourteen, defended the miners from the stigma of the beer-swilling gambler, Keating described the miners as a "very high type of citizen, good-humoured, kind, skilful, hard-working, and naturally intellectual and pious."[40] J. Millott Severn was also from a mining community, and he thought mining especially conducive to thought:

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[38] Percy Redfern, Journey to Understanding (London: George Allen & Unwin, 1946) 23-24. It is not clear what Percy's father did for a living, but he was prosperous enough to have a maid, Percy's mother in fact.
[39] Keating, My Struggle, 82-83.
[40] Keating, My Struggle, 84.

> There are many very intelligent miners. To those intellectually inclined, mining is productive of thoughtfulness, and the eight-hour day helped many a studious miner to qualify as an M.P., or fit himself for some other public service or high intellectual calling.[41]

Typical topics discussed were evolution, socialism, Shakespeare, and poetry. In some instances, special neighbours were recalled as having made a contribution to the pursuit of knowledge. Tom Barclay expressed gratitude to Jem Dillon, a neighbour, who loaned Tom a cheap edition of Shakespeare when Tom was a boy. According to Tom, this occurred before the introduction of free libraries, so he was glad to have the book for even a short time.[42] In his early twenties, Barclay set sail on the "sea of science" with the help of another working-class mentor, George

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[41] Severn, Life Story, 38.

[42] Barclay, Memoirs, 15. Barclay describes how he dressed up in his best clothes to make his first visit to a free library but he does not date the experience. It is in his chapter on adolescence but he begins that chapter at eight years old so it is difficult to be sure when this event occurred. Regardless, Barclay is incorrect when he suggests that 1860 was before the days of free libraries. Rate supported libraries were established by Parliament in 1850; however, it is possible the Leicester had not yet established one and this is what Barclay means. For more on libraries see R. Altick, English Common Reader, Chapter 10.

Robson, and for Barclay a new course was permanently set.[43] Tom Bell and T.A. Jackson also cited mentors who helped to structure their reading and improve their grasp of scientific ideas.[44] These autobiographical accounts of friends and neighbours make it clear that many working men and women considered study to be a process that did not end with day school.[45]

Self-improvement and education, for those who were interested, was a combined effort involving family, friends, and neighbours. Despite the obstacles, creative solutions could be found, and it is this conclusion that forms one of the central contentions of this thesis: that the working-class intellectual environment must be defined as much by creative solutions as by the obstacles. Though it is true that economic pressure limited exposure to formal schooling for many working-class children, families found alternative means to obtain information, and they passed on the requisite skills that enabled children to survive in an increasingly scientific culture, albeit at

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[43] Barclay, Memoirs, 41.
[44] Bell, Pioneering, 10, 36; Jackson, Solo Trumpet, 60-61.
[45] See Annie Kenney's account of her Lancashire co-workers who studied at night schools, Memories of a Militant (London: Edward Arnold, 1924) 18-21.

varying levels. Be it private study, alternative schools, pupil-teaching jobs, or home tutoring, many working-class parents assisted the coming generation in the development of the skills required for the pursuit of knowledge that led many members of the labouring sector to popular and specialized presentations of scientific ideas.

Community Resources: Evening Study

Beyond the assistance of individuals, neigbourhood institutions provided opportunities to study and discuss intellectual and political topics. Sunday schools, evening study, clubs, libraries, visiting lecturers, and organizations such as the secularists and co-operative societies offered convenient, affordable education, and science was an integral component of their respective programmes. This is less true of the Sunday school curriculum that necessarily emphasized Biblical training, but evidence indicates that by mid-century, working-class interest in science was on the rise, and secular material was included as part of general instruction for youth and

adult education depending on local administrators.[46] In Sheffield, Birmingham, and "most of the large towns," science lectures were delivered "regularly" by clergy, and "several Sunday School unions…[provided] scientific lectures for children during the winter."[47] Additionally, at the national level, the Sunday School Union provided lists of recommended reading related to natural history, botany, technology, and animal behaviour, and non-conformist schools included a small percentage of science books as part of their reward system.[48] At the very least, for the nearly 6 million children and adults attending Sunday school in the 1880s, basic reading and writing were taught through scriptural lessons; autobiographical

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[46] For a summary on cultural changes affecting Sunday schools, see Philip B. Cliff, The Rise and Development of the Sunday School Movement in England, 1780-1980 (Surrey: National Christian Educational Council, 1986) Chapters 10-11. For the local, often proletarian, nature of schools in the pre-1850 period, see Laqueur, Religion and Respectability 3, 61-63. Laqueur argues that many of the local teachers were drawn from the ranks of the working-class (3, 92). See also Thomas Bell, Pioneering Days, who recalled that the village day school teacher was from a local mining family (17).

[47] Ian Inkster, Science and the Mechanics' Institutes, 1820-1850," Annals of Science, 32 (1975) 465.

[48] Lacqueur, Religion and Respectability, 103, 113-18, 205. On nonconformist Sunday schools and reward books, see Dorothy M. Entwistle, "Children's Reward Books in Nonconformist Sunday Schools, 1870-1914: Occurrence, Nature, and Purpose," diss., University of Lancaster, 1990, 389, 398.

testimony confirms that these lessons furthered their acquisition of necessary skills.[49]

The amount of science training available through evening study varied with the type of institute and local management. Through a complementary network of mechanics' institutes, local classes and discussion groups, workingmen's clubs, and reading rooms, evening study was available for the acquisition of basic skills and exposure to more difficult topics such as science. Available at assorted costs, these educational opportunities "assisted men of exceptional intelligence and enterprise to make the most of their abilities" and "helped to diffuse knowledge and ideas among a wider section of the working population...reinforced by the efforts of the workers themselves."[50] Often set against middle-class prejudice and interference, institutes predominantly overseen by workers had a radical, irreverent edge to them with an "eclectic" mix of educational programmes that included "phrenology,

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[49] Lacqueur, Religion and Respectability, 104-09, 246. On the development of useful skills, see for example, Tom Mann, Tom Mann's Memoirs, preface by Ken Coates (London: Macgibbon & Kee, 1967) 6-7; Lansbury, My Life, 32, 77.

[50] Thomas Kelly, A History of Adult Eduation in Great Britain from the Middle Ages to the Twentieth Century (Liverpool: Liverpool University Press, 1962) 181.

mesmerism, astrology [and]…more orthodox political and scientific topics."[51] As will be demonstrated, the accumulated presence of scientific issues across the broad spectrum of opportunities for continuing education is substantial, and the fact that scientific ideas were accessible, affordable, and varied in degree of complexity makes a strong case for popular engagement of science. In restricting the definition of science to the scholarly level and the locations for scientific study to, for example, the mechanics' institutes, historians unnecessarily confine descriptions of scientific study in accordance with elitist standards. If, instead, science tit-bits, general science reading, courses in basic science, village discussion over geology or botany, and the science news of Sunday magazines are admitted, then the low road to science emerges as an impressive provider of scientific information at the local level. Moreover, mechanics' institutes were clearly a source of scientific training but they did not have an intellectual monopoly.

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[51] Susan Budd, Varieties of Unbelief: Atheists and Agnostics in English Society, 1850-1960 (London: Heinemann, 1977) 13-14.

The origin of the mechanics' institutes can be traced to the efforts of George Birkbeck, son of a Yorkshire banker, who upon completing his medical training in Edinburgh (1799) moved to Glasgow and began a series of free lectures to workingmen at Anderson Institution where he had been appointed Professor of Natural Philosophy.[52] In 1804, Birkbeck moved to London and in conjunction with the editors of Mechanics' Magazine, J.C. Robertson and Thomas Hodgskin, and radical Benthamite Francis Place, the London Mechanics' Institution was launched in 1823.[53] Disagreement over autonomous working-class financing or middle-class patronage hindered early discussions of the mandate of the London institute, and it was finally agreed that middle-class money was acceptable if two-thirds of the managing committee came from the working sector. Middle-class money and control have been cited as reasons for instability in the pre-1850 phase of the movement, but it has been argued that management varied depending on the local context and

[52] Kelly, History of Adult Education, 118-19.
[53] Kelly, History of Adult Education, 120-21.

by the second phase of the movement after 1850, working-class control increased.[54]

By 1851, the organization of the institutes was shifting towards worker control.[55] At this time, there were approximately 700 institutes of various sizes in England, in both towns and "quite small villages."[56] By 1875, the movement was still "vigorous," but towards the end of the century, mechanics' institutes were being replaced by extended elementary schooling, state-supported technical and evening schools, and the increasing availability of libraries, museums, and inexpensive books.[57] In a study of the Yorkshire Union of Mechanics' Institutes, founded in

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[54] There is also disagreement over whether the institutes attracted mainly skilled workers or whether a wide range of workers, men and women, attended lectures and took courses. Broad generalizations derived from the larger institutes' middle-class spokesmen have not been useful in settling the debates, and local studies indicate that membership and management depended on the community. For a discussion of these issues, see Kelly, History of Adult Education, 121-24, 155-57; J.F.C. Harrison, Learning and Living, 1790-1960 (University of Toronto Press, 1961) 62-74; Steven Shapin and Barry Barnes, "Science, Nature and Control: Interpreting Mechanics' Institutes," Social Studies of Science, 7 (1977), 31-35; John Laurent, "Science, Society and Politics in Late Nineteenth-Century England: A Further Look at the Mechanics' Institutes," Social Studies of Science, 14 (1984) 585-589; Ian Inkster, "Science and the Mechanics' Institutes, 1820-1850: the Case of Sheffield," Annals of Science, 32 (1975), 466; Ian Inkster, The Steam Intellect Societies, ed. Ian Inkster (Nottingham: Department of Adult Education at Nottingham University, 1985) Chapter 1.

[55] Laurent, "Science, Society and Politics," 588. See also Laurent's unpublished dissertation "Science Education, Evolution Theory and the British Labour Movement, 1860-1910," diss., Griffith University, 1984.

[56] Kelly, History of Adult Education, 125.

[57] Kelly, History of Adult Education, 199, 211-13.

1837, John Laurent found that the 109 institutes with approximately 18,000 members in 1850 had grown to 276 institutes with 60,000 members by 1890.[58] The average age of attendance ranged between 15-23, and approximately two-thirds of the membership came from manual occupations.[59]

The main goal of the mechanics' institutes was to develop or refresh forgotten skills such as reading and writing, and then to apply these skills to the study of science, although art and literature were also considered worthy topics.[60] After the inauguration of the Department of Science and Art in 1859, some science courses qualified for grants.[61] Topics included chemistry, phrenology, natural philosophy, geology, botany, and animal physiology.[62] Throughout England, the style and size of the institutes varied, with lectures sometimes delivered in the local pub.[63] Science was the central preoccupation of these

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[58] This figure combines institutes with their affiliated reading rooms and village libraries. See Laurent, "Science, Society and Politics," 589.
[59] Laurent, "Science, Society and Politics," 589-91.
[60] Kelly, History of Adult Education, 128
[61] Laurent, "Science, Society and Politics," 590-91.
[62] Kelly, History of Adult Education, 128; Laurent, "Science, Society and Politics," 590-93.
[63] Inkster, Steam Intellect, 3. The Steam Intellect Societies are described by Inkster as part of the same tradition as the mechanics' institutes.

institutes. The main achievements of the mechanics' institute movement were the popularization of science and a substantial contribution to the "legacy of useful public institutions."[64] Autobiographical testimony from the second half of the century confirms the usefulness of the mechanics' institutes and other forms of unofficial education. Tom Mann (1856-1941), son of colliery clerk, attended classes at the Midland Institute in Birmingham for five years, studying, for example, machine construction and design.[65] Flora Thompson, a lover of fiction, history, and natural history, took out a library ticket with the local mechanics' institute when she ran out of reading material at home.[66]

In a "humbler" version of the mechanics' institute, ambitious workers could attend evening classes generally held in local day schools operated by the Church of England.[67] A course of study involved either six or twelve classes with tutorials and homework; completion was followed by an examination and certificate. The cost of

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[64] Kelly, History of Adult Education, 198.
[65] Mann, Tom Mann's Memoirs, 6.
[66] Thompson, Lark Rise, 415.
[67] Kelly, History of Adult Education, 200.

study could be as high as several shillings or as low as one shilling; the high-end courses were less affordable, so less popular.[68] These night schools became "absorbed into the country's system of technical education" towards the end of the century. Typically, they were attended by teens and adults from a wide array of occupations, including craftsmen, agricultural labourers, factory hands, and domestic servants. In the 1851 Census, nearly 12,000 women indicated that they attended evening classes compared to 27,000 men, and throughout the remainder of the century, further provisions for female scholars were provided in adult education programmes and university extension courses.[69] In 1858, there were approximately 2000 of these programmes available to 81,000 students, and as such, they formed a useful complement to the more formal mechanics' institutes. By 1890, evening schools were an important component of working-class technical and scientific

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[68] Kelly, History of Adult Education, 224-25. These numbers pertain to the extension courses in 1891.

[69] Kelly, History of Adult Education, 155, 199-202, 224-27. See also Brian Graham for mid-century debates over admitting women to reading rooms in Nineteenth-Century Self-Help in Education - Mutual Improvement Societies Case Study: The Carlisle Working Men's Reading Rooms (Nottingham: Department of Adult Education, University of Nottingham, 1983) 39.

education, with scientific topics being among the most popular.[70] Annie Kenney (1879-1953), sister of Rowland Kenney and famous suffragette, praised workers in the Lancashire area for working all day and studying in the evenings.[71] Furthermore, Tom Bell, who attended a city college in Glasgow, recalled that "cheap classes and lectures were arranged on every subject." Bell took classes in geology and astronomy.[72]

Community Clubs and Pubs

In addition to the mechanics' institutes and night schools, mutual improvement societies provided skill development and general education. The history of these

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[70] Kelly, History of Adult Education, 155-57, 197, 200, 225-26. Out of the 457 Extension courses provided by Oxford, Cambridge, and London in 1890-1, 191 were on science. The other main draw was political economy/history with 159. Lectures were sometimes offered for a shilling and these were very popular; lectures that were more expensive were sometimes beyond the range of struggling workmen. However, Kelly demonstrates intention with a few anecdotes on working-class efforts to get to science classes despite several miles of walking in bad weather.

[71] Annie Kenney, Militant, 18.

[72] Bell, Pioneering Days, 66. Of the 30 main autobiographies used in this study, all of them endorsed evening study of some kind except Edwin Grey, who was trained on the job at Rothamsted Agricultural Station. See for example, Barclay, Memoirs and Medleys, 22, 35, 64; Fred Edwards, Paper Sir? The Autobiography of an Old News Boy (London: Drane's, Danegeld House, 1912) 35, 54-59. Edwards took classes despite a five-mile walk to the school.

societies can be traced to the late eighteenth century.[73] Less formal and less expensive than mechanics' institutes or a course of study at an evening school, these clubs were described by Brian Graham as the "foremost" form of cooperation.[74] Local societies may have had hundreds of members or only a few depending on the location, but it was always a case of the skilled assisting the less skilled. They met in homes or whichever location was convenient, and they mainly provided instruction in reading, writing, and arithmetic, along with general discussion.[75] In his examination of the Carlisle mutual improvement societies, Brian Graham found that reading room discussions were more popular than classes, and that a wide range of reading material, including scientific, was available, with shared subscriptions easing the financial burden of less prosperous workmen.[76] Graham described the Carlisle societies as "bona-fide working men's associations," often located in the poorest sections of the city, charging

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[73] Kelly, History of Adult Education, 117.
[74] Graham, Self-Help, 1.
[75] Graham, Self-Help, 1.
[76] Graham, Self-Help, 28-36.

membership fees as low as one penny.[77] Working-class autobiography testifies as to the importance of mutual improvement societies, and this "humble" form of community support provided informal opportunities for skills acquisition, debate, and for those inclined, scientific study.[78]

One example of a prominent improvement society is the Club and Institute Union (CIU) organized by Henry Solly, a Unitarian minister, in 1862. Managed by middle-class patrons, these small town clubs offered all types of workmen a place to learn and socialize without alcoholic beverages.[79] Lack of beer threatened to topple the club, and so in 1875, Solly accepted the inevitability of drink. Thereafter, the clubs achieved "financial independence and...evolved towards full democracy."[80] In a study done on the evolution of the CIU from 1860-1972, John Taylor found that Solly's original goal of housing reading rooms,

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[77] Graham, Self-Help, 3.
[78] Graham, Self-Help, 1, 53. Tom Mann started a mutual improvement society in London. See Mann, Tom Mann's Memoirs, 18-19. See also Hodges, My Adventures, 17-24 and Severn, Life Story, 57.
[79] Peter Bailey, Leisure and Class in Victorian England: Rational Recreation and the Contest for Control, 1830-1885, 2nd ed. (London: Methuen, 1987) 128. Women were excluded from these clubs.
[80] Royle, Modern Britain, 281-82.

classes, libraries, and lectures at one location for the education of the working class was undermined by elite patronage and working-class preferences for relaxation.[91] The CIU continued to operate, but as Taylor observed, each "generation of working men produces its own kind of club."[92]

Taylor designated the 1890s as the beginning of the shift from education to recreation.[93] Although it appears from Taylor's description that a majority of the CIU clubs offered relaxation rather than study, working-class leisure habits need not be assigned to one category at the expense of another. Recreation was always important in working class communities, and intellectually inclined workers maintained a visible presence within the changing forms of working-class culture.[94] Any observable drift towards entertainment in the 1890s points towards a number of large societal changes including access to cheap publications and free libraries that allowed individual study to supplement communal efforts, delegation of political and economic interests to labour organizations, and the gradual

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[91] John Taylor, From Self-Help to Glamour: the Working Men's Club, 1860-1972 (Oxford: History Workshop Pamphlets, 1972) 3-5, 59.
[92] Taylor, From Self-Help, iii.
[93] Taylor, From Self-Help, 59.
[94] Bailey, Leisure, 12, 121-39.

renegotiation of the relationship between working-class families and official educators as the state took control of both day and evening schools. With diminishing need for collective study and agitation, the clubs were left with the task of providing relaxation.[85] Taylor's assessment is based almost entirely on the Club and Institute Journal, and this accounts for his generalized conclusions. Furthermore, it is unclear whether Taylor extended his analysis of the CIU to workingmen's clubs in general, but Gareth Stedman Jones took it in this larger sense in his influential analysis of the de-politicization of London's working class between 1870 and 1900.[86] Stedman Jones claimed that by the 1890s working-class capitulation to capitalist forms of leisure was well underway as labourers "ceased to believe that they could shape society in their own image" and so retreated to music halls and the "culture of consolation."[87] Looking mainly for Chartist radicalism

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[85] Kelly, History of Adult Education, 224-30.
[86] Gareth Stedman Jones, "Working-class Culture and Working-class Politics in London, 1870-1900: Notes on the Remaking of a Working Class," Languages of Class: Studies in English Working Class History, 1832-1982 (Cambridge: Cambridge University Press, 1983) 208-210.
[87] Gareth Stedman Jones, "Working-class Culture and Working-class Politics in London, 1870-1900: Notes on the Remaking of a Working

and the language of class, Stedman Jones failed to perceive the achievements of the labour and socialist movements and the powerful language of evolution.[88] Many of Stedman Jones' conclusions are contradicted by autobiographical descriptions of collective political and intellectual activity and, in addition, Stan Shipley's study of London clubs stands in opposition to the recreation or revolution ultimatum.[89]

In his article on London's "Clubland," Stan Shipley claims that "in the 1870s and early 1880s, the politically minded working man found his natural habitat in the club," although he qualifies this by defining London club members as most likely skilled rather than unskilled workers.[90] Clubs varied from place to place with some being more educational, more radical, or recreational, but most

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Class," Popular Culture: Past and Present, eds. Bernard Waites, Tony Bennett, and Graham Martin (Kent: Croom Helm, 1982) 117.

[88] Jones, "Working-class Culture and Working-class Politics" (1982), 117. This is an excellent example of failure to recognize the social meaning of science in working-class culture as both an intellectual and political rejection of privileged forms of knowledge and power.

[89] Keating, My Struggle, 20, 158; F. J. Gould (1855-1938), The Life-Story of a Humanist (London: Watts and Company, 1923) 1-2; Barclay, Memoirs, 43, 53-54; Stan Shipley, Club Life and Socialism in Mid-Victorian London, History Workshop Pamphlets No. 5 (Oxford: Ruskin College, 1971).

[90] Shipley, Club Life, 21, 27.

"combined all of these features."[91] The mandate of the clubs included collecting dues, providing goods for members in distress, holding lectures on topics as diverse as the Irish Question or phrenology, Shakespearean recitations, and conducting classes on scientific topics such as astronomy and natural history. Shipley asserts that these Sunday evening meetings attracted large groups.[92] Tom Mann was president of one such club called the Shakespeare Mutual Improvement Society, which held its meetings at the Devonshire Club, Chiswick.[93] In debates, the "clash of opinion could be sharp," and "close reasoning" and a "high level of political knowledge and intellectual understanding" were expected.[94] Shipley's article is based on records of several of these clubs, periodical announcements and reviews, contemporary studies, and autobiographical accounts, and it is supported by the diverse lists of lecture announcements issued weekly in Reynolds's Newspaper, Justice, and The Star.[95]

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[91] Shipley, Club Life, 21.
[92] Shipley, Club Life, 22-23.
[93] Mann, Tom Mann's Memoirs, 19; Shipley, Club Life, 23.
[94] Shipley, Club Life, 23-24.
[95] For more on lecture announcements, see Chapters 4 and 5 of this study.

One of Shipley's key points is his correction of an essential misunderstanding of working-class culture, namely the "artificial distinctions" which have disallowed the public house to be considered as a legitimate location for intellectual and political activity. This misunderstanding of the pub arises if "we regard the club first as a premises rather than as a regular social meeting." If, on the other hand, the club is "seen to be people sharing common activities such as playing draughts or billiards, listening to a lecture, taking part in a debate, or reading aloud from Shakespeare," then "the difference disappears."[96] From this perspective, the pub becomes less associated with drink and more closely linked to culture. This is supported by Ian Inkster's study of the Steam Intellect Societies that sometimes held lectures at taverns, and by autobiographical recollections of the public house as part of the intellectual and political culture of the working-class community.[97]

Autobiographical testimony supports Shipley's conclusions. Flora Thompson's local pub was the site of

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[96] Shipley, Club Life, 22.
[97] Inkster, Steam, 3.

cultural activity, and her depiction is of a local meeting place where men could escape to talk over the issues of the day.[98] Similarly, Ben Turner claimed that "public houses were good debating places—at least, certain best rooms on Sunday nights and after chapel and church time had set debates, discussions and interesting evenings." As a young man, Turner attended local pub discussions on local and national events, and believed that debates in the local pubs and clubs provided "training grounds for speech-making."[99] Pubs also served practical functions in the community. Percy Redfern's description of the role the public house played during a miner's strike in Nottingham should remind modern readers that the pub served as local headquarters in times of community distress.[100] If the pub, as Shipley suggests, is seen as a place where people of similar interests could meet to pursue discussion, or even worship, then its varied and central importance for working-class culture becomes clear, and it is equally clear why this failed to be perceived by middle-class

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[98] Thompson, Lark Rise, 64-68.
[99] Turner, About Myself, 59.
[100] Redfern, Journey, 20.

reformers and critics of the working class. However, the cultural meaning of these meeting places would not have been lost on the children who witnessed their parents and neighbours participating in the religious, political, and intellectual life of their communities at the local halls and pubs.

In an important study of the cultural contribution of the pub, Anne Secord's article on the Lancashire botanists demonstrates that the public house was a meeting place for local artisans interested in science.[101] Moreover, the pub was one of the few places where elitist expectations of deference were "pointedly ignored by working men."[102] Working men from surrounding areas came together to share in their "love of plants" and conduct the Botanical Society's business:

> Local botanical societies met once a month for the inspection of specimens and the borrowing and return of books. At the end of each meeting, specimens were

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[101] Anne Secord, "Science in the Pub: Artisan Botanists in Early Nineteenth-Century Lancashire," History of Science, xxxii, (1994), 269-315.
[102] Secord, "Science in the Pub," 291-93.

> selected to add to the society's herbarium which, together with library, was kept in the pub.[103]

Secord also discovered that local botanical societies had rules and fines for "turning up without plants, swearing, pinching specimens, and arriving at a meeting in an intoxicated state," and they had membership fees that were used to purchase books and maintain the library.[104] Additionally, though the pub clubs underwent some changes after 1850, Secord has established that "botanical societies continued to meet in pubs until the 1920s."[105] Nevertheless, the pub as a legitimate meeting place along with its working-class style of "communal learning" continued to be "little understood by middle-class observers."[106] Secord argues that cultural activities, and in particular scientific pursuits, "became increasingly associated with specific sites from which 'the people' were excluded."[107] As the distinction between amateur and professional scientist took shape in the latter half of the

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[103] Secord, "Science in the Pub," 278.
[104] Secord, "Science in the Pub," 279.
[105] Secord, "Science in the Pub," 280.
[106] Secord, "Science in the Pub," 281.
[107] Secord, "Science in the Pub," 297.

century, working-class scientific work was defined as "popular" and was thereby divorced from legitimate science.[108]

The Co-operative Approach

One of the main contributors to working-class education and the popularization of science in the second half of the nineteenth century was the cooperative societies, and one of the most elaborate was in the Manchester area: the Rochdale Pioneers. Rochdale had a well-developed co-operative society drawing in members from many sectors of the labour community.[109] Funded mainly by profits from the stores, the Co-operative's departments served a variety of needs including access to artifacts and equipment, educational programmes, meeting halls, libraries, and an active club life. In an address in 1877, Abraham Greenwood, a prominent member of the Rochdale

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[108] Secord, "Science in the Pub," 299.

[109] For membership descriptions see Percy Redfern, "Up From the Past: Stories of Men Who Helped," pamphlet no. 10 of The People's Papers, (Manchester: C.W.S. Publicity Department, 1929); George Jacob Holyoake, The History of the Rochdale Pioneers (London: Swan Sonnenschein, 1907).

Equitable Pioneers since the 1850s, described the atmosphere at the Toad Lane Store:

> The early Pioneers were in the habit of assembling themselves together after the day's toil was done, in the back room of the old store, for the purpose of hearing the news of the week. It could not then be said 'the news of the day' for the Government had for a long time before this taken means to render impossible to the workmen even a weekly newspaper, let alone a daily…. News of the day was circulated by word of mouth to a very great extent among the working classes, at that time, and often gained rather than lost something of the truth in being thus diffused.[110]

The Pioneers established educational programmes, libraries, and clubs, and many of the surrounding boroughs were affiliated with the central organization at the Co-operative Hall in Toad Lane. Classes and lectures on

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[110] A. Greenwood, The Educational Department of the Rochdale Equitable Pioneers' Society Ltd.: Its Origin and Development (Manchester: Central Co-operative Boards, 1877) 3.

science were featured prominently, and both the central and branch libraries boasted impressive holdings.[111] Classes were given on such topics as astronomy, applied mechanics, physiology, chemistry, and basic physics, and they were well attended until the late 1890s when the Technical Educations Act empowered municipal programmes, thereby undermining local initiatives.[112] The Co-operative Union was an outstanding example of working-class effort to provide mutual aid and educational opportunities for workers and their families.[113]

Rochdale's promotion of science depended in part on its library holdings and scientific equipment. By 1876, Rochdale's holdings included 12,000 volumes in the

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[111] Ian Hardcastle, "The development of the Rochdale Pioneers' Education Department and its influence on Education in the nineteenth and early twentieth centuries," Education Diploma thesis, School of Education, Leicester University, 1980, see Chapters 6-7.

[112] Syllabus of the Science and Art Classes held by the Rochdale Equitable Pioneers Society, 1884-5; Charles Walters, History of the Oldham Equitable Co-operative Society Limited: From 1850-1900 (Manchester: Co-operative Wholesale Society, 1900) 127-33; John Attfield, With the Light of Knowledge: A Hundred Years of Education in the Royal Arsenal Co-operative Society, 1877-1977 (London: RACS/Journeyman Press, 1981) 5-8; Phil Barnard, "Professor James Stuart and the Rochdale Pioneers, or How Astronomy as food for thought became a Co-op dividend," Lyra, Winter, 1992, 10-11.

[113] Eric Hopkins, Working-Class Self-Help in Nineteenth-Century England (London: University College London Press,1995) 221. Hopkins cautions that the co-operative movement catered to mainly skilled workers and not the "lumpenproletariat." From other evidence, I take this to mean a broad array of regularly employed workers and intellectuals as opposed to vagrants and hooligans.

circulating library at Toad Lane and 1,190 volumes in the surrounding reference libraries. The circulation number for the year ending June 1876 was 30,314, and a year later, this figure increased by 7,000 volumes.[114] Of the library's holdings in 1877, 267 were categorized under "Natural History" and 402 as "Arts and Sciences." These included both celebrated and lesser-known works on botany, agriculture, chemistry, physiology, mathematics, engineering, zoology, medicine, phrenology, geology, and astronomy, and circulation in these categories was estimated at 1,647 for the period beginning 24 July 1876 and ending 30 June 1877.[115] However, in addition to the clearly demarcated scientific works, entries listed as social, philosophical, metaphysical, and geographical often dealt directly with scientific topics and controversies. Three hundred and eighty-eight titles were listed under "Social and Political Philosophy," 446 were categorized as "Theology, Morals, and Metaphysics," and 630 were listed as

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[114] Greenwood, The Educational Department, 8-9.

[115] Catalogue of the Library of the Rochdale Equitable Pioneers' Society, passim; Greenwood, The Educational Department, 9. "Works of Fiction, Tales, &c" fared well at 12,196 loans on 2,070 titles, while "Theology, Morals, and Metaphysics" had the poorest showing at 400 loans on 446 titles. Natural and social science made a respectable showing.

"Geography, Voyages, and Travels." Of these, many were science-related works such as Herbert Spencer's Social Statics (1850), William Paley's Natural Theology (1802), Auguste Comte's Catechism of Positivism; or Summary Exposition of Universal Religion (1852), George Combe's The Relation between Science and Religion (1857), and Alfred Russell Wallace's The Amazon (1853). In total, Rochdale's library offered a large assortment of titles in both the natural and social sciences.

In addition to books, the Central Newsroom subscribed to 27 daily papers, 55 weekly papers, 33 monthlies and 9 quarterly magazines including Agricultural Economist, All the Year Round, Contemporary Review, Gentleman's Magazine, Leisure Hour, Homeopathic World, Edinburgh Review, Popular Science Review, and the Quarterly Journal of Science. The holdings of branch libraries and newsrooms varied, and several of them carried mechanics magazines and radical periodicals. In particular, the Oldham Branch subscribed to the English Mechanic, Reynolds's Newspaper, and the National Reformer, all of which carried science news and

ideas.[116] After 1852, subscription fees to the library and newsroom were abolished and replaced by a grant from the educational fund, determined as 2.5% of the profits.[117] This fund also supported classes in science and art, attended by 345 students in 1891.[118]

Another important use for the educational fund was the instrument department, which boasted "32 opera glasses, three magnetic batteries, one very large and one small telescope, one microscope, two zoetropes, four large microscope boxes, two stereoscopes, and one cosmoscope." In addition to the instruments, the department owned a variety of lenses, glass slides relating to natural history, mineralogy, photography, and English and foreign scenery.[119] All of these items were lent out for a small fee ranging from 6d per day for the cosmoscope and 1d per day for a hand-held stereoscope with a case of fifty views.

The issue of library resources is an important one. The ample material made available by co-operative libraries

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[116] Greenwood, The Educational Department, 9-13; Catalogue of The Library of the Rochdale Equitable Pioneers' Society Ltd. (Rochdale: December, 1868)
[117] Hopkins, Working-Class Self-Help, 206.
[118] Hopkins, Working-Class Self-Help, 213-14. The society had 11,647 members at the time.
[119] Greenwood, The Educational Department, 11.

can be attributed to internal educational goals and funding commitments, but this arrangement is specific to the co-operatives. What was the general state of libraries available to working-class readers? According to Brian Graham, even the most humble reading room "managed to establish a collection of books" in addition to an ample stock of newspapers and periodicals; a small percentage of books were of a scientific nature.[120] Among the Yorkshire mechanics' institutes, holdings were large and contained an impressive assortment of scientific books.[121] Although collections in other regions varied from "15,000 volumes at Liverpool to a shelf of books in a village institute," workmen's libraries were "within their limits useful."[122] Additionally, John Laurent's research on Leeds, Leicester, and London found extensive scientific collections utilized by workmen.[123]

Autobiographical testimony indicates the importance of libraries for working-class readers. Trips to the library

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[120] Graham, Self-Help, 32-34.
[121] Laurent, "Science, Society and Politics," 595-97.
[122] Kelly, History of Adult Education, 175.
[123] Laurent, "Science Education, Evolution Theory, and the British Labour Movement," 369. Annie Kenney described the Lancashire libraries of the 1880s as a "credit to the people" (18).

as young children were recalled with affection and awe; in the library, early reading skills were encouraged and developed. The semi-rural village of Tom Bell's youth was described with fondness:

> There was a local lending library in the village, established for many years by these old radicals, the books being kept in a small ante-room in the Public Hall. My father was a member of this library. For a shilling a year he had the privilege of taking out two books a fortnight, on paying twopence a week for each book…. The keeper of the library, old Tom Bennett, a real old bookworm after Burton's own heart, for some reason took a special interest in me and used to chat with me when I came in…. This was my earliest contact with books, and no doubt laid the foundation for that love of literature which I regard as being as important for a man's soul as meat and drink are for his body.[124]

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[124] Bell, Pioneering Days, 15-16.

In much the same way, Tom Mann described the importance of his library in the 1870s when he was in his teen years:

> It was of great value to me that there was fine Public Library at Birmingham, easily get-at-able, and available to all. I read considerably, but not systematically…. Still, I was groping my way, if not directly, towards the light. At least I was becoming conscious of mental darkness.[125]

Similarly, the world of knowledge situated in the local library was sufficiently alluring to convince young Percy Redfern to play truant: the "stolen hours being mostly spent in a public reading room" because it, unlike school, was a "place of education."[126] For Tom Barclay, the library experience was a mixture of joy and freedom:

> There was no Free Library in those days; I don't know who instituted it, but may his tribe increase! I was one of the earliest borrowers: I could hardly believe

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[125] Mann, Tom Mann's Memoirs, 9-10.
[126] Redfern, Journey, 14.

> the tidings of great joy. What, be able to get books without buying or renting? I washed and titivated and sewed the rent in my trousers, and presented myself respectfully, diffidently. Yes, it was no fiction. What rapture! Handy Andy, Traits and Stories of the Irish Peasantry, Ivanhoe, Pickwick Papers, Adam Bede, The Last of the Mohicans.[127]

Even the poorest child in Leicester understood the value of the local library. A bottle-washer and unskilled labourer for his entire life, Tom Barclay transformed his early love of knowledge into intellectual achievements that earned him the respect of both his community and many prominent members of the Victorian Left. In the final decades of the nineteenth century, village libraries, public libraries, reading room resources, school libraries, and book boxes delivered to villages by larger holders such as the Yorkshire Union of Mechanics' Institutes brought knowledge, sometimes scientific, to readers throughout England.[128] The

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[127] Barclay, Memoirs, 15.

[128] Kelly, History of Adult Education, 173-77, 213-14. Museums may have been rare in working-class communities, but the example of Anne Secord's artisans and their herbarium suggests that local collections

Rochdale collection is an example of one of the larger holders of scientific publications but smaller libraries provided whatever assistance they could.

In addition to libraries and scientific instruments, cooperative societies funded Field Naturalist Clubs, and examples of this in Yorkshire have been documented by John Laurent. Laurent's description of the Yorkshire Naturalists' Union based on various local co-operative newspapers, outlined club activities involving rambles, discussion groups, extensive library holdings, and lectures that often linked science and politics. Unfortunately, the occupational breakdown of the Yorkshire club members is not provided by Laurent. The one exception to this refers to the Leeds Co-operative Field Club that included "a warehouseman...a painter, a hairdresser, a pawnbroker, and a letter carrier."[129] Laurent's primary goal was to establish a central role for science at the artisan level and a solid

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on display could be an alternative form of museum. Tom Barclay's "local museum" contained specimens collected by a co-worker from "Cooper and Corah's Hoisery Factory" (41-42). See Anne Secord, "Science in the Pub," 278.

[129] Laurent, "Science Education, Evolution Theory and The British Labour Movement," 380-82, 403. Laurent occasionally identified occupations for working-class science enthusiasts, see for example Willie Brooke, a painter (406). More detailed information on the occupational status would be helpful in answering a number of question surround self-help.

working-class intellectual foundation for evolutionary socialism. His exposition of the educational function of the co-operatives and their overt concern for the popularization of science as both hobby and political ideology helps to elaborate provincial opportunities to connect with scientific information, particularly in West Yorkshire.[130]

Branches affiliated with the co-operative movement such as the Bolton Co-operative Society similarly placed a high value on education, and their society journal kept members apprised of opportunities to study and improve.[131] Science topics figured prominently, although The Bolton Co-operative Record indicates that science was not overtly connected with socialism, evolutionary or otherwise. Instead, The Bolton Co-operative Record serves as a monthly testimony to the community's faith in science and science education. Its main concern was the recording of

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[130] Laurent's subsequent article on the mechanics' institutes in the Yorkshire area provided more occupational information and its relation to institute management. See Laurent, "Science, Society and Politics," 585-619.

[131] See Laurent, "Science Education, Evolution Theory and the British Labour Movement," especially Chapter 8. Eric Hopkins points out that not all societies followed the 2.5% funding mandate for education (217).

educational events having to do with health and domestic issues, biology, physiology, geology, and botany, and at the local level, it took on the role of science popularizer. Facts and specimens gained during local rambles were regularly documented, and field trips to science lectures and Owens College were publicized each month. Demonstrating a sturdy love of the countryside while simultaneously advocating the self-help programme of the cooperative movement, this society basked in scientific ideas and mutual improvement.

Science lectures were offered by the Field Naturalist Society and the Women's Guild. Admission to lectures was twopence, and reviews suggest that audiences were often "large and appreciative," although a lecture on botany in January 1890 failed to bring in a crowd.[132] Controversial discussions of social science do not appear to have been a prominent feature of lectures. Lectures on science presented by the Field Naturalist Society focused on the study of "botany, entomology, zoology, and

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[132] The Bolton Co-operative Record, April 1890, 7. With respect to the botany lecture, the reviewer commented that "botany does not seem to be a popular subject," February 1890, 3.

geology…illustrated by specimens, microscopes, and frequently by printed floral syllabuses." Lectures were offered weekly by local members who were "specialists in their own domain." In November and December of 1889, topics included "Mosses," "Trees," "Birds of the District," "Geology," and "The Great Ice Age."[133] In March 1890, two lectures were given on "Insects and Flowers," one of which included supporting evidence from Charles Darwin's work.[134]

Not to be outdone, the Women's Guild gave its own "scientific lectures" primarily on topics relating to health.[135] Women were not generally listed as members of the co-operatives until women's advocates successfully created the Women's Guilds by 1891, at which point 100,000 women were officially registered as shareholders.[136] Despite difference of opinion over the place of women in the co-operatives, their role as educators was considered valuable. Women lectured on topics such as "Good Health,"

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[133] The Bolton Co-operative Record, December 1889, 6.
[134] The Bolton Co-operative Record, April 1890, 7. The writer did not name which of Darwin's works were cited but simply referred to Darwin's views on cross-fertilization.
[135] The Bolton Co-operative Record, December 1889, 1.
[136] Hopkins, Working-class Self-Help, 215-17.

"The Skin and Its Work," and "The Uses of Food."[137] Reviews indicate that more than quaint adages and old family recipes were being exchanged, and that these lectures were considered by members to fall within the scope of scientific knowledge. The lecture on food, for example, explained the "composition of the different kinds of foods" in relation to nutrition and prolonged health.[138] These lectures, in combination with those of the Field Naturalist Society, were given substantial attention in the BCR, appearing alongside reports on the financial, social, and organizational business of the Co-operative. Disseminating useful information to members and maintaining the "vigour" and "progress" of the community, the Education Committee claimed with some pride that "probably no society of this kind has ever done so much work and so well" in acquiring the kind of expertise as found in their Field Naturalist Society.[139]

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[137] The Bolton Co-operative Record, December 1889, 1; March 1890, 12.
[138] The Bolton Co-operative Record, March 1890, 12.
[139] The Bolton Co-operative Record, December 1889, 6.

The Secularist Influence

The coming together of unofficial educators and eager students was an essential feature of the low road to knowledge and a key provider of scientific information. Socialist and labour organizations made important contributions of this kind in the 1880s and 1890s, but secularist lecturers appealed to a broad audience from the 1860s to the 1890s by providing a forum for discussion of both moderate and radical topics.[140] Secularist lecturers traveled the country speaking on radical politics, Church authority, and the natural world. Contemporary accounts often cite the importance of local secularist and freethought lectures as a main influence in their intellectual development; Charles Bradlaugh's name figures prominently.

The National Secular Society began in 1866 under the direction of Charles Bradlaugh, editor of The National Reformer. Lecture tours were a fundamental component of

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[140] Working-class political organizations are discussed in Chapter 5 of this study.

the Society's "missionary work."[141] The founding goal of the Society was the promotion of republican democracy, and secularists were linked to the Reform League and the Freethought Movement.[142] In all facets of the secularist propaganda network, scientific ideas were enlisted to support ideological challenges to ignorance, superstition, and church authority.[143] One of the most prominent secularists of the 1870s and 1880s, Annie Besant, drifted towards socialism in the 1880s and her arguments against individualism and capitalism were suffused with evolutionary socialism and Marxist economics. In a four-day debate with G. W. Foote at London's Hall of Science, chaired by William Morris, Besant laid out her socialist-evolutionist argument and was countered by Foote's use of liberal Darwinian arguments.[144] These debates were a

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[141] Edward Royle, Radicals, Secularists, and Republicans: Popular Freethought in Britain, 1866-1915 (Manchester: Manchester University Press, 1980) 1-4, 149.
[142] Royle, Radicals, 4-7.
[143] Royle, Radicals, 167-74.
[144] "Is Socialism Sound? A Verbatim Report of A Four Night's Debate between Annie Besant and G.W. Foote at the Hall of Science, Old St., London on February 2nd, 9th, 16th, and 23rd (London: Freethought Publishing Company, 1887) 4, 16-19, 23.

"spectacular form of propagandism" and attracted large crowds.[145]

Audiences at secularist lectures varied but popular lecturers Annie Besant, Charles Bradlaugh, and G.W. Foote could expect to attract 1,000 listeners to the Hall of Science in London, and could often fill lecture halls in the provinces. Bradlaugh noted in 1869 that a large portion of the audiences appeared to be the "elite of the working classes in their respective districts."[146] Working-class members of the secularist movement varied within local contexts, but Edward Royle has determined that approximately 22% were skilled workers and 25% were semi-skilled and unskilled workers.[147] Autobiographies of working-class intellectuals attest to the occupational breadth of the audience, as several of the autobiographers recalled attending secularist lecturers during their apprentice years.

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[145] Royle, Radicals, 154-55.
[146] Royle, Radicals, 132-33
[147] Royle, Radicals, 127-28. Royle compares his figures to Susan Budd's quantification of 20% for skilled workers and 40% semi-skilled and unskilled. Royle questioned Budd's use of data from 1852-1965, confining his analysis to 1865-1915 (126). See Susan Budd, "The British Humanist Movement: 1860-1966," diss., Oxford, 1968.

Tom Bell's search for a political ideology took him first to secularism.[148] Bell attended Sunday meetings in the morning and evening:

> The Secular Society in Glasgow held meetings every Sunday morning and evening, in Brunswick Street, in a little hall that apparently was used as the Fruit Brokers' Exchange. It always smelled fruity! Here the late G. W. Foote, Chapman Cohen, Joseph McCabe, Percy Ward, F. G. Gould (sic), J. T. Lloyd, J. M. Robertson, Denis Herd (sic), Mrs. Bradlaugh-Bonner, and occasionally a socialist speaker—Herbert Burrows, etc.--would hold forth.[149]

This club was instrumental in Bell's political and intellectual development, and the location for the meetings is particularly useful with respect to the suggestion that working-class organization may have gone unrecognized by middle-class observers. In Birmingham, Tom Mann attended Secularist lectures by G. W. Foote, Annie Besant, and

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[148] This was also true for several of the autobiographers examined in the next chapter including Percy Redfern, Tom Barclay, F.J. Gould, and Tom Mann.

[149] Bell, Pioneering Days, 31.

Charles Bradlaugh at Baskerville Hall, and he praised them for having made important contributions to the early formation of a working-class movement.[150] His own intellectual formation was similarly indebted.

Percy Redfern's experience with secularism began when he "discovered" the Nottingham branch of the National Secular Society, where he formed a friendship with a young woman who guided him in his search for truth. From that point on, Percy began "another apprenticeship, listening to the lectures of "Lollards, Levellers and Diggers" along with those of pantheists, socialists, and anarchist-communists.[151] Every Sunday, Percy and his fellow secularists climbed the "drab, empty steps" to meet in the Secular Hall located above the shops in the east end of Nottingham to listen to Free-thought lecturers and search for truth. Much of Percy's autobiography is vaguely contradictory, but it appears that in this case he found what he wanted. Some of the Secular Halls were described in more lively terms than Percy's local branch. Tom Barclay recalled a variety of standard features including

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[150] Mann, Tom Mann's Memoirs, 8.
[151] Redfern, Journey, 23.

meetings, lectures by George Holyoake and Joseph McCabe, books, and debates, but more unusually, he also described the club as a place to drink, sing, and socialize. In the early days, these meeting were held "over some stables" but in 1881 a hall was erected in front of the stables.[152]

Reynolds's Newspaper carried a lecture announcement column for socialists, radicals, and secularists. During the 1880s and 1890s, the London Secularist Federation and National Secularist Society frequently offered lectures with clearly demarcated scientific titles such as "Evolution Proved," along with more suggestive titles such as "A Higher Authority than Religion."[153] In February 1889, the topics "Science, the only True Religion" and "Two Freethought Martyrs: Galileo and Bruno" linked science directly to the secularist cause.[154] The issue for 3 January 1892 listed four secularist lectures relating to science, two of which were overtly connected to scientific theory: "The Origin of Life," and "Religion in Relation to Evolution." Closely related topics included "Is there a

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[152] Barclay, Memoirs, 67. See also, F.J. Gould, Life-Story of a Humanist, 87. Gould was a prominent secularist in his advocacy of positivist humanism and in his educational activities.
[153] Reynolds's Newspaper, 20 May 1888, 8.
[154] Reynolds's Newspaper, 10 February 1889, n.p.

Moral Governor of the Universe" and "The Bible and Science."[155] The next week a similar list appeared with the addition of lectures on "A Trip to Other Worlds" and "The Origin of Species," both delivered by members of the London Secular Federation.[156] These lectures, the provincial tours, and the hugely popular public debates put the secularist message in the centre of Victorian cultural controversy, and science was a key component of the secularist presentation.

Conclusion

In Lark Rise to Candleford, Flora Thompson wrote that "all times are times of transition, but the eighteen-eighties were so in a special sense, for the world was at the beginning of a new era, the era of machinery and scientific discovery." Thompson further stated that even "simple country people" perceived the changes.[157] With perception comes a need to understand and even control, and

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[155] Reynolds's Newspaper, 3 January 1892, 6. The likelihood of "Is there a Moral Governor of the Universe" being related to science is high because it was a Secularist lecture. Another lecture from this group, "An Oration on the Heavenly Bodies," may have been astronomical rather than spiritual.

[156] Reynolds's Newspaper, 10 January 1892, 6.

[157] Thompson, Lark Rise, 68.

the low road to knowledge provided the means to participate for those not inclined to passive observation. In the sense it is used here, "low" refers not to social status but to the longer, harder road traveled in the intellectual and recreational pursuit of scientific knowledge.

In determining what constituted self-improvement, it was clear to many working men and women that science was a cultural force that could be harnessed by an intelligent mind attuned to useful knowledge. Popular science offered everything from humorous anecdotes to entertaining exhibits, magazines, and hobbies. At this level of interest, science could be had for the price of a penny newspaper or membership at one of the inexpensive local societies; for the more serious, a shilling could purchase a course of study. For the politically inclined, it was equally clear that scientific authority was the secular heir to the fading authority of the Church and aristocratic privilege. Having some control over the direction of the newly emerging scientific culture required mastery over relevant scientific theories in biology and geology.

In the schools, institutes, lectures, periodicals, newspapers, and discussion groups, contact with science nurtured hobbies and curiosity as much as dreams of a socialist or secular England. That so much was available at so little a cost, establishes that the low road to science—the difficult journey—serves as a testimony to working-class ingenuity and deserves no condescension from modern historians. The low road may have been more hazardous than the high road of elite institutions and the advantages of money, but it was nonetheless a road well traveled by many working-class Victorians, their families, friends, and neighbours. Accordingly, the low road should not be seen so much as a reflection of intellectual obstacles but of creative solutions.

Chapter 3: "The Tale Deserves to Be Generally Known": Working-class Intellectuals and the Quest for Science

The preface to Joseph Gutteridge's autobiography proclaims that the "tale deserves to be generally known" as proof that "true manhood is superior to external conditions," and that the "love and study of nature, science, and art may be successfully and happily pursued under the most untoward circumstance."[1] Gutteridge (1816-1899), weaver and naturalist, exemplified the serious-minded impoverished Victorian worker who obtained his science training through inexpensive books, evening education, local opportunities for specimen and fossil collecting, and personal sacrifice as pennies were saved to purchase scientific instruments or the materials to construct them. With the recent discovery of several hundred autobiographies, similar stories of the pursuit of science under difficult circumstances have been made

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[1] Joseph Gutteridge, Lights and Shadows in the Life of an Artisan (Coventry, 1893), in Master and Artisan in Victorian England (London: Evelyn, Adams & Mackay, 1969) 77. References to autobiographies are given in full the first time they are cited; subsequently, only the author's surname and page number appear.

available.[2] John Buckley (b. 1820) earned a career in science despite a life plagued by poverty and tragedy. Buckley, orphaned as a young child, worked his way from apprentice carpenter to science master in a technical school for boys.[3] Similarly, James Croll (1821-1890) worked as a salesman, millwright, janitor, and eventually civil servant, while contributing to Victorian physics and evolutionary discussion in articles and correspondence with John Tyndall (1820-1893) and Alfred Russel Wallace. Croll pursued science at enormous personal cost, and at the end of his life, he was penniless.[4]

These achievements attest to the willpower of working-class intellectuals and the potential for scientific

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[2] John Burnett, David Mayall, and David Vincent, The Autobiography of the Working Class: An Annotated, Critical Bibliography, vol. 1 (New York: New York University Press, 1984).

[3] John Buckley, A Village Politician: The Life-Story of John Buckley, edited by J.C. Buckmaster, introduction by A. J. Mundella (London: T. Fisher Unwin, 1897). While fulfilling his obligations as an apprentice, he attended night school and read science texts when possible. Shunned by fellow workers for his inventiveness, his intellectual potential was recognised and encouraged by the owner of a local china shop. Buckley honed his talents for writing while involved in the Temperance Movement, Chartism, and the Anti-Corn Law League, and his abilities drew the attention of a benefactor who steered Buckley into teacher training. Inspired by his love of science, Buckley gradually worked his way into the position of science master and educational reformer (16-18, 84, 93, 98, 105, 114, 247) Buckley's account of hardship is confirmed in the introduction written by A. J. Mundella, M.P.

[4] James Croll, Autobiographical Sketch of James Croll, with memoirs of his life and work by James Campbell Irons (London: Edward Stanford, 1896) 9-17, 40-41, 105, 257-58, 471.

enquiry along the low road of informal education in the first half of the century. Scientific careers and hobbies were possible despite obstacles, and Anne Secord's work on the artisan naturalists of Lancashire provides a compelling example of scientific practice at the working-class level. Adrian Desmond's study of Chartist appropriations of Lamarckian biology demonstrates that radical artisans made a connection between science and political reform. David Vincent listed several science enthusiasts in his study of pre-1850 working-class autobiography including Roger Langdon (signalman and astronomer), Thomas Oliver (tin-maker and science reader), William Dodd (factory worker and science reader), the Dundee Factory Boy (factory worker and member of a local zoological and botanical group), William Lovett (Chartist leader, cabinet-maker, and science reader), William Heaton (weaver and member of a local science club), Willie Thom (weaver and science reader).

This chapter draws upon twenty-four working-class autobiographies and presents twenty case studies of intellectuals pursuing scientific ideas in the final decades of the nineteenth century. Fortunate to have been

born in an age of popular science, Darwinian controversies, the mass press, inexpensive books, and working-class mobilization, these men and women benefited from improved access to scientific ideas as compared to their early century counterparts. Their autobiographical testimony provides an opportunity to examine the low road to science from a personal perspective and to understand the meaning science had for individuals. As will be seen, the reasons for pursuing scientific ideas varied from self-improving hobbies to serious engagement with the philosophical and political meaning of science; in this sense, working-class interest in science paralleled larger trends in Victorian scientific culture.[5]

In the final decades of the century, the infrastructure of working-class intellectual pursuits and the social context of science were evolving with the times. Self-improvement, recreation, and social and political reform continued to draw workers to science but the mass press, cheap re-prints of scientific texts, free libraries,

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[5] Since there has been no quantification of middle-class interest in science, it is difficult to determine whether the minority status of working-class science differs from that of other sectors of society.

the secularist and political lecture circuit, middle-class popular science, and working-class educational initiatives, brought improved opportunities for contact with scientific ideas. As science entered popular culture through lectures and the cheap press, working-class intellectuals and hobbyists were increasingly part of a collective pursuit of knowledge, reducing reliance on autodidacticism.[6] Popularization of science was further developed in the 1880s and 1890s as the Victorian Left seized upon science in confrontations between capital and labour. Pre-Darwinian Chartist Lamarckism was replaced with socialist science, argued within the context of Darwinian natural selection. The Left's propaganda network churned out pamphlets and periodicals attacking liberal capitalism and its scientific rationale, offering alternative models of natural cooperation and mutual aid. As a result, science became entwined with a renewed campaign to prepare workers for greater participation in national decisions, if not for complete emancipation, and the popularization of science

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[6] The early century autobiographies emphasized self-study and evening classes, but by the second half of the century, autobiographers also noted secularist lectures, discussion groups, socialist classes, and lectures by popularizers of science such as Richard A. Proctor.

was partially achieved by politically minded working-class intellectuals. With the school curriculum confined to basic skills until after the turn of the century, obtaining training in science continued to rely on the informal education available along the low road.

The autobiographies of working-class intellectuals pursuing science in the final decades of the century conform to basic patterns despite differences in geographical or temporal location, education, or income.[7] Growing up in communities as different as the rural mining villages of Wales to the slums of London, the path to science was remarkably similar with respect to age, means, and reaction to first encounters with scientific knowledge.[8]

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[7] This has also been demonstrated in different contexts by David Vincent, Adrian Desmond, and Anne Secord. Investigating working-class science in the early and middle decades, their findings support the idea that working-class traditions of self-improvement, independence, and assertion of customary rights influenced the pursuit of science more than any one particular region, time, or event. The autobiographers in this study came from village, town, and city environments in England, Wales, and Scotland; they came from various divisions within the working class; their formal schooling varied; and, their birth dates span four decades.

[8] Early age of reading, love of books, fascination with science, community helpers, and a variety of applications in intellectual, political, and social contexts present compelling evidence that science was central to working-class goals. See David Vincent, Bread, Knowledge and Freedom: A Study in Nineteenth-Century Autobiography (London: Europa, 1981) and Gretchen Galbraith, Reading Lives: Reconstructing Childhood, Books, and Schools in Britain, 1870-1920 (New York: St. Martin's Press, 1997).

These shared experiences may be accounted for to some extent by the fact that autobiographers are predisposed to explain their lives within the context of a particular genre; however, this view evaluates a life from its conclusion rather than as part of an evolving process. Although it is correct to note the fact that writing an autobiography was an uncommon endeavor--so autobiographers shared an unusual position in the working-class community--this alone does not explain how or why they persevered in their intellectual development despite obstacles or why they were drawn to science in particular. The clearest sense that emerges from the autobiographies is that intelligence and a desire to improve their lives and the lives of others from their community, combined with opportunities to obtain information in an increasingly scientific culture, compelled working-class intellectuals to study and reflect. This put them in a position to write their memoirs; the act of writing their memoirs did not dictate the life-choices that led to the moment of setting pen to paper. Certainly, in small ways, writing imposes order on a disorderly process and constructs an acceptable

public presentation, but these subjective mediations are common to any historical source, and are not in themselves adequate reasons for discounting autobiographical testimony. Autobiography remains the best source for understanding individual reactions within the larger social context.[9]

Several of the autobiographers recalled reading at an early age--between three and seven—with help from family members, and many of them claimed that their interest in scientific ideas was first noticed in their early teen years. In the pursuit of science information, they typically relied on cheap books, shared books, reading clubs, lectures, night classes, newspapers, libraries, and affiliation with secularist and political clubs, and many of the autobiographers attributed much of their progress to the influence of a mentor who provided books, explanations, and encouragement. Striving to extricate themselves from the superstitions and ignorance that made working people vulnerable to economic, political, and cultural marginalization, they sought the advantages of the

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[9] Patterns of development indicate that many points of access existed and that working-class intellectuals took advantage of them.

Victorian intelligentsia. Increasingly, science pointed the way to power, escape, and emancipation.

For some, this meant intellectual development through scientific hobbies or escaping manual labour through a teaching career; science in these cases was revered as a non-ideological empirical discipline. For the remaining autobiographers, science was linked to ideology through life-altering epiphanies, usually coming during first contact with scientific texts, in particular the work of Charles Darwin. In these instances, science was linked to the social sciences and revised in conjunction with other intellectual disciplines, and most of the autobiographies in this group were of political activists. Frequently, first contact with science was an emotional as well as intellectual experience, and it was described variously as an "awakening," a "mental revolution," or as being "filled with a sense of wonder."[10] These mental revolutions were central to the self-definition and philosophy of the

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[10] Benjamin Tillett, Memories and Reflections (London: John Long, 1931) 77; J. Millott Severn, The Life Story and Experiences of a Phrenologist (Brighton: the author, 1929) 44; Frank Hodges, My Adventures as a Labour Leader (London: George Newnes, 1924) 16; Percy Redfern, Journey to Understanding, foreword by Albert Mansbridge (London: George Allen & Unwin, 1946) 12.

autobiographers. As such, science was intimately linked to questions concerning religion, capitalism, poverty, political freedom, and philosophical reflections on ethics, morality, and truth. This chapter looks first at examples of secular conversion experiences resulting from scientific encounters, and then examines scientific hobbies and careers.

Ideology: Science and Religion

Is there a God? In several of the autobiographies, there was little evidence of a conflict between science and religion, but for a few, their intellectual teeth were cut on this question. Tom Barclay, Tommy Jackson, and Rowland Kenney grappled with religious doubt, finally jettisoning Christianity for the laws of nature and economics as articulated by scientific and evolutionary socialism. For them, humanity was governed by biology and history, not providence, and even metaphysics could be accounted for by scientific theories of the mind. Nonetheless, these men were driven by what Tommy Jackson described as "ethical exaltations," and each of them explored a variety of

science-based humanist approaches to social justice and collectivist ethics as a replacement for traditional morality.[11] Conversely, Tom Mann and Percy Redfern shifted uneasily between science and Christianity, ultimately recognizing the need for a balanced view that allowed for both nature and spirit as part of a reformed Christianity. Mann retained close ties with clerics sympathetic to the cause of socialism, but he remained critical of dogmatic and corrupted church authority.[12] Redfern returned to Christian ethics in his adult years after secularism had left him unfulfilled, but his renewed love of God and Christ took him not to the church but to the co-operative movement.[13] F. J. Gould found a compromise of a different sort by retaining the laws of nature and the ethical precepts of Christianity in his advocacy of positivist humanism, which drew upon Auguste Comte's theories, evolutionism, and an ethical socialism that advocated

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[11] Thomas Alfred Jackson, Solo Trumpet: Some Memories of a Socialist Agitator and Propagandist (London: Lawrence & Wishart, 1953) 95.
[12] See for example, Tom Mann, "Preachers and Churches," Vox Clamantium, The Gospel of the People, ed. Andrew Reid (London: A. D. Innes & Company, 1894) 289-314. See also Tom Mann, Tom Mann's Memoirs, preface by Ken Coates (London: Macgibbon & Kee, 1967) 85-97, originally published in 1923 by The Labour Press.
[13] Redfern, Journey, 196-216.

justice, co-operation, peace, and love.[14] In each case, the introduction of science to their newly forming ideologies had life-altering effects. Consistent with larger trends in Victorian belief and unbelief, the search for a unifying ideology to replace Christianity was no easy task for this group.[15]

For Tom Barclay (1852-1933, general labourer and socialist journalist), son of rag sellers, his youthful respect for religious authority proved to be a formidable intellectual obstacle.[16] As an Irish Catholic, Barclay regularly attended church as a child, and he recounted a story from his early youth in which he drew a chalk altar

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[14] Frederick James Gould, The Life-Story of a Humanist (London: Watts and Company, 1923) 155-70.

[15] For studies on the Victorian crisis in faith, see James R. Moore, The Post-Darwinian Controversies: A Study of the Protestant Struggle to Come to Terms with Darwin in Great Britain and America, 1870-1900 (Cambridge: Cambridge University Press, 1979); Frank Turner, Contesting Cultural Authority: Essays in Victorian Intellectual Life (Cambridge: Cambridge University Press, 1993).

[16] Tom Barclay, Memoirs and Medleys: The Autobiography of a Bottle Washer, introductions by David Nash and Nessan Danaher (Leicestershire: Coalville, 1995), originally published in 1934 by Edgar Backus, Leicester. Barclay's father was a reader, and Tom was reading fiction and struggling through Shakespeare by age eight (11-17). He did not attend day school and may have learned to read partially with his father's help and partially at Sunday School (37). He later attended a Workingmen's College where he improved his writing and speaking skills (35). Barclay's love of books and knowledge is a prominent theme in his autobiography, and his achievements as journalist and speaker for the socialist movement confirm his status as a working-class intellectual. Barclay lived mainly in Leicester and London.

on the wall of his family's tenement apartment as a symbol of his devotion.[17] However, Barclay began to question his dedication during his teen years, reading increasingly secular material. He continued his secular studies, finally coming upon Draper's History of the Conflict between Religion and Science (1875), which ignited his rejection of religious authority.[18] By his early twenties, he was sailing the "Sea of Science," finally declaring that he no longer understood "how a Catholic with any intelligence can read Darwin, Huxley, Tyndall, Spencer, and such good philosophers as Kant or Hegel and remain a good Catholic."[19]

For many of the autobiographers, encounters with scientific texts began in their teen years, but Barclay had to wait until he was twenty-three. After years of autodidactic studies in literature, history, and theology, he found science through his work-mate George Robson, who set Barclay on the path of scientific studies that led him to secularism and socialism. Under the Sunday tutelage of

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[17] Barclay, 27. Barclay recalled with some bitterness the treatment of Irish Catholics in Leicester (7).
[18] Barclay, 44-46.
[19] Barclay, 44.

Robson, Barclay studied geology, botany, and physiology. He described Robson as a rare "working-man scientist" and "enthusiastic naturalist" whose specimens could be found in the local museum.[20] Robson offered his expertise to Barclay and in return, Barclay helped "polish" Robson's grammar. On Sundays, joined by one of Barclay's shop-mates, they went on long rambles collecting and discussing plants and insects. This led Barclay to take examinations in geology, botany, physiography, and physiology from the Science and Art Department.[21] Even though the utility of these sciences escaped Barclay, his encounter with works by Darwin, Huxley, Tyndall, and Spencer brought him to the conclusion that he had at last "got the very truth."[22] Science provided the capstone in his quest to free himself from the oppression of religion, ignorance, and uncritical acceptance of elitist authority.

Spared the religious angst suffered by Barclay, T. A. Jackson (1879-1955, compositor, socialist agitator, and journalist), son of a radical compositor and foreman,

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[20] Barclay, 41-42.
[21] Barclay, 42-43.
[22] Barclay, 44.

described his family's religious practice in casual terms.[23] Jackson attributed his family's church attendance more to his mother's desire to appear respectable than to Christian faith.[24] This made it easier for Jackson to include the "creed and formularies of Christianity" in the broad indictment of elitist authority that led eventually to his wholehearted conversion to socialism.[25] Faced with the formidable task of constructing an ethical base to replace Christianity, Jackson looked to collectivism and his faith in the intelligence of British workers.[26]

Jackson claimed that his mother began to teach him basic reading at age three.[27] Due to serious eyesight problems, he was forced to wear glasses, preventing him from participating in rough games and sports.[28] Reading was

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[23] Jackson's parents and grandparents were readers, and he claimed to have been reading at a basic level by age three (39). Tommy was born in Clerkenwell and attended school until age thirteen.
[24] Jackson, 40-41.
[25] Jackson, 95.
[26] For more on Jackson, see Vivien Morton and Stuart Macintyre, "T. A. Jackson, a centenary appreciation," Our History, Pamphlet 73, (London: History Group of the Communist Party, 1979). Vivien Morton was Jackson's daughter.
[27] Jackson left school at age thirteen. He was a passionate reader as a youth, and his autobiography lists many works of fiction, history, and economic theory which he read during his teen years.
[28] Jackson, 13-14, 39-40. Jackson's mother was concerned that the glasses would be broken if he played rough games. Jackson recalled that his mother and some of his peers considered his "book-worming" odd.

his solace and his passion, and happily, the family library contained works by Dickens, Shakespeare, Thackeray, and Scott, along with Cassell's Illustrated History of England and a large illustrated family Bible.[29] In his teen years, Jackson became disillusioned with government and party politics, and he devoted himself to intellectual improvement as a means of developing a "critically-scientific view." It was a time when Darwinian texts had reached the used bookstores, and Jackson found his imagination "fired up" by Huxley and Tyndall.[30] At the same time, Jackson became critical of "Christian beliefs" because they demanded a passive endurance of suffering and provided a "bar to the acceptance of Socialism." To "burst through this barrier" was a "necessary contribution towards Socialist advance."[31]

Jackson went to South Kensington Natural History Museum to study evolutionism. This led to the dissolution of "the last shreds" of his "belief in the Supernatural."[32] Soon after, having re-read Blatchford's mixed bag of

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[29] Jackson, 13-15.
[30] Jackson, 42.
[31] Jackson, 96.
[32] Jackson, 42.

evolutionism and socialism in Merrie England (1894), Jackson was "struck as by a thunderbolt" with the thought that a society based on private property was necessarily an immoral one.[33] This was Jackson's conversion moment, and he became a lifelong advocate of socialism and evolutionism.[34] Jackson's exaltation continued with a reading of that "masterpiece of popularization," Engels' Socialism: Utopian and Scientific and the Communist Manifesto. The two components of his thinking—evolutionism and socialism—were brought into a "blazing revelation," as the bits of "miscellaneous information" were brought into "a completely inter-related Universe."[35]

In this state of untrained exaltation, Jackson met Jack Fitzgerald, an Irish bricklayer who taught classes in Marxist economics in his spare time. Jackson described Fitzgerald as "very nearly the best-read man I have ever met."[36] Fitzgerald helped Jackson make his way through Karl Marx's difficult Capital, bringing discipline and structure to Jackson's eclectic ideology and his materialist ethics.

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[33] Jackson, 49.
[34] Jackson, 48-49.
[35] Jackson, 58-59.
[36] Jackson, 60.

As a reward for his sophisticated understanding of scientific Marxism, Fitzgerald gave Jackson secondhand copies of Henry Mansel's Bampton Lectures, The Limits of Religious Thought and Herbert Spencer's First Principles.[37] Fitzgerald continued to tutor Jackson in Marxist literature, and it was to Fitzgerald that Jackson owed much of his uncompromising radicalism, shrewd political analysis, and ethical sociology.[38] Jackson would go on to lecture on Darwinism, and in 1936, he wrote a lengthy analysis of Darwin and Marx in Dialectics: The Logic of Marxism.[39]

Like Jackson, Rowland Kenney (1882-c.1950, general labourer, journalist, editor, author), son of a frequently unemployed factory worker, was an earlier reader who "read endlessly" during his early school years.[40] His first

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[37] Jackson, 59-61.
[38] Jackson, 64-66.
[39] Jackson, 91. See also, Dialectics: The Logic of Marxism (London: Lawrence and Wishart, 1936).
[40] Rowland Kenney, Westering: An Autobiography by Rowland Kenney (London: J.M. Dent, 1939). Kenney was born in Shelderslow, Yorkshire. He attended day school intermittently until he was nine years old but much of his learning was self-taught (3-9). Kenney's grandmother, a fan of Robert Blatchford (1851-1943), was a big influence in his life (20). Kenney worked as a miner and as a navvy, but his writing talent eventually earned him a job as a journalist and editor for the Daily Herald and later as a government correspondent (33-63, 103, 172-92, 307). Kenney was a socialist and his sister Annie was a famous

exposure to science likely came from Robert Blatchford's Clarion. Kenney began reading Blatchford's column in the Sunday Chronicle at age nine with his grandmother, and they followed "Nunquam" when he moved to the Clarion. At age fourteen, Kenney read the collection of articles in Merry England (1894), and it was in these formative years that Blatchford's socialism and attacks on religious authority helped Kenney to articulate his views on science, politics, and Christianity.[41]

Kenney recalled that Blatchford sought an explanation for "political prejudice and popular ignorance of economics," and so turned his attack on religion, which he saw as pacifying the masses with promises of eternal bliss in Heaven. Blatchford urged workers to create "a heaven on earth," which entailed "shattering Christian faith."[42] Kenney had already observed that "capitalism was an evil stupidity," and that "the upholders of Capitalism must therefore be either too lazy to study…or deliberately

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suffragette. See Annie Kenney, Memories of a Militant (London: Edward Arnold, 1924).

[41] Kenney, 20-21, 25-27. According to Annie Kenney, Blatchford was a powerful influence in her life too. See Annie Kenney, Memories of a Militant, 23.

[42] Kenney, 26.

concerned to perpetuate a gross and colossal evil."[43] In response to Blatchford's "anti-religious campaign," Kenney re-read the Bible. Although he found much to praise in its literary merit, he rejected its elitist and dogmatic superstitions and aligned himself with socialism. This led Kenney to science as he searched for a logical structure for his socialist critique of society.

By the age of seventeen, wishing to understand secularism, Kenney "read avidly volume after volume of the cheap secularist literature produced by the Rationalist Press Association," organized in part by F. J. Gould.[44] These included Darwin's Origin of Species and Ernst Haeckel's Riddle of the Universe (1899), which he "soaked in as welcome supports" to his own "vaguely formulated but firmly held convictions." Kenney also read works at this time by Huxley, Spencer, Tyndall, Grant Allen (1848-1899), and Edward Clodd (1840-1930).[45] Kenney, like Tommy Jackson, "found the last shreds of [his] belief in the Supernatural dissolving in the acid of critical-realism and materialism"

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[43] Kenney, 25.
[44] Kenney, 9, 27.
[45] Kenney, 27.

that he acquired with the study of evolution and the ideas of Huxley and Tyndall.[46] In his adult years, Kenney continued to study science, taking an interest in psychology and modern physics.[47] Nevertheless, Kenney remained what T. A. Jackson referred to as a "religious type," studying mysticism, yoga, and the spiritual psychology of Georges Gurdjieff (1872-1949) and P.D. Ouspensky (1878-1947).[48] Through philosophy, psychology, science, and socialism, Kenny developed a collectivist ethic that included recognition of larger forces at work in the mind and in the universe, and his autobiography is written as a political, spiritual, and psychological journey in which science played a key role.[49]

For Tom Mann, Christianity was not so easily discarded. Mann (1856-1941, engineer, writer, lecturer, labour organizer), son of colliery clerk, continually re-evaluated the political, economic, social, and spiritual components of his ideology, and he maintained ties with

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[46] Jackson, 42.
[47] Kenney, 323-45.
[48] Jackson, 95. Kenney, 320-45.
[49] Kenney, 311-16. This section is appropriately titled "Pilgrimage."

members of the clergy throughout his life.[50] Mann was a seeker of knowledge and genuinely ethical individual, and his interest in everything from temperance to anarcho-syndicalism provides much material for historical analysis.[51] In his evolution from Warwickshire youth to one of the main agitators of the Victorian Left, Mann's story draws attention to the deep, heartfelt questions that brought autodidacts to the door of modern science.[52]

By age fifteen, Mann was concerned with intellectual, religious, and physical salvation. Living in Birmingham, he joined the local temperance and vegetarian leagues, took Bible classes, and trained as an apprentice engineer.[53] Interested in social problems, he took an "orthodox" Christian approach in that he believed that "all social distress...is the direct outcome of neglecting the soul's

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[50] Mann, 85-95.

[51] For more on Tom Mann, see Dona Torr, Tom Mann (London: Lawrence and Wishart, 1944); Graham Osborne, Tom Mann: His Australasian Experience 1902-1910 (Ph.D, Australian National University, 1972); and John Laurent, Tom Mann, Social and Economic Writings (Nottingham: Spokesman, 1988). I would like to express my gratitude to Dr. Laurent who directed me to much of my information on Mann.

[52] Mann provided only the basic outline of his youth in his autobiography. He left school at ten and worked hauling coal. By fourteen, he was an apprentice engineer. His education was supplemented by Sunday school, Bible classes and evening study at the Midland Institute in Birmingham, to which Mann and his father moved in 1870 (3-11).

[53] Mann, 9-10.

salvation."[54] As part of his "missionary zeal," Mann advocated healthy diets and temperance as the means by which the "vicious environment" responsible for so much destruction could be tempered, and he later became involved with the Malthusian League as an extension of this approach.[55] In retrospect, Mann criticised his crude understanding of environmental factors for being devoid of economic or sociological theory, and he wrote that "had I had the guidance at this stage, to teach me how far environment is really responsible for character…I should have changed my attitude."[56] Reading at the Birmingham Public Library as a teenager, Mann was "groping" his way "towards the light" and "becoming conscious of mental darkness."[57]

In his mid-teens to early twenties, Mann studied composition, science, mathematics, and geography while also practicing his debating skills at a local club; like many of the autobiographers, Mann was in a continual state of study. Tom Mann took engineering-related classes connected

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[54] Mann, 9.
[55] Mann, 9, 16.
[56] Mann, 9.
[57] Mann, 9.

with the Science and Art Department, South Kensington, three nights a week at the Midland Institute in Birmingham for five years beginning at age fifteen.[58] Concurrently, he was enrolled in Bible classes where the instructor also gave him lessons in grammar.[59] These teachers had a "big influence" on Mann, and when in 1877 he left Birmingham for London, he continued to study science with friends who also had a "scientific turn of mind."[60]

In London, Mann was interested "in two subjects apart from workshop affairs—social problems and astronomy."[61] First looking to the Malthusians for answers to social questions, Mann's conversion to left-wing social science began with his reading of Henry George's Progress and Poverty, followed soon by Thorold Roger's Six Centuries of Work and Wages. With these books, Mann was able to "see more clearly the vastness of the social problem," and he rejected Malthusianism completely.[62] At the same time, his interest in scientific ideas found a forum in the

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[58] Mann, 6.
[59] Mann, 6-7.
[60] Mann, 6-7, 18-19.
[61] Mann, 13.
[62] Mann, 16. Henry George is frequently noted in political autobiographies.

Shakespearean Mutual Improvement Society, a group set up by Mann in London that took up a variety of scientific topics in addition to their literary discussions. Mann also attended lectures in London given by Richard A. Proctor, science popularizer, astronomer, and editor of the popular science journal Knowledge.[63] Mann, a "regular reader" of Knowledge, adopted astronomy as his favourite hobby and even purchased a telescope, which he was forced to sell in hard times.[64] Additionally, in 1882, Mann took a trip to Paris where he became acquainted with the philosophy of Emanuel Swedenborg, eighteenth-century Swedish scientist and theologian.[65]

As Mann's social and political views developed, he became more involved in London's working-class movement, joining the Social Democratic Federation in 1884, which grounded its programme in Marxist scientific socialism, and the remainder of Mann's life was devoted to working-class

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[63] Mann, 19. Proctor edited Knowledge from 1881 until his death in 1888. For more on Richard Proctor, see Bernard Lightman, "Astronomy for the People," Facets of Faith and Science, ed. Jitse M. van der Meer (Lanham, New York and London: The Pascal Centre for Advanced Studies in Faith and Science, Redeemer College, Ancaster, Ontario, and University Press of America, 1996) vol. 3, 31-45.
[64] Mann, 19, 48. Joseph Gutteridge constructed his own microscope, see David Vincent, Literacy and Popular Culture, England 1750-1914 (Cambridge: Cambridge University Press, 1989) 161.
[65] Mann, 20.

emancipation.[66] Nevertheless, Mann returned to religious topics throughout his career as an agitator for the Labour movement and as a popular lecturer on evolutionary socialism, refusing to be intimidated by his atheistic comrades.[67] Though Mann's journey to evolutionary socialism was not articulated fully until his late twenties, his journey to that point was filled with the questions and remedial schemes common to thoughtful men and women exploring religion, politics, science, and philosophy in search of class emancipation and personal enlightenment.

Like Tom Mann, Percy Redfern was unable to completely sever ties with Christianity. In his adult years, he derived much of his ethical standpoint from Christ's example, but it was to be an eclectic philosophy touched by science, secularism, socialism, and the cooperative movement. Redfern (1875-1958, clerk, journalist, historian), the illegitimate son of the man for whom his mother was servant, began reading in early childhood, and

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[66] Mann, 14-17, 20-22, 28-38.

[67] As early as 1884, Mann lectured on astronomy (19), and there are many reviews and announcements for Mann's evolutionary lectures in The Barrier Daily Truth, a labour paper in Barrier Hill, Australia. Mann was a prominent labour organizer during his visit from 1902 to 1910. See, for example, Barrier Daily Truth, June 4, 1909.

his quest for scientific knowledge began at the age of thirteen when he was "directed" to abandon his love of sensationalist fiction for "scientific, informative books."[68] Redfern described his approach as "skirting that dark continent dubiously," but soon found himself beckoned by "the popular and romantic introductions to astronomy of R. A. Proctor."[69] Not only was Redfern's interest stirred as he considered the possibilities of inhabited planets, he rejected an "earth-centered universe" and the Bible along with it.[70] For many years, Percy followed a secular path that placed science and scientific reasoning at its centre, guided by a thorough study of Darwin, Huxley, Comte, and Marx.

Biblical criticism and a challenge to religious authority were at the heart of Percy Redfern's teen angst, but his rebellion was as much about self-realization and the discovery of a rational and just universe as it was

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[68] Redfern, 12. Redfern does not say what his father did for a living or who directed him to science texts. Redfern was born in Leicester and attended a variety of schools until age fourteen. He worked in several sales-related jobs, eventually becoming a clerk with the Co-operative Wholesale Society. He remained attached to the CWS for the remainder of his life as a journalist, editor, and historian (see Chapter 12 of Redfern's autobiography).
[69] Redfern, 12.
[70] Redfern, 12-13.

about elitist authority. Percy began his attack on society with an exploration of all things secular, and his conversion moment occurred during an astronomy lecture by R. A. Proctor. Proctor's description of the universe launched Percy on a "journey that at once took [him] away from the Bible."[71] During the next few years, he flirted with socialism, anarchism, pantheism, and Marxism, and he rejected the Ethical Movement because it gave authority to neither science nor religion.[72] He knew that he must find a creed that saw the integral union between man and Nature, and yet he wondered, "to what Heaven would this lead?"[73]

Percy looked for answers in Huxley's tenuous balance between civilization and "Nature's wilds" and in Darwinian evolution but he found that he could not reduce life to that "shared with rats."[74] Nature, he realized, was "non-moral," and even the cooperative version of evolution put forward by Kropotkin was ultimately unsatisfying because while "Kropotkin had protected the finer feelings from Darwin and Huxley," he had remained "on their own ground"

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[71] Redfern, 12.
[72] Redfern, 23, 41.
[73] Redfern, 40.
[74] Redfern, 40-41, 50-56.

had failed to get to the "roots of desolation."[75] In this realization, Redfern made an unusual choice within the context of the Victorian Left: he cited the limitations of science both as authority and as an emancipatory strategy. Science, like the Church, was limited in its ability to regulate or improve the quality of life. Redfern's recognition that even a leftist adaptation of evolution left scientific authority intact demonstrated a keen awareness of the trouble yet to come for the Labour movement in its failure to establish a coherent ethical programme that made humanity, not Nature, responsible for human action. Redfern eventually reconciled with Christianity in his adult years, becoming increasingly critical of science for its essential neglect of the spirit.[76]

Finding a balance between science, ethics, and social justice was an essential component of the personal and professional goals of F. J. Gould. In the early 1870s, Gould (1855-1938, teacher, writer, publisher, and humanist), son of struggling jeweler and opera singer,

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[75] Redfern, 53.
[76] Redfern, 40-41, 53-56, 66-70, 107, and Chapter XIV.

began his secular reading with Dickens and Carlyle while a divinity student and teacher at Chenies Rectory in Buckinghamshire.[77] Increasingly Gould embraced secular ideas, and at sixteen he requested as his prize for having passed a South Kensington science examination a copy of Charles Darwin's The Origin of Species for "some inexplicable impulse."[78] Gould's journey from divinity student to prominent secularist and humanist drew upon evolutionary theory and positivism, and he assigned the start of a "humanist leaven" to his teen years.[79]

Gould recalled his secular conversion as years in which "the shattered fragments of [his] Evangelical beliefs …diminished daily," culminating in his momentous encounter with the secular ideas of Charles Bradlaugh.[80] By 1877, secularism had transformed Gould's faith so profoundly that he abandoned the conservative rural atmosphere of his post at Chenies. In 1879, Gould made his way to the radical

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[77] Gould, 26. Gould was born in Brighton but lived mainly in London and Leicester. His mother was a dressmaker and Gould lists her as a hero along with Bradlaugh and Hyndman (5). Gould's family was very poor but his mother made sure that he received an education by having him placed in the Chorister Boy's School at Windsor Castle (5-7). For Gould's time at Chenies, see 16-25.
[78] Gould, 26-27.
[79] Gould, 26.
[80] Gould, 44-45.

environment of London, where he taught for the London School Board.[81] There, Gould began his lifelong association with the London socialist, freethought, labour, agnostic, and secular groups.[82] Always emphasizing education in the large sense of the word, Gould helped to organize the Rationalist Press Association, which published inexpensive re-prints of classic books, and he worked tirelessly as a lecturer, writer, and organizer in his effort to promote "social progress and the humanizing of thought and education."[83]

From 1899 to 1908, Gould was organizer and secretary for the Leicester Secular Society. Many famous secularists and socialists were invited to lecture at the hall, including Annie Besant, Charles Bradlaugh, Tom Mann, Prince Kropotkin, and William Morris; evolution was among the topics discussed.[84] It was during this time that Gould became interested in the positivist humanism of Auguste

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[81] Gould, 37-45.
[82] Gould, 49. See also, Bernard Lightman, "Ideology, evolution and late-Victorian agnostic popularizers," History, Humanity and Evolution: Essays for John C. Greene, ed. James R. Moore, 291.
[83] Gould, 60, 72-78, 92-109, 117. Gould contributed articles to the children's journal The Young Socialist, edited by Lizzie Glasier. See for example the issues for February-April, 1912. For more on The Young Socialist, see Chapter 5 of this study.
[84] Gould, 87-89.

Comte.[85] Comte's positive philosophy was based on a developmental model of the human mind: humanity was evolving through successive philosophical stages that began with the theological, followed by the metaphysical, and ending with scientific stage. For Gould, positivism articulated the "true line of evolution": a non-theological "religion of humanity" based on "love, order, and progress."[86]

By 1908, Gould was ready to resign his position with the Leicester secularists in favour of organizing the Leicester Positivist Society. This organization's mandate emphasized positivism, humanism, and pro-labour activism, and its goals were eloquently summarized in a circular issued by Gould in 1908:

> I want to express my conceptions of life, science, duty, and education in a religious form, as understood by Positivists (a form which is altogether from free theology). By 'religion' I mean the Service of Humanity….I want to be more at liberty to assist the

[85] Gould, 40-51, 109.
[86] Gould, 51.

> Labour Movement. Half a century ago Comte declared that the great social needs of the proletariat were a sound free education to the age of twenty-one, and regular employment; and I want to help towards the accomplishment of these two aims…. The Labour Movement, the Woman Movement, and the Moral Education movement are the most hopeful signs of the age….[87]

It was to be a humanist morality based on science, love, duty and peace, with acceptance of all faiths and people. This religion of humanity would promote education, justice, the rights of labour, and a re-orientation of Christ's teachings to a non-theological defence of the unemployed, the hungry, the homeless, and the outcast.[88] Gould's faith was in the evolution of humanity towards a just and noble future, and he rejected the "God-doctrine" because it was "not noble enough for the human To-day."[89] Gould believed that "on the evidence of history, that our race journeys,

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[87] Gould, 109.
[88] Gould, 106, 121.
[89] Gould, 165.

in a pilgrimage of joy and pain, towards an ever-larger sanity and a final world-unity."[90]

Ideology: Science and Politics

The unified ideology of ethics, religion, humanism, science, and social justice pursued by F. J. Gould did not always appeal to those with a less philosophical approach to social reform; their pragmatic intellects yearned for a sound political and economic system grounded in scientific and judicial law. Autobiographers such as Tom Bell and Frank Hodges emphasized social and political conversions, and in each case science was attributed with sharpening what Tommy Jackson described as a "critically-scientific view of politics."[91] Striving for class emancipation through collective action or revolution, science provided a foundation for the economic and political re-structuring of society based on reliable, objective universal laws. As a counterforce to privilege, left-wing interpretations of Darwinism supported labourism as easily as it did total revolution. Freeing themselves from entrenched authority

[90] Gould, 115.
[91] Jackson, 42.

and outmoded dogma, the political use of science was liberating whether it was articulated as the evolutionary socialism, the coming of a Marxist revolution, or the basis for improving the status of women. If these autobiographers experienced a crisis of faith, they concealed it and, on the contrary, the text indicates that each of them was comfortable with a progressive materialist analysis of history and society. Tom Bell considered science a necessary component of economic and social analysis. Frank Hodges found justification for collective action in Darwinism, and Ben Tillett gained the confidence he needed to challenge authority through his reading of the Darwinists. Lastly, Margaret Bondfield brought science to working-class mothers in her lectures on physiology, birth, and childcare.[92]

Tom Bell (1882-1944, factory worker, iron worker, and communist organizer), son of a stonemason, recalled in the foreword to his autobiography that it was his mentor George S. Yates who saved him from "endless floundering" by

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[92] Stuart Macintyre's study of Marxism as a "proletarian science" lists several additional working-class intellectuals who made this connection between science and socialism. See Stuart Macintyre, A Proletarian Science: Marxism in Britain, 1917-1933 (Cambridge: Cambridge University Press, 1980) 71-75, 106-108.

leading him to the "basic theoretical works of Marxism and the writings of the great masters of science and general literature."[93] George Yates was an engineer who managed to obtain employment at Edinburgh University "attending to the scientific instruments."[94] Capitalizing on the opportunity, Yates studied mathematics and design, and eventually found work in Glasgow as a draughtsman and designer.[95] Bell struggled with political and scientific texts throughout his teen years, but it was Yates who helped Bell formulate a coherent ideology when Bell considered joining the Social Democratic Federation in 1902.[96]

Bell recalled in his autobiography that the "first scientific text-book I bought was The Descent of Man by Charles Darwin, and subsequently The Origin of Species and other books by Darwin."[97] Bell was sixteen or seventeen at that time and had been reading political and secularist

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[93] Thomas Bell, Pioneering Days (London: Lawrence & Wishart, 1941) 10. Thomas Bell was born in Glasgow, where he spent most of his life. He attended school until age eleven, and he spoke respectfully of his radical father and local radical artisans who gathered at the shops to read and discuss the news. He made early use of the library by volunteering to return books for his father, where the librarian "took a special interest" in him (13-15).
[94] Bell, 10.
[95] Bell, 36.
[96] Bell, 35.
[97] Bell, 32-33.

literature from the age of twelve.[98] After reading Darwin, Bell went "in search of scientific knowledge," and like other young intellectuals of the 1890s, he selected the Rationalist Press Association's reprints of classics by Huxley, Ernst Haeckel, Edward Clodd, Grant Allen, and an additional text by Samuel Laing (1812-1897), Modern Science and Modern Thought.[99] Bell also noted that a copy of Dr. Foote's Plain Home Talk and Cyclopedia, which touched on many scientific and medical issues, made "a great impression" on him. He noted further that it was passed around to his workmates until it was "black as coal, and the batters torn."[100] When Bell was twenty, he studied Marxist economics with George Yates, and prepared for his career as an organizer in the Socialist Labour Party and the Communist Party; his ideology was no longer floundering.

Bell continued to study science, and astronomy was a favourite hobby. Working as an ironmoulder and reading Marx's Capital on the tram to and from work, Bell found

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[98] Bell, 26, 30-31.
[99] Bell, 32. Rowland Kenney also noted the usefulness of the RPA reprints.
[100] Bell, 32-33.

time in the evening to study geology, French, and astronomy at the Andersonian College.[101] Bell was joined by his close friend Arthur McManus, an Irishman ten years younger than Bell, whose knowledge of literature made a fine addition to Bell's growing expertise in science and economics.[102] Together they "read feverishly, discussed fiercely, and walked the streets, often after midnight, in an effort to sort out…the problems of man and the universe."[103] It was at an Andersonian College lecture on radium that Bell experienced a moment of revelation, which he described as "a great psychological impression."[104] Listening to Professor Soddy's theory on the disintegration and reintegration of the heat of radium that completely overturned "Laplacian theories of gradual dissipation of the earth's heat," McManus and Bell extrapolated a political parallel. If Laplacian dogma could be revised, then they no longer need to be the "the slaves of dogmas" touted by the "ossified" Socialist Labour Party.[105] Bell's

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[101] Bell, 13-15, 32, and 66. Andersonian College was endowed by "an old shipyard owner to provide technical instruction for workers" (66).
[102] Bell, 94.
[103] Bell, 97.
[104] Bell, 96.
[105] Bell, 96-97.

communist views were confirmed, and he continued to promote left-wing unity and revolution, eventually becoming a founding member of the British Communist Party.[106]

Taking a less radical approach to political reform but also attributing a crucial role to scientific ideas in the formation of his political beliefs, Frank Hodges supported unionism rather than communism. Although most of his life falls outside the range of this study, many of his influences derived from Victorian political and intellectual culture, and his story epitomizes many of the recurring themes in working-class intellectual autobiography.[107] Frank Hodges (1887-1947, miner, union leader, MP), son of miner, was in his early teens when Darwin's The Origin of Species impressed him as "the greatest of all revelations" opening up "an entirely new world."[108] Having left school at twelve, Hodges began working in the mines as a door-boy, a job that required him

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[106] For more on Bell and communism, see The British Communist Party (London: Lawrence and Wishart, 1937).
[107] Frank Hodges was born in Gloucestershire but moved to South Wales with his family at an early age (1-9). His father was farmer, then a miner, with radical democratic views. Reading was part of Hodges' family life, and he attended school until age twelve. He was an agent for the South Wales Miner's Union for much of his life (170-75).
[108] Hodges, 16.

to open and shut the two doors used for ventilation as the pit ponies traveled through the mine. He described the wait between ponies as a "lonely vigil" that "made one contemplative."[109] To pass the time, he began to sneaking an "old copy of Shakespeare into the mine," hidden from the scrutinizing looks of the "over-man" and protected from the nibbling mice that chewed up the corners of his "Venus and Adonis."[110] One of his workmates who could not read or write convinced Hodges to read aloud to him during breaks, and so whenever possible Hodges read to the "old road-man," beginning with "A Midsummer Night's Dream."[111] Shakespeare "awakened a tremendous passion for other books" in Hodges, and he subsequently enrolled in night classes, studying a wide range of topics including composition, science, mathematics, and geography.[112]

A local mining official took "special delight" in Hodges' intellectual development, befriending the provocative young miner.[113] Hodges had gained a mentor who enjoyed long walks during which they could talk. Hodges

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[109] Hodges, 11-12.
[110] Hodges, 13.
[111] Hodges, 14-15.
[112] Hodges, 15.
[113] Hodges, 16.

recalled that the mining official was a "geologist, a mining student, and a keen mathematician." On their walks, they studied rock formations and fossils, measured the growth of trees, and observed the habits of animals. However, the "greatest of all revelations" came when Hodges' mentor presented him with The Origin of Species. It was this book which "opened up an entirely new world" for Hodges, and lead to a "mental revolution."[114] From Origin, Hodges moved on to The Voyage of the Beagle and T. H. Huxley's essays: "armed and equipped with this new information, I was ready to become a member of the local debating society." Hodges keen mind and debating skills earned him a scholarship to Ruskin College.[115] He lived most of his life as a union official, finally being elected to Parliament in 1923.[116] Though Hodges provided few details of the ideological impact of Darwinism, in the context of late Victorian sociology, it is probable that the progressive materialism of evolution provided a

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[114] Hodges, 16.
[115] Hodges, 33-35.
[116] Hodges, 59-75, 170-75.

foundation for Hodges' confidence in improving conditions through collective action.

This was certainly the case for Ben Tillett (1860-1943, union leader, writer, lecturer, and MP for North Salford, 1917-1931), son of a factory worker, who drew on evolutionism in his defence of working-class rights based on the role environment played in the development of character.[117] Tillett argued for a neo-Lamarckian developmental model, leading to improved conditions and progressive adaptation. Changing conditions was part of history and nature, but improved conditions could be helped along by human intervention, in this case by the labour movement. For a man who felt his life was "written in deeds, not words," and whose first serious contact with books did not begin until his teen years, Ben Tillett understood clearly the political importance of the Victorian evolution debates.[118]

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[117] Benjamin Tillett, An Address on Character and Environment (Labour Press Society, Manchester, n.d.).
[118] Tillett, 18. See also chapters 1 and 2.

In 1876, Ben Tillett was approximately sixteen when he embarked on an "enduring fascination of books."[119] Placed in the position of tutoring his seven-year-old nephew, Tillett began to read seriously despite his late start resulting from a nomadic youth as circus boy, tramp, and sailor. From that point on, Tillett bought books with spare pennies, and his intellectual journey led him to Darwin, Haeckel, Huxley, Spencer, and Carlyle, with the "conflict between science and religion" being of particular interest.[120] Tillett described his reaction to science as an "awakening," and he soon became a major organizer and pragmatic theorist for the labour movement.[121] Tillett did not pursue the abstract philosophical dimensions of socialism or the religious and ethical discussions among labour groups; instead, he made continual reference to science and biology in his relentless promotion of organized labour and trade unionism.

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[119] Tillett, 76. Benjamin Tillett was born in Bristol. He did not attend school. He provides very few details of his family life and claims to have left home at seven to join a circus. He wandered for several years, finally signing on as a sailor. His one family attachment was to his sister and her son, and it was their encouragement that brought Ben to books and science at the age of sixteen (18-28, 77, 270).
[120] Tillett, 77.
[121] Tillett, 77.

Like Tillett, Margaret Bondfield (1873-1953, shop assistant, union activist, lecturer, politician), daughter of a foreman lace maker, incorporated scientific ideas into her social reform, and her autobiography is more concerned with the labour movement than with metaphysics or personal history. Bondfield came from a radical political family with intellectual leanings.[122] She attended school until age thirteen and was a pupil-teacher for a brief period.[123] At age twenty-one, Margaret moved to London where she became involved in the trade union movement and the Independent Labour Party.[124] She eventually affiliated with the Fabians and held important positions in the Labour Party. A member of the Women's Cooperative Guild, Margaret lectured "working housewives" on physiology and the "scientific treatment of child-bearing."[125] She rejected Darwinian explanations for the higher infantile death rate among working-class families, stressing that it was more a matter of nurture than nature that accounted for the disparity (136). Campaigning to bring science to working

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[122] Margaret Bondfield, A Life's Work (London: Hutchinson, 1948). The Bondfields had intellectual and scientific-minded friends (Chapter 1).
[123] Bondfield, 14-29.
[124] Bondfield, 48-58.
[125] Bondfield, 133.

mothers was, according to Bondfield, a matter of national concern, and improved living and working conditions for British labourers remained the central preoccupation of her life.

In sum, science provided the framework within which these working-class intellectuals explored the causes and ideas most important to them as individuals. Frequently noting early reading and inspirational encounters with science in their teen years, this group of men and women overcame economic obstacles and found the necessary resources within their own communities, relying on family, friends, and mentors. Another important recurring theme was the key role played by Darwin in several descriptions of intellectual epiphany. Moreover, in most cases, his ideas were not adopted uncritically. In conjunction with Karl Marx, Henry George, or Robert Blatchford, the Darwinists provided the basic theories but working-class advocates and intellectuals filled in the details and shaped the correct interpretation. Whether science was counterpoised to religious authority, fixed class relations, or capitalist economics, it presented an

ideological foundation for an indictment of systemic poverty and inequality, along with a hopeful prognosis for securing justice and independence for labouring Britons. At the personal level, science offered ambitious working-class intellectuals freedom from the oppression of manual labour and mental stagnation.

Hobbies and Careers: The Empirical Approach

As a hobby, reading scientific texts could be instructive or entertaining, and several of the autobiographers who showed a limited interest in science participated at the recreational level. Ben Turner (1863-1942), son of a weaver, noted that the "even the local weeklies" carried articles on all subjects, including science, and he referred on several occasions to science in conjunction with daily concerns such as food, medicine, and unions.[126] Flora Thompson (1876-1947), daughter of a

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[126] Ben Turner, About Myself, foreword by James Ramsay Macdonald (London: Humphrey Toulmin, 1929) 50-51, 47, 74, 143. Ben Turner was born in Holmfirth, Yorkshire. His father was a weaver and a unionist. The family took in radical newspapers and Ben recalled reading newspapers to neighbours. He attended school until age thirteen, followed by night classes, and secularist and freethought lectures (17-44). He

stonemason, in recounting stories of the local postmistress Dorset Lane's love of scientific books and her uncle's attic library complete with tempting natural history texts, provides an excellent example of the place assigned to science by the rural general reader.[127] Flora felt it unlikely that many of her neighbours knew of Darwin, but for those who were interested in science, reading material and intellectual discussions were available. Joseph Keating (1871-1934) son of a shipyard worker, like Flora, was an avid reader with some interest in science and psychology, and spent a year tackling Herbert Spencer's Principles of Psychology.[128] Even Will Thorne (1857-1946),

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worked early on as a farmhand and factory worker but became involved in textile union agitation. He was a member of the Leeds Socialist Party, the Leeds Trade Council, Mayor of Bately, and eventually, Minister of Mines in Macdonald's Labour government in 1929 (86-103, 139-51).

[127] Flora Thompson, Lark Rise to Candleford, A Trilogy (London: Penguin, 1973) 351, 365. First published by Oxford University Press in three parts, 1939, 1943, and 1945. Thompson's autobiography is written as a fictional biography of Laura and her family, residents of a small village in Oxfordshire. Her father and mother taught Laura and her brother to read at early ages (41-45) and Laura read a great variety of books throughout her life (351-65, 414-16). Laura attended day school and eventually worked as assistant post-mistress and writer. She supported the socialists for a while because they wanted to help the poor, and the socialist-based Daily Herald published some of her poems under the "literary editorship" of Gerald Gould (417,467). Thompson's book is useful for descriptions of the many ways working people obtained books (passim).

[128] Joseph Keating, My Struggle for Life (London: Simpkin, Marshall, Hamilton, Kent and Company, 1916) 170-71. Keating was born in Mountain Ash, a small village in South Wales. His father was a shipyard worker

who learned to read late in life, listed among his favourite authors several who regularly employed science as a component of their argument such as Robert Blatchford, Friedrich Engels, Edward Aveling, August Bebel, and Henry Mayers Hyndman.[129] Although these autobiographers were not inclined to pursue science as more than a casual hobby, their testimony confirms that scientific materials were obtainable if desired.

Aside from reading, public lectures provided another point of access for working-class science enthusiasts. As

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and mother did sewing work to add to the family income (1-7). Keating's father frequently returned from trips with "a bagful of books on all conceivable subjects," and much of Keating's autobiography is dedicated to defending the intelligence of the working class (12-13, 30, 73-74, 83, 152). Keating attended school until age twelve, and later evening school, but he was mainly self-taught (65-66, 120, 170). His first job was in the coalmines but he soon left, becoming a general labourer, finally finding regular employment as a clerk (37, Chapters XI and XXIV). Keating was also a novelist, and his autobiography lists eight published novels.

[129] Will Thorne, My Life's Battles (London: George Newnes, 1925) 47. Thorne was born in Birmingham. He was the son of bricklayer but his father died when Will was six years old. His mother supported the family by sewing hooks and eyes on cards for 1½d per gross, less the cost of materials. Will helped by taking odd jobs, eventually assisting his uncle at brick work (13-16). Thorne continued to work in strenuous labouring jobs and did not attend school. He was illiterate until later in life when, as a union organizer, he was befriended and tutored by Eleanor Marx, daughter of Karl Marx (47, 117). Thorne moved to London in 1881 where he soon joined the Social Democratic Federation and attended lectures at the Hall of Science (49-55). In 1889, he was elected to General Secretary of the newly formed National Union of Gas Workers and General Labourers of Great Britain and Ireland, and Thorne and his union were soon a weighty presence in the Dock Strike of 1889 (61-97). Thorne was the MP for West Ham South from 1906-1945.

previously noted, lectures were given by secularists, freethinkers, political groups, and science popularizers, and several of the autobiographers made use of these opportunities.[130] In particular, lectures by Charles Bradlaugh, Annie Besant, G. W. Foote, Dennis Hird, Joseph McCabe, John Burns, Keir Hardie, H. M. Hyndman, the Webbs, and George Bernard Shaw were noted by several of the autobiographers.[131] For many of these lecturers, science was a regular companion to social and political analysis. In addition, empirically-based scientific lectures were attended by Severn, Bell, Redfern, and Mann, and at times they were accompanied by friends.[132]

In Severn's case, the lectures had to do with phrenology and, at times, social and political issues.[133] Tom Bell, in addition to the lectures at Andersonian College, attended lectures in astronomy organized by the West of Scotland Astronomical Society, of which Bell was a

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[130] This subject is dealt with in Chapter 2 of this study.
[131] See for example Tom Bell (31), Tom Mann (8), Will Thorne (55), and Percy Redfern (22-23).
[132] Mann, 19; Bell complained that it was "no easy task" to find scientific-minded friends and when he did something was lacking elsewhere in their friendship. All of his requirements appear to have been met my Arthur McManus. See pp. 87, 94-97.
[133] Severn, 99.

member.[134] Mann and Redfern were similarly fascinated by astronomy, and both attended lectures given by R.A. Proctor.[135] Mann recalled attending one of Proctor's lectures with two of his workmates, and even though the lecture was engrossing, his exhausted friends regretfully fell asleep.[136] Mann maintained a close connection with scientific ideas throughout his life, acknowledging in his autobiography that aside from social questions, science was his "chief standby as a recreative study."[137] For Redfern, Proctor's lecture was more than engrossing; it changed his life. Redfern recalled that for the "first time in my life, it seemed, I looked at the stars" and he felt himself filled with a sense of wonder. Redfern embarked on a process of self-discovery at that moment.[138]

Although not all of the autobiographers described their first contact with science in dramatic emotional terms, many highlighted the encounter as a decisive turning point. Fred Edwards (b. 1885, journalist and photographer), son of a station master, recounted a

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[134] Bell, 66.
[135] Redfern, 23; Mann, 13.
[136] Mann, 19.
[137] Mann, 13.
[138] Redfern, 12.

decision made New Year's Eve, 1900, after randomly picking up a chemistry text, in which he resolved to study chemistry despite the five mile journey he would have to make three nights a week.[139] It was a resolution he kept, and he subsequently passed exams in chemistry.[140] Edwards pursued a variety of scientific hobbies and this helped to make up for some of the loneliness he endured due to a childhood deformity.[141] Edwards was not content, however, to just dabble in science. His chosen hobby was chemistry, and he used this knowledge to improve his understanding of photography and to experiment on radium.[142] Edwards' achievements in chemistry qualify him as a practitioner of science, even if he remained an amateur by late Victorian and Edwardian middle-class standards.[143]

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[139] Fred Edwards, Paper Sir? The Autobiography of an Old News Boy (London: Drane's. Danegeld House, 1912) 54-56. Edwards was born in Leicestershire. He attended day school briefly but benefited from evening and Sunday school, especially enjoying chemistry classes (8-12, 35, 55, 104). His career included journalist, writer, and photographer, and he elected Fellow of the London Chemistry Society in 1909 (27, 47-52, 58-59, 79).

[140] Edwards, 58-59.

[141] Edwards, 8-9. Edwards suffered from a cleft-palate (31).

[142] Edwards, 49, 59-61.

[143] Edwards' experimentation with radium is a good example of working-class disregard for the supposed boundary between professional and amateur scientific practice.

For a few of the autobiographers, science was linked to occupational goals.[144] Edwin Grey (1859-c.1935) worked as an assistant and eventually superintendent at an agricultural laboratory in Hertfordshire.[145] Alfred Cox, admittedly less interested in science than he was in his patients, chose to become a doctor while in his teen years despite the inevitable hardships.[146] He had to work his way

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[144] There was some evidence of science in the workplace as being a stimulus to hobbies, but little work has been done on this important aspect of working-class culture other than anecdotal citations of coalminers discussing geology or botany during breaks. See for example, Macintyre, Proletarian Science, 94, 103, 107. Tom Mann recalled an incident working in an engineering shop in which he was asked to cut a meteorite into pieces. This started him thinking about where it had come from, and Mann thereafter adopted astronomy as a hobby. He claimed also to have interested some of his workmates in Richard Proctor's astronomy lectures. See Mann, Tom Mann's Memoirs, 12-13, 19. Additionally, Frank Hodges recalled in his autobiography that one of his first intellectual allies was a mining official who gave him a copy of Darwin's Origin of Species (16). The workplace as a site for discussion of politics and current events is commonly accepted but as a location for the exploration of scientific ideas and intellectual discussion, it has yet to be examined.

[145] Edwin Grey, Rothamsted Experimental Station; Reminiscences, Tales, and Anecdotes of the Laboratories, Staff and Experimental Fields, 1872-1922 (Published by the author, Hertfordshire, n.d.) 3. Edwin Grey was born in Hertfordshire. He wrote his autobiography Cottage Life in a Hertfordshire Village (St. Albans, Fisher, Knight, and Company, 1935) in 1934. He did not provide details of his family life but did describe his village as a farming community. Grey attended school until age thirteen, after which he became took on minor jobs at the Rothamsted where he was employed in various capacities throughout his life (Cottage Life, 27-30, 57).

[146] Alfred Cox, Among the Doctors (London: Christopher Johnson, 1950) 14-20. Cox was born in Darlington. His father was a unionist and a weaver (9-16). He attended day school, night school, and Sunday school, but claimed to have little interest in science despite his eventual choice to become a doctor (14-15). He worked his way to a medical career through the difficult path of assistantships, and this

up to M.D. through assistantship and apprenticeship until such a time as he had passed the necessary examinations.[147] In the opening paragraphs of his autobiography, Cox borrowed from Shakespeare to explain how he felt about medicine: "There's a divinity that shapes our ends."[148] He eventually became one of the chief organizers of the British Medical Association.[149]

In the science of phrenology, J.M. Severn (1860-c.1940s, carpenter, journalist, and phrenologist), son of a silk-stocking weaver, described his interest in the science of phrenology as "the awakening" that changed the course of his life.[150] Severn began to consider a career in phrenology around the age of fourteen, but it was a long journey through mining and carpentry before he could afford to study phrenology and eventually open up his own practice. He was originally attracted to phrenology because it was so "rational," and he immediately embarked

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may have contributed to his interest in unionizing the medical profession (Chapters 2-3, 71). Cox was a socialist and an atheist, although later in life he rejected socialism (18, 64-69).

[147] Cox, Chapter II.
[148] Cox, 9.
[149] Cox, Chapter VII.
[150] Severn, 43; Tillett, 77.

on a quest for self-improvement.[151] Eventually he succeeded, reading many famous heads, and he contributed articles to the popular science periodical Science Siftings.[152] His achievements as a phrenologist were acclaimed in the Foreword written by his long-time friend Robert Blatchford.[153]

Abel Jones (1877-1949) earned degrees in science and education from Aberystwyth University College in South Wales, Cambridge University, and the university at Jena.[154] Jones came from a family of tailors, and he attended day school until age fourteen. After leaving school, he was employed first as a shopkeeper's assistant, but Jones was determined to achieve more.[155] He secured a position as a pupil-teacher and managed to earn the Queen's Scholarship for entrance to Aberystwyth.[156] He pursued his college education with vigour, and earned Aberystwyth's Bachelor of Science degree and Teaching Certificate.[157] Jones later

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[151] Severn, Chapters V, VII, and IX.
[152] Severn, 150. Science Siftings is discussed in Chapter 4.
[153] Severn, vii.
[154] Abel Jones, I Was Privileged (Cardiff: Abbrevia, 1943) 13-15, 32-40. Jones was born in Monmouthshire, South Wales.
[155] Jones, 5-13.
[156] Jones, 13-15.
[157] Jones, 15-22.

completed a doctorate from Jena where he attended lectures by Ernst Haeckel.[158] Jones' training in science included physics, chemistry, biology, and psychology, and in 1913, he wrote a book on psychology with Lamarckian features.[159] His autobiography portrays him as dedicated and confident, secure in the knowledge that he would eventually become a teacher in his chosen field, science. Tending towards an apolitical stance, Jones' autobiography serves an excellent example of how science was linked to independence in ways not addressed by the identification of working-class science with radical political activity.

One of the more entertaining careers involving science can be found in the autobiography of the lovable "bottom dog," William Margrie (1877-c.1960, playwright and author). Margrie was a passionate advocate of "Shakespeare, Evolution, and Self-Culture," and in a "Universal Prayer" he advocated the "full and practical recognition of the doctrine of evolution."[160] For Margrie, Darwin was a genius

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[158] Jones, 35.
[159] Jones, 32-41. Character in the Making (London: John Murray, 1913)
[160] Margrie, Cockney's Pilgrimage: In Search of Truth (London: Watts and Company, 1927) preface, 169. Margrie also wrote an earlier autobiographical collection of tit-bits, The Invincible Smile: The Autobiography of a Bottom Dog (London: Watts and Company, 1924) He was

for "writing the most impressive book of the nineteenth century" which teaches that we are "all born different" and "the only way to improve the race is to encourage and breed from the best."[161] Of course, the only person in either of his autobiographies who qualified unconditionally as good stock, aside from the occasional celebrity, was the "bottom dog," a category ably occupied by Margrie himself.[162] Margrie had little use for parsons, teachers, authors, workingmen, theatre critics, Tolstoy, Zola, Ibsen, Strindberg, Hardy, and all political factions including Liberals, Tories, Socialists, and Fascists.[163] For Margrie, ideology was bound with traditional notions of John Bull, independent and masculine. In the midst of racial deterioration, Margie--himself rather full of John Bull--championed Darwinian evolution as truth and salvation in his literary contributions.[164]

In addition to Margrie, several of the autobiographers wrote or lectured on scientific topics. J. Millott Severn

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born in North Camberwell, and was the son of a carpenter. He attended school until age ten and thereafter pursued his own course of study (Bottom Dog, 4-5; Cockney's Pilgrimage, 4).

[161] Margrie, Bottom Dog, 6-7.

[162] Margrie, Bottom Dog, 5-6.

[163] Margrie, Bottom Dog, 5-7; Cockney's Pilgrimage, 170.

[164] See "The Other John Bull" in Cockney's Pilgrimage, 85-129.

wrote several books on phrenology, including Popular Phrenology (1913).[165] F.J. Gould was the author of books and articles dealing directly with science and positivism, or indirectly in relation to humanism and socialism. He was a regular contributor to The Young Socialist in articles on such topics as Henry Bessemer, microscopes, and "Natural Knowledge Lessons."[166] Abel Jones' psychology-driven study of education, Character in the Making (1913), praised Herbert Spencer's recognition that education was wasted on the majority of the working class, but Jones criticized Spencer for failing to acknowledge that educational reform was the solution.[167] Character in the Making opposed Spencer's educational views by demonstrating that a child-centered environment promoted the development of the traits and characteristics essential to a healthy individual, and the book elaborated current theories in child psychology.

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[165] J. M. Severn, Popular Phrenology (London: W. Rider, 1913).
[166] The Young Socialist, February and March 1912. For a list of Gould's publications, see The Last Years of a Great Educationist: A record of the work and thought of F.J. Gould from 1923-1938 (Bungay: Richard Clay, 1942).
[167] Jones, Character in the Making (London: John Murray, 1913) 3.

Among the socialist agitators, several made their views on science and, in particular, evolutionism part of their propagandist efforts. T.A. Jackson considered Darwinism to be a central component of his Marxism, and books such as Dialectics: The Logic of Marxism (1936) relied on evolutionary theory. In addition, Jackson lectured on evolution as a socialist agitator.[168] Ben Tillett's talk on "character and environment" was published as a pamphlet, and his friend and colleague, Tom Mann, frequently wrote and lectured on evolution and the centrality of science in determining social and economic reforms.[169] Mann's pamphlet Socialism declared that sociology needed to be as scientific as "astronomy and geology," and he cited Alfred Russel Wallace's socialist evolutionism as proof of the inevitability of a collectivist future.[170] While Mann was in Australia (1902-1910), he lectured regularly on religion, evolutionism, and natural law, including "What Ye Think of Christ," "The

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[168] See Jackson, Dialectics, and Solo Trumpet, 91.
[169] Benjamin Tillett, An Address on Character and Environment (Labour Press Society, Manchester, n.d.).
[170] Tom Mann, Socialism (Melbourne, Tocsin, 1905). Re-printed in John Laurent, Tom Mann, Social and Economic Writings (Nottingham: Spokesman, 1988) 79, 115.

Marvels of Science," "Communism in Animals," a 1907 lecture on "Man's Place in Nature," and a 1909 address on "Various Sorts of Creation," in which he rejected creationism.[171] For these autobiographers, science was more than just a hobby, and their articles and lectures contributed to the popularization of science in working-class communities. Although many scientific ideas were imported from outside the working class, they were reconstituted in the hands of working-class intellectuals to take on a meaning and importance relative to their goals rather than those projected onto them by middle-class theorists.

Conclusion

F. J. Gould wrote in his autobiography that "no phrases or formulations, whether Christian, or Rationalist, or political, or philosophical, could ever indenture me." Describing himself metaphorically as a "runaway apprentice," Gould declared that he loved "the living and the evolving" and that he gave only small respect to mere

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[171] The Socialist (Melbourne, edited by Tom Mann), 6 May 1906, 13 May 1906, 19 May 1906, 11 May 1907, and 3 September 1909. For more lectures on science by Tom Mann, see the John Laurent's introduction to Tom Mann.

words "whether Divine, Scientific, or Ethical."[172] His intellectual quest was grounded in the social problems and inequities of his time, as he explored a variety of doctrines and ideologies searching for truth, progress, and the power to improve conditions for working Britons. Rejecting dogma, exploitive authorities, and class barriers, Gould and others searched through ideas and philosophies, selecting and rejecting according to utility rather than convention. Towards that end, science—natural, social, and economic—was ransacked for its liberating potential. Whether this involved political and social agitation, career goals, or simply self-improving hobbies, scientific ideas provided the means by which working-class intellectuals could assert their personal and collective independence.

Across the generations of Victorian working-class intellectuals, the utility of science as an emancipatory strategy remained intact, but as the context of Victorian society and sociology changed, the access points for materials and the social relevance of certain theories

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[172] Gould, 113.

shifted with the times. Frank Hodges began his exploration of Darwinism at the turn of the century, giving him access to cheap books and the expanding working-class press, thereby increasing his opportunities to study science. Reaching adulthood during the first decade of the twentieth century, Hodges' understanding of evolutionary theory was formed within the context of trade unionism and labour socialism. Born just a few years earlier, Jackson, Kenney, and Bell benefited from improved access to printed materials, but unlike Hodges, they were old enough to come under the influence of Robert Blatchford and a radical socialist propaganda network that popularized science as part of its ideological programme. Additionally, in an instance of one generation assisting the next, Jackson and Kenney both noted the crucial role of reprinted classics from the Rationalist Press Association (RPA). This was, of course, one of Gould's main reasons for instigating the Rationalist Press Committee in 1893—forerunner of the RPA—in the belief that "tens of thousands" could be reached with cheaper publications. Given that Rowland Kenny partially attributed his intellectual development to the

RPA reprints, it would seem that Gould achieved his goal.[173] Conversely, Tom Barclay was looking for challenging reading material in the early 1860s when free libraries, the lecture circuit, and the cheap press were just beginning to expand. Nevertheless, Barclay and his contemporaries, Gould and Mann, found ways to obtain challenging material and by the 1870s, scientific ideas were becoming widely available in lecture and print.

The autobiographers discussed in this chapter belonged to a minority sector of the working class who were natural-born intellectuals and who, through personal inclination and perseverance were undeterred by obstacles in their pursuit of knowledge. Whether their status as a minority makes them working-class anomalies or part of a cross-class per capita representation of intellectuals to non-intellectuals has not been quantified. The answer to this question may be forthcoming as more autobiographies are uncovered and attention to working-class scientific activity increases. For now, the essential message is that a great many access points existed for serious study in the

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[173] Gould, 74, and Kenny, 27.

natural and social sciences, and that these access points were utilized by workers despite financial and educational obstacles.

Moreover, access to scientific information was not confined to the ponderous, difficult path taken by many of the autobiographers; scientific ideas came in a variety of forms from the complex to the simple, from the uncommon, specialized study of scientific texts to the common knowledge of the popular press. In this latter form, science news, events, and gossip were widely publicized in manageable tit-bits: science could be had for the price of a penny and a few moments of reading time. Consequently, bringing science into common knowledge was partially accomplished by earnest working-class intellectuals who struggled "under the most untoward circumstances."[174] As hobbyists, science workers, social critics, and philosophers, the achievements of these autobiographers in the field of science are germane to the history of science and to working-class history. Whether challenging authority, escaping manual labour, or satisfying

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[174] Gutteridge, 77.

intellectual curiosity, working-class intellectuals participated in the making of a modern scientific culture, and the "tale deserves to be generally known."

Chapter 4: Common Knowledge - Popular Science and the Working-Class Press

In 1888, The Star reported that the "great majority of general readers, as is the case with all classes everywhere, are mainly satisfied with newspapers and periodicals; and if they read books at all their choice is guided by their public journals." This statement came as part of an observation of the reading habits of poor and elderly labourers in the east-end slum, Bethnal Green, where even the marginally literate visited the library to look at the "pictures in the illustrated journals."[1] The Star's enthusiastic assessment of east-end readers delivers a particularly poignant example of the long-standing relationship between the press and the people in evidence "from the appearance of Cobbett's Twopenny Trash in 1816 through to the launching of the Daily Herald in 1912."[2]

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[1] 31 January 1888, 4.

[2] David Vincent, Literacy and Popular Culture, England 1750-1914 (Cambridge: Cambridge University Press, 1989) 242. For more on the centrality of the press in working-class communities, see Virginia Berridge, "Content Analysis and Historical Research on Newspapers," The Press in English Society from the Seventeenth to Nineteenth Century, eds. Michael Harris and Alan J. Lee (London and Toronto: Associated University Presses, 1986) 201-18; Aled Jones, Powers of the Press: Newspapers, Power and the Public in Nineteenth-Century England (Aldershot: Scolar Press, 1996) 1-27; Alan J. Lee, The Origins of the Popular Press, 1855-1914 (London: Croom Helm, 1976) 29-40.

In the late Victorian period, the working-class press was a lively and booming industry with enormous variety in both format and subject matter. With the removal of burdensome taxes beginning in the 1850s, along with improvements to print technology and transportation, the popular press extended newspaper circulation to the least prosperous sectors of Victorian society.[3] Increasingly, the press was a source of knowledge, a vehicle for communication, a tool for lobby groups, and a weapon for the more aggressive wing of working-class agitation.[4] In the general and left-wing press, sympathetic middle-class editors and proletarian journalists churned out information on political reform, the rights of Labour, abuses of power by Church and State, cultural events and the important milestones of scientific and technological progress while also providing entertainment and sporting news. Newspapers

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[3] Jones, Powers of the Press, Chapters 2 and 3; William H. Brock, "The Development of Commercial Science Journals," The Development of Science Publishing in Europe, ed. A.J. Meadows (Amsterdam: Elsevier Science Publishing, 1980) 95-122, see especially 95-104.

[4] Brian Harrison, "Press and pressure groups in modern Britain," The Victorian Periodical Press: Samplings and Soundings, eds. Joanne Shattock and Michael Wolff (Leicester: Leicester University Press, 1982), 261-95; and for late century press and the Left, see Deian Hopkin, "The Left-Wing Press and the New Journalism," Papers for the Millions: The New Journalism in Britain, 1850s to 1914, ed. Joel Wiener (New York: Greenwood, 1988), 225-41.

such as The Clarion and Reynolds's Newspaper or periodicals such as Justice and Commonweal, cannot be considered entirely the project of middle-class intellectuals nor completely proletarian, and the ideological content of these publications resists rigid categorization. In each case, middle-class editors were in charge but several of the publications had proletarian staff members or hired freelance working-class writers.[5]

After mid-century, each decade brought increases in the number of newspaper and periodical titles so that by 1874, the London press carried 410 publications.[6] Furthermore, by the 1880s, expansion in the geographical

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[5] For example, Justice's editor was Henry Mayers Hyndman, son of a wealthy merchant, and the co-editor was Harry Quelch, a London warehouseman and autodidact. J. Millott Severn, working-class phrenologist, wrote for Science Siftings, and Tom Barclay, general labourer and son of rag sellers, contributed to Commonweal (29 November 1890, 370). For more, see "Harry Quelch," in Joyce M. Bellamy and John Saville (eds), Dictionary of Labour Biography (10 vols., London, 1972-2000) v. VIII, 198-204, and J. Millott Severn, The Life Story and Experiences of a Phrenologist (published by the author in Brighton, 1929) 445. Furthermore, several of the autobiographers discussed in Chapter 3 of this study—Tom Mann, Percy Redfern, T.A. Jackson, Roland Kenney, Ben Tillett, F.J. Gould—wrote for periodicals and newspapers. Additionally, in The English Mechanic, letters comprise much of the content and some of these would have been from working-class intellectuals such as John T. Sprague, the electrician. It is unfortunate that in most cases articles are unsigned, so while it may be known through biographical data that a journalist contributed to a publication, it is not always possible to say how. I have, when possible, included supplementary works by working-class journalists such as pamphlets.

[6] Alan J. Lee, The Origins of the Popular Press, 29-40.

distribution of the cheap press added a thriving national press to the infrastructure of traditional local papers.[7] In the distribution of useful and entertaining information, the mass circulation press was influential beyond measure.[8] Periodicals were published by local cooperative societies, political groups, lobby and social reform groups, religious groups, advocates of working-class intellectual improvement such as mechanics' magazines, and popularizers of science.[9] Many of these could be purchased for a penny and for those that were more costly, libraries and sharing reading materials provided access to low-income readers. The penny press was the most accessible form of public information, and with the growth of the mass-circulation newspaper industry, the information network extended well beyond the elite artisan sector into general, or common, knowledge. Oddly, the penny press has not been examined as a vehicle for communicating scientific ideas to the working class.

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[7] Aled Jones, "Local Journalism in Victorian Public Culture," Investigating Victorian Journalism, eds. Laurel Brake, Aled Jones, Lionel Madden (London: Macmillan Press, 1990) 63-70: 65.

[8] David Vincent, Literacy, 242. For more on the centrality of the press in working-class communities, see Aled Jones, Powers of the Press, 1-27.

[9] Brian Harrison, "Press and pressure groups in modern Britain," and Aled Jones, "Workmen's advocates: ideology and class in a mid-Victorian labour newspaper system," The Victorian Periodical Press: Samplings and Soundings, eds. Joanne Shattock and Michael Wolff, 261-95 and 297-316.

This chapter rectifies this with an exploration of general science and general news publications.

Despite the centrality of the press in working-class culture, several obstacles still prevent full exploitation of this rich primary source.[10] Insufficient research, incomplete records and runs, and an over-reliance on the content of feature articles make it difficult to situate publications in their proper cultural context.[11] Content analysis is particularly troublesome in that it is vulnerable to the historian's preconceived ideas about what constitutes content.[12] Moreover, relying wholly on feature articles ignores smaller items including tit-bits, advertising, and correspondence, which can provide important clues about reader interests if reviewed in the

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[10] Joel Wiener, "Sources for the Study of Newspapers," Investigating Victorian Journalism, eds. Laurel Brake, Aled Jones, and Lionel Madden, 155-65: 155; Jones, Powers of the Press, 3.

[11] Patricia Anderson, The Printed Image and the Transformation of Popular Culture, 1790-1860 (Oxford: Clarendon, 1994), 91; William H. Brock, "Science," Victorian Periodicals and Victorian Society, eds. J. Don Vann and Rosemary T. VanArsdel (Toronto University Press, 1994) 81-96: 83-4; J. Rose, "Workers' Journals," Victorian Periodicals and Victorian Society, eds. J. Don Vann and Rosemary T. VanArsdel, 301-10: 301; Edward Royle, "Newspapers and Periodicals in Historical Research," Investigating Victorian Journalism, eds. Laurel Brake, Aled Jones, and Lionel Madden, 48-62: 48-9.

[12] Virginia Berridge, "Content Analysis and Historical Research on Newspapers," The Press in English Society from the Seventeenth to Nineteenth Century, eds. Michael Harris and Alan J. Lee, 201-18: 201-04.

context of price and circulation data. Without attention to the smaller deals of publications, working-class reading interests can be misrepresented as simple, partisan-level political issues and sensationalist fiction, ignoring the intellectual diversity.[13]

Scientific information has been particularly vulnerable to these problems in working-class press studies, and while historians have made progress in refining content analysis, many of them underestimate their readers by ignoring the ample scientific content in the penny press.[14] Virginia Berridge's study of Reynolds's Newspaper is an excellent example in that a great deal of science news can be found in Reynolds's publications, and yet no indication of this is given in her dissertation or subsequent articles.[15] The reason for this omission appears

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[13] Pat Anderson stated in The Printed Image that "the myth that all working people shared a uniformly degraded taste was just that—a myth" (179). It is this myth that prevents careful examination of the content of working-class reading material.

[14] One notable exception is David Vincent in Literacy. Berridge included science as a category in her thesis but it surfaces only as an item in the Appendix and is not explored. Given the frequent appearance of science in Reynolds's publications, this serves as an excellent example of the degree to which science is overlooked.

[15] Berridge, "Popular Journalism and Working-Class Attitudes 1854-1886: A Study of Reynolds's Newspaper, Lloyd's Weekly Newspaper, and the Weekly Times," diss., London University, 1976. Ben Turner recalled the eclectic mixture in local weeklies and in publications such as

to be simply that science is not expected to be found, and so it is not. Berridge and historians such as Patricia Anderson, Brian Harrison, Deian Hopkin, Aled Jones, Alan Lee, and David Vincent are making progress in refining the social history of press readership but all of them, with the exception of David Vincent, continue to underestimate their readers by ignoring the ample scientific content in the penny press.

A complementary oversight in the history of science restricts working-class interest in scientific information to the better-educated, prosperous artisans by focusing on costly scientific periodicals. Science, it is assumed, was of little concern to the general working class. For science historians, public culture has increasingly become a topic of legitimate research, and previous emphases on the scientific elite have been supplemented with studies on popular science.[15] Many of these studies draw on material

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Reynolds's Newspaper and the National Reformer in his autobiography About Myself (London: Humphrey Toulmin, 1929), 27, 51.

[15] Roger Cooter, The Cultural Meaning of Popular Science: Phrenology and the Organization of Consent in Nineteenth-Century Britain (Cambridge: Cambridge University Press, 1984); Bernard Lightman, "'The Voices of Nature': Popularizing Victorian Science," Victorian Science in Context, ed. Bernard Lightman (Chicago and London: University of Chicago Press,

from the Victorian popular press and commercial science press; however, for the most part research interests focus on periodicals with a distinctly middle-class appeal and middle-class prices. Bernard Lightman and Ruth Barton, for example, both examine the boundary between professional and middle-class popularizations of science, demonstrating an autonomous public culture of science.[17] Nevertheless, in these studies, designation of a popular audience remains predominantly bourgeois, suggesting an elitist rather than popular appeal. This problematic location of what constitutes a popular audience has been acknowledged by Roger Cooter and Stephen Pumfrey who suggest that it may be the science community's lack of training in social history that is to blame.[18] In rare cases, studies have attempted

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1997) 187-211; Alison Winter, "Mesmerism and Popular Culture in Early Victorian England," History of Science xxxii (1994) 317-43.

[17] Lightman, "Voices of Nature," Victorian Science in Context, ed. Bernard Lightman, 187-211; Ruth Barton, "Just Before Nature: The Purposes of Science and the Purposes of Popularization in some English Popular Science Journals of the 1860s," Annals of Science 55 (1998) 1-33.

[18] Roger Cooter and Stephen Pumfrey, "Separate Spheres and Public Places: Reflections on the History of Science Popularization and Science in Popular Culture," History of Science (1994) 237-67: 245. Taking the low road to popular science through the penny press suggests an alternative approach to popularization in many respects reminiscent of alternative approaches to working-class education. That is, middle-class programmes were often supplemented by efforts from within the working class. In this case, pro-Labour mediators of science may have

to venture beyond the middle-class perimeter focusing on "cheap" popular scientific periodicals that potentially straddled the boundary between the middle class and highly skilled working class.

Susan Sheets-Pyenson's study of low scientific culture analyzed the editorial mandates and contents of popular science journals published in Paris and London between 1820 and 1875, several of which were identified as artisans' or mechanics' magazines.[19] Mechanics' magazines avoided overly technical language while allowing "the scientific artisan" to participate in the "Republic of science."[20] Additionally, W.H. Brock's study of The English Mechanic documented the solidarity of the periodical's artisan audience who referred to the magazine as "Ours."[21] These studies opened up the question of what constituted a popular audience for science beyond the middle class, extending research into working-class culture at the upper

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performed the main service of spreading science language and ideas among working people.

[19] Susan Sheets-Pyenson, "Low Scientific Culture in London and Paris, 1820-1875," diss., University of Pennsylvania, 1976.

[20] Sheets-Pyenson, "Low Scientific Culture," 59.

[21] Brock, "Development of Commercial Science Journals," Development of Science Publishing, ed. A. J. Meadows, 95-122: 113.

social and economic level, consisting of approximately "ten to fifteen percent" of the labouring population.[22]

While these studies go some distance to redressing exclusion of the working sector, several important problems remain with respect to audience restrictions. One of the main issues concerns journal prices as an indicator of readership. Pyenson states that price data can be used as a general indicator of the social status of readers, but it cannot offer details on the individual reader.[23] While it is true that price does not define the individual reader, the assignment of publications to a particular social group is troublesome. Sheets-Pyenson claimed that only the highest paid workers—the artisans-would have been in a position to purchase science periodicals, and below this, workers would have been "unable to purchase even the cheapest periodical," at a cost of twopence.[24] Moreover, she described the "audience for popular science periodicals" as resembling a "pyramid" that had at its lowest level "tens of thousands of urban workers" whose

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[22] Sheets-Pyenson, "Low Scientific Culture," 22.
[23] Sheets-Pyenson, "Low Scientific Culture," 61
[24] Sheets-Pyenson, "Low Scientific Culture," 22-23.

reading material cost "several pence per issue."[25] Sheets-Pyenson's categorizations were presented as stable and fixed, and she did not recognize alternatives to purchasing. Essentially, she upheld the rigid social categories that unnecessarily ostracize the intermediate sectors of the working class from the kinds of scientific pursuits normally assigned to artisans.

Current research in Victorian social history establishes that sub-sections of the working class were in closer contact and divisions more fluid than Pyenson suggests. A set of complex factors involving trade fluctuations, economic cycles, family circumstances, and a shared working-class cultural community undermine the use of rigid social and economic divisions.[26] Additionally, while Sheets-Pyenson acknowledged that circulation data are inaccurate because reading materials were shared, she failed to include this as a contingency of price-based conclusions: low-income readers had many more options than simple purchasing. Aside from the empirical data, Sheets-

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[25] Sheets-Pyenson, "Popular Science Periodicals in Paris and London: the Emergence of a Low Scientific Culture, 1820-1875," Annals of Science, 42 (1985), 549-572: 555.
[26] Edward Royle, Modern Britain, 2nd ed. (London: Arnold, 1997), 86-88, 102-104.

Pyenson shored up her conclusions with an assertion that the best way to gauge an audience is through content analysis, which she described as a "more precise" method for determining readership.[27] This encapsulates the central problem in the history of the science press. Sheets-Pyenson's idea of content is restricted to science periodicals, and this is in part due to her assumption that workers below the artisan level could not have afforded even the cheapest of periodicals. The penny press is not a consideration because no one expects to find science at so common a level.

Fundamentally, this represents a failure to acknowledge the millions of readers at the semi-skilled and unskilled levels due to vague definitions of a "popular" audience and oversimplified economic and social categories. Based on assumptions about the science-minded artisans and the non-intellectual labourers, a general reluctance to look into working-class culture prohibits investigation of alternative sources of science information that lie beyond the boundary of proper science periodicals. Adopting a

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[27] Sheets-Pyenson, "Low Scientific Culture," 62.

more refined social and economic analysis and taking direction from studies of the working-class press, historians of working-class science can approach a much-needed reevaluation of what constitutes scientific publication within the context of working-class readership. Rather than reasoning from science to the working class, it is time to begin with the workers and look for science as they experienced it. By employing cross-disciplinary methods, both the history of the working-class press and the history of working-class science stand to benefit.

The most noticeable feature of scientific information in the working-class press between 1870 and 1900 is that there is plenty of it. Science, it turns out, had many destinations and access points. Peter Bailey wrote of middle-class fears of the "plebification of art," and it could easily be asserted that this should be expanded to include a plebification of science.[26] Pick up a copy of Science Siftings, The English Mechanic, The National Reformer, Reynolds's Newspaper, or The Star and the science

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[26] Bailey, Leisure and Class in Victorian England, 2nd ed. (New York: Methuen, 1987) 114-15.

comes tumbling off the page.[29] For the most part, information was presented in accessible language, though some articles on more difficult and technical topics may have had a more limited appeal. This was also the case for political and social topics, and demonstrates that working-class publications included items of interest for both serious and general readers.[30] Reaching a large readership, the combined weekly circulation of Science Siftings, The English Mechanic, The National Reformer, and Reynolds's Newspaper could reach as high as 450,000, with an additional 125,000 daily for The Star.[31] Items of general

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[29] Full run-dates are as follows: Science Siftings (1891-1927), The English Mechanic (1865-1926), The National Reformer (1860-93), Reynolds's Newspaper (1850-1967), The Star (1888-1960). The price of these publications was twopence for The National Reformer and The English Mechanic; all others were sold for a penny. Issue selections for this study fall mainly within the final two decades of the nineteenth century, but earlier samples were obtained when possible.

[30] Science Siftings, Reynolds's Newspaper, and The English Mechanic were recommended in the category of social reform publications. See Joseph Edwards, ed., The Labour Annual (Manchester: Labour Press Society, 1897), 33-62. Additionally, the library catalogue for The Rochdale Equitable Pioneers' Society (1868), a cooperative society based in the Manchester area, lists the following holdings for the central and ten branch libraries: Reynolds's Newspaper carried in 5 of 11, The National Reformer carried in 4 of 11, and The English Mechanic carried in 2 of 11. See Chapter 2 for more on the Rochdale library.

[31] Based on the figure reported in the early issues of Science Siftings, circulation began near 21,000 and continued to grow; claimed circulation of 80,000 for The English Mechanic (1868) reported by William H. Brock in "Development of Commercial Science Journals," (Meadows, 113), but The English Mechanic v.120 (1924) reported

scientific interest, notices of lectures and classes, book recommendations, articles on scientific celebrities and theories, analyses of the social relevance of scientific findings, and editorials on the sociopolitical ramifications of scientific authority are scattered liberally throughout the publications. This may not be so in other types of working-class publications—the temperance press and conservative working-class press for example—and studies of these should no doubt be undertaken. However, representations offered here from the general science and general news categories, and in the following chapter on the labour and socialist press demonstrate a keen awareness of scientific authority and progress.[32]

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circulation at 100,000; a figure of 6000 in 1872 with increases into the early 1880s for The National Reformer, reported in E. Royle, Radicals (157), and a high point circulation of 350,000 for Reynolds's Newspaper, reported by Virginia Berridge in "Content Analysis," Press in English Society, eds. Michael Harris and Alan J. Lee, 201-18: 208. Daily circulation for The Star was reported as 125,000 on average but reaching peaks of over 300,000 during public scandals in John Goodbody, "The Star: Its role in the Rise of the New Journalism," Papers for the Millions, 147-50.

[32] Science Siftings, The English Mechanic, and Reynolds's Newspaper were endorsed as pro-labour in Joseph Edwards, ed., The Labour Annual (Manchester: Labour Press Society, 1897). See the recommended social reform periodical list, 33-62. Of the 231 publications listed, 18 were explicitly connected to science. This does not include less obvious inclusions of science in periodicals such as The Labour Prophet, and so further research into the scientific content of the 231 listed publications is needed.

Format and ideological differences created a wide assortment of science presentations with varying degrees of theoretical complexity. Science Siftings was a penny science popularizer that survived for over thirty years. Ideologically, it was democratic and encouraged participation and broad discussion of the social sciences. Similarly, The English Mechanic was guided by a liberal democratic viewpoint and it fell roughly into the popular science category. In contrast to Science Siftings, The English Mechanic provided more space for debate among a broad assortment of correspondents, and it offset scientific material with popular mechanics and popular philosophy. The National Reformer was a cross between a periodical and a newspaper in that it included news, lengthy discussion of political ideology, and intellectual material. It also adhered to a liberal democratic ideology but was clearly part of the radical republican and secularist traditions. With Charles Bradlaugh as editor, it had working-class appeal. Science was an important feature of The National Reformer's secularist arguments and so served in its own way as a science popularizer.

Appealing to a larger and more general readership, Reynolds's Newspaper and The Star[33] were politically radical, mass circulation newspapers with ties to the labour and socialist community. Although dominated by political and social information, basic science news and events were reported regularly, bringing science out of the rarefied community of serious intellectuals, mechanics, and secularists into the stock of common knowledge. In total, the combined circulation of the specialized journals and the penny newspapers made science accessible to both serious and general readers.

In each of the journals, a distinction can be made between contemporary treatments of fact and theory. It was generally accepted that an objective study of nature yielded facts of mechanical laws and relationships of cause and effect. Conversely, scientific hypotheses and the controversial social sciences and sociology involved an interpretative process and so both were subject to debate. None of the periodicals and newspapers questioned the

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[33] My research on The Star is confined to the years that T.P. O'Connor served as editor, 1888-91. After his replacement as editor, the socialist element receded and the mandate became more decidedly liberal. See Goodbody, "The Star," 156-57.

validity or authority of scientific fact, although a thin line divided fact from theory at times. Where basic facts of scientific discovery were accepted, they remained undisputed; where there was doubt, controversy followed. Each publication interpreted scientific theories according to ideological and editorial considerations. In these cases, scientific theories and the scientific practitioner behind them were scrutinized, and in cases of extreme criticism, the sanctity of fact was seen as vulnerable to the folly of biased scientists and human error.

Additionally, each publication, regardless of its political or ideological goals, exhibited variations on the theme of instruction and education, whether that took the form of trivia, lengthy lessons on basic science and social science, or lecture announcements and reviews. The presentation of information was designed to stimulate the minds of readers and alert them to the importance of science in national affairs. Information, easily explained, cultivated personal growth and class elevation by encouraging rational thinking, greater intellectual awareness, and sound judgment in the face of social crises.

Moreover, proper training offered working families the tools with which to educate the next generation. These general expectations are found in all of the publications despite their wildly different conclusions about which social and scientific theories were established facts and which were subjective and flawed. Furthermore, as the ideology of the editorial staff shifted farther to the left, the subject of class emancipation supplanted the goal of class elevation, and the socially relevant sciences became a battleground for cultural authority. This discernable shift in the political representation of scientific material sets the pattern for this chapter's analysis of the working-class press, moving across the political spectrum from the mildly democratic Science Siftings to the moderate socialism of The Star during T.P. O'Connor's editorship in the late 1880s.

Science Siftings (1892-1926)

Science Siftings, a penny science popularizer, was edited throughout its run by Charles Hyatt Woolf. Claiming a circulation of more than 20,000, this comprehensible

periodical—self-described as a "chatty journal"—offered samples of the latest facts, theories, and inventions (see Figure 1, Appendix).[34] Brief articles on health, insanity, children and chastisement, clouds, compasses, bees, and ant communities were included each week along with longer articles on evolution, astronomy, geology, biology, and fitness, some of which presented summaries of controversial debates and hypotheses (see Figure 2, Appendix). Recommended as "democratic" by The Labour Annual, Science Siftings had a friendly feel to it, consulting readers on name changes and running a weekly "Science Queries and Answers" column in which simplicity was the rule and readers were invited to participate in the answering of questions.[35] The paper also ran regular photography contests with prizes valued at approximately £2 and a weekly "Sale and Exchange" column that indicates various income levels.[36] Additionally, Woolf printed rival articles

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[34] Circulation figures were reported in the 23 April 1892 issue. Woolf was identified as the editor in J. Millott Severn, Life Story, 445. No other information is provided other than that Severn was grateful for the opportunity to write articles on phrenology for the periodical.
[35] Labour Annual, 1897, 39.
[36] Items included microscopes, fossil and mineral collections, scientific texts purchased "by mistake" in a box of miscellaneous books, and a stuffed alligator the owner wished to trade for a strong

on controversial topics such as women's education, although subsequent articles from the editor made clear his point of view. Deriving the magazine's democratic format the science community's declared mandate of open and free enquiry rather than from political democracy, Science Siftings was proud of its inclusiveness and penny-price.

Science Siftings used the trivia and long article formats. A section described as "Gleanings from the Globe" offered quick facts of interest such as "the sun advances through space with a velocity of 154 million miles per annum," or the general bit of information that "blood travels from the heart through the arteries ordinarily at the rate of about 12 in. per second" (see Figure 3, Appendix). Comments could be found on "big spiders of the New World," or a "two mouse power" engine developed in Boston, or why women's voices made them more suitable than men for work as telephone operators.[37] In a slightly longer format, "Science News and Notes," provided mini-reports on diverse topics. For example, a report on electricity

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cage or small livestock. Prices when specified ranged from 3s to £10. Owning scientific equipment was possible for the employed worker, though selling it in times of dearth was likely. See Tom Mann's Memoirs, pref. Ken Coates (London: Macgibbon and Kee, 1967), 48.

[37] Science Siftings, 23 April 1892, 4.

announced that Victorians had become accustomed to the "importance of electricity for purposes of life and death," and listed among its increasingly commonplace uses that of "growing vegetables at an enormous rate, turning day into night, cattle-slaughtering, [and] electrocuting," finally summarizing possible military applications.[38] Additional topics for that week were inventions and their debt to previous discoveries, ocean navigation, bridge strain, and physiognomy, the last of which praised Charles Darwin's "The Expression of Emotions in Men and Animals."[39] This section occasionally touched on controversial theories in biology and geology, but sociological issues mainly appeared in the longer feature articles.

Feature articles dealing with the physical universe similarly extended across a wide range of topics including physics, biology, technology, the antiquity of man, and medicine. Astronomy was also a frequent topic, and articles on "A Star No Man Has Seen" and "Communication with Mars" provided basic astronomical information in

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[38] 23 April 1892, 1.
[39] 23 April 1892, 2.

conjunction with current debate in the field.[40] Several articles appeared on the versatile uses of the microscope including one that explained in simple terms the nature of diatoms and the other linking microscopes to murder investigations. In each case, the unknown or unseen world was made accessible to the common reader who was subsequently enriched by the knowledge through closer ties with the scientific community. These articles, alongside titles such as "When the Sun Must Die," "How Much Electricity Will Kill," "A Theory of Thought Transference," "Water and Air Barometers," "Is Old Age the Best for Brilliant Thought?" and "How Old is Man?" give a sense of the broad range of natural science available at the penny level.[41]

In addition to lessons in the natural sciences, Science Siftings brought the working class into social discussions through articles dealing with the broader ramifications of scientific knowledge. One issue contained an article on "What Science is Doing for Society" in which

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[40] 23 April 1892 and 16 July 1892.
[41] 14 May 1892, 55; 18 June 1892, 121; 9 July 1892, 160-61, 165; 28 October 1905. The last of these was a survey of the great geological and biological theories of Lyell, Darwin, and Spencer.

science was touted as an organizer and simplifier of everyday facts.[42] Monthly columns on "Social Science" and "Sociology" democratically discussed various general issues with the assumption of scientific authority. In fact, the very presence of social issues in a popular science periodical is evidence of this assumption in that the apparently non-partisan methodology of scientific analysis is extended to social questions; the boundary between social theory and scientific fact is blurred.

For example, the issue of women's education was taken up at several points in the 1890s, with Science Siftings printing opinions for and against, even including contributions by women.[43] Arguments ranged from the physiological stress of secondary education to the emancipation of women through education, with one article from 23 July 1892 blasting Science Siftings for printing antiquated educational views in a magazine normally devoted to the "freshest news" in material science.[44] A similarly

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[42] 19 November 1892, 69.
[43] 21 May 1892, 63-64; 28 May 1892, 79-80; 18 June 1892, 124-25; 16 July 1892, 180-81. These articles discuss the education, work, and cultural role of women, and many viewpoints were represented.
[44] This article, written by Maria Sales, President of the Syndenham Ward of the Women's Liberal Association, was prefaced by the editor with

"non-partisan" viewpoint was presented in articles promoting a non-coercive settlement in conflicts between capital and labour, the necessity of both science and religion, and the importance of civic responsibility in discussions of hereditary traits versus self-determination.[45] At a more basic level, Science Siftings took on commonplace issues such as tight fitting versus loose clothing, public behaviour, and even celibacy, the last of which was particularly important because, as Science Siftings speculated, what would have happened had Erasmus Darwin opted for celibacy: the results would have been disastrous for science and society.[46]

With respect to the social relevance of evolution, Science Siftings took a moderate position. Articles portrayed evolutionism as explaining a good many things, but its ultimate social implications were yet unclear. For example, Science Siftings presented readers with an optimistic yet cautionary evolutionism that included

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both a warning as to its provocative nature and a declaration of the periodical's non-partisan mandate as befits a "studiously impartial" science magazine. Even so, the magazine did insert a quick comment regarding Mrs. Sales' neglect of the rights of "man."

[45] 3 September 1892, 279; 5 February 1898, 237; 18 June 1892, 119 and 7 May 1892, 40.

[46] 23 April 1892, 8 and 12.

environmental factors and personal responsibility in a broad hodgepodge of Darwinism and Lamarckism. In "Evolution and Physical Development," the physique of civilized man compared unfavourably to that of the savage struggling to survive in a "lower state of civilization" (see Figure 4, Appendix).[47] Defining fitness and determining the physical cost of acquiring the "advantages of civilization" were, therefore, topics of great sociological significance.[48] With characteristic optimism, Science Siftings addressed the positive and negative implications of evolution, arriving at a compromise. The solution offered was a neo-Lamarckian exhortation to apply scientific knowledge to physical exercise based on the truism that "a man is what his habits and surroundings make him."[49] This kind of critical review supported the open-discussion format of the science community and was in no way a rejection of scientific naturalism. Darwin, Huxley,

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[47] 23 April 1892, 7.

[48] These kinds of racial degeneration fears were common in the late nineteenth century. For more, see Daniel Pick, Faces of Degeneration (Cambridge: Cambridge University Press, 1989).

[49] "Evolution and Physical Development," Science Siftings, 23 April 1892, 7. Science Siftings regularly included feature articles on debates in anthropology and morphology that might take up heredity one week and the workings of the brain in another. See for example, 7 May 1892, 40 and 18 June 1892, 114.

and Spencer were treated as cultural heroes, and their authority lent scientific expertise to articles on biblical questions, botany, industrial development, social propriety, language development, and even pipe smoking!

The style of Science Siftings resonated with the democratic mandate of the progressive middle class. Its kindly and reassuring tone carefully avoided inflammatory issues while offering a tame version of political theory and social reform mixed liberally with useful information. Educating the workers and bringing them into social debates as informed, pro-democratic, non-revolutionary participants was the underlying mandate, but at times, the paper took a more overt stance. In the "Social Science" column, topics occasionally turned towards mass politics and the articulation of a link between science and working-class emancipation. In May 1892, an article on "Reform and Reformers" urged readers to be calm. Even though "we have not evolved a flawless plan of life," it was crucial that readers not fall prey to "simple fault-finding" and look towards those who truly add to the "stock of useful

knowledge."[50] Two months later, an article ran on "Political Bigotry" in which all political parties were condemned for narrow partisanship, and readers were reminded that political parties are not "the ultimate force" because "behind them and above them stand the people."[51]

In October, the article "Social Reform" added a new dimension in that science was clearly assigned an authoritative role:

> The social reformer, therefore, who would work in harmony with the tendencies and laws of nature must direct his efforts towards convincing the judgments and influencing the motives and moral nature of individual men and women rather than towards forcibly changing the customs of society by legal enactments…or majority votes under the white heat of an emotional political campaign.[52]

The boundary between science and society are eradicated here, with all social issues falling within the authority

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[50] 14 May 1892, 54-55.
[51] 9 July 1892, 163-64.
[52] 15 October 1892, 363-64.

of natural law translated by scientific practitioners. Partisan advocates and social agitators were directed to observe the gradual development of the natural world. Scientific education, rational participation in the life of the nation, calm action in the face of emotions, and slow progress in a moral and democratic direction would lead to harmony and progress. Science Siftings' optimistic universe of equal opportunity extended to an ever-expanding readership with a penny to spend on ideas, and it resonated with Huxley's view in its uncritical promotion of scientific authority in cultural issues and in its advocacy of nature as the blueprint for progress and democracy. Conversely, this uncritical acceptance of liberal science and liberal capitalist democracy was rejected by the more radical working-class press for a more decidedly pro-Labour science.

The English Mechanic (1865-1926)

The English Mechanic was established by J. Passmore Edwards in 1865 as a forum for workingmen interested in

technical, scientific, and philosophical issues.[53] With a circulation of approximately 80,000-100,000, this twopence periodical was significantly more popular than science journals such as The Lancet or Nature.[54] Similar to Science Siftings, The English Mechanic expressed a liberal democratic ideology but it was clearly designed to appeal to a broad intellectual audience and skilled labour, likely a reflection of the editor's pursuit of knowledge and his working-class background.[55] In contrast to Science

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[53] Passmore Edwards, the son of carpenter, strove to educate himself with the aid of a dictionary and evening classes, and spent much of his life dedicated to the establishment of adult education and free libraries. See Passmore Edwards' autobiography, A Few Footprints (London: Watts and Co., 1906).

[54] See Brock, "Development," 113, in which he cites Alvar Ellegard's estimated circulation in 1871 of 30,000, and his later article on The English Mechanic in Science for All: Studies in the History of Victorian Science and Education (Hampshire: Variorum, 1996) in which he adjusts this figure to the 80,000 range as cited in the 1868 volume. However, in the issue for 10 September 1869, the journal addressed its "hundred thousand readers." See v.120 (1924), 321-22. The retrospective also noted that the price was briefly set at one penny but increased to two when it expanded from twelve to twenty pages. It remained at twopence despite subsequent expansions until its demise in 1926.

[55] In the opening pages of the first volume, Passmore Edwards made it clear that the journal would be a forum for mechanics, and that it would stay clear of politics as much as possible. This was followed by an article on protecting the rights of inventors from the "filching" State, and a letter written by "Y" on the reasons behind a strike in the iron trades. In the next issue, lockouts were declared by the journal as worse than strikes, and the following issue carried news of developments in a strike in Staffordshire. After these first issues, however, only the rare article appeared on individualism and socialism with partisan politics remaining in the background. See v.1 (1865) 2, 10, 14, and 26; v.60-61 (1895) 6, 64.

Siftings, The English Mechanic devoted a great deal of space to philosophical, scientific, and ethical debates carried on through correspondence. These debates addressed evolution, free will, theology, spiritualism, the antiquity of humanity, vivisection, and biological determinism; criticism quickly registered when discussions became too lofty.[56] Reader responses to changes in the magazine's content or critical responses to scientific theories and schemes were integral to the magazine's liberal democratic mandate, and this appealed to a wide assortment of correspondents from gentleman naturalists to the charming electrician John T. Sprague who wrote under the pseudonym "Sigma."[57] The magazine reads as if it were as much a product of its readers as of the editor, and it is easy to understand why readers referred to it as "Ours."[58]

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[56] See for example v.57 (1893), passim, on free will, evolution, science and theology; discussion of spontaneous generation, v.60-61 (1895), 68; vivisection in v.19 (1875), 33; and see "A Mechanic's Complaint," v.19, 99 on the need to keep the periodical out of the hands of gentlemen.
[57] Brock, "Development," 115 and The English Mechanic, v.120 (1924), 321 on "Some Old Controversies." The first issue of The English Mechanic declared that it would remain an apolitical open forum, catering to mechanics by providing information at a cheap price, v.1 (1865). See also v.45 (1887), 575-77 for a criticism of T.H. Huxley's influence in government programmes for technical education.
[58] The English Mechanic, v.120 (1924), 321.

Despite the expected emphasis on mechanical topics, the scientific base of The English Mechanic was substantial, and a retrospective published in 1924 drew attention to the ongoing debates and articles on astronomy, heat theory, health issues, sound waves, chemistry, mesmerism, psychic research, and vegetarianism.[59] Often, articles initiated impassioned debate, and an article in 1869 advocating vegetarianism included a criticism of T.H. Huxley's theory that "white blood corpuscles are the protoplasm or physical basis of life."[60] This prompted a mocking retort by "Sigma" who was a devoted carnivore. Alfred R. Wallace became embroiled in a debate with "Parallax" over whether the earth is round or flat, but Wallace refused to continue unless his opponent was able to "keep to the point"; the controversy ended quickly. Richard Proctor, a frequent contributor of articles and letters, is described in the retrospective issues as the most "voluminous writer" who was inundated with "ill-natured critics" suffering from "petty jealousy."[61] Proctor

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[59] The English Mechanic, v.120 (1924), 321-22, 336-37.
[60] The English Mechanic, v.9 (1869), 48, and for "Sigma's" response, see 113.
[61] The English Mechanic, v.120 (1924), 322.

wrote regularly on astronomical topics. Less controversial articles were also consistently featured in The English Mechanic on "Insects and Evolution," "The Persistence of Vitality," and "A New Theory of Colour."[62]

The assumption on the part of the staff and readers was that science is an objective authority and a reliable source of knowledge, but its usefulness was as co-partner to technology and philosophy. Everywhere the "boundaries of nature were yielding to the genius of man."[63] The work of men such as Huxley, Kelvin, Herschel, Draper, and Humboldt was frequently praised and discussed but not at the expense of practical science. Science added to the "growth of the soul" in an "advancing civilization" but this included the engineers and mechanics.[64] Notices of science classes, funding for science museums, and state-funding for technical instruction were signs of a positive appraisal of the value of scientific knowledge, but these

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[62] See for example, v.60-61 (1895), p. 11 on insects; v.57 (1893), pp. 55 and 150 for articles on colour and vitalism as the survival instinct in animals.
[63] The English Mechanic, v.1 (1865), 5; v.60-61 (1895), 65-66. Also see v. 57 (1893), p. 34 for praise of the "indefatigable servant of science" who never goes on strike!
[64] The English Mechanic, v.45, 1887, 575-77.

were accompanied by criticisms of the imprudence of assuming facts not yet in evidence.

The limitations of science were connected to necessary caution in science education.[65] In response to an overall decrease in British patents and industrial production, legislation was being discussed that proposed State funding for technical schools. These schools would replace traditional craft-based training and the authority of mechanics. In a critical letter to The English Mechanic, "The Engineer" drew attention to the realities of foreign competition, and reminded readers that such programmes were expensive if they were to be effectual, and that any such programme would disrupt the infrastructure of skilled work. As part of his critique, the "Engineer" cited T.H. Huxley in particular as an ill-informed spokesman from the scientific community:

> In support, furthermore, of the [Technical Instruction] Bill, the authority of Professor Huxley was cited. Professor Huxley is a very able man; as a biologist, none but his enemies admit that he has a

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[65] See for example, v.1 (1865), 14; v.19 (1875), 57; v.60-61 (1895), 65-66.

> rival. His monograph on the anatomy of the frog is perfection. But as an authority on trade matters or commercial questions, his opinion is not worth more than that of the Llama of Thibet or the Archbishop of York.

The "Engineer" supported funding for technical education but he vehemently opposed special schools, mandatory attendance, and legislated reforms that failed to address the real problems of mass production, free trade, and cheap American goods.[66] Despite their general love of science, the readers of The English Mechanic were confident enough to criticize scientific experts who they treated as fellow labourers in search of fact, not as their betters. Within the pages of The English Mechanic, nearly everything was possible.

The English Mechanic opened its intellectual borders to a great variety of subjects and approaches. In its treatment of evolutionary theories, The English Mechanic offered something that Science Siftings could not: it allowed for many levels of discussion. Dr. Edward Aveling,

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[66] The English Mechanic, v.45 (1887), 575-77.

a Darwin scholar and prominent socialist, contributed a series of articles titled "The Battle of the Microbes."[67] Less celebrated contributors spent years of their lives participating in the debates that raged through entire volumes over evolution's biological determinism in conjunction with free will, theology, the Deluge, and the antiquity of man.[68] Unlike Science Siftings, the editor did not seek closure in discussions but instead allowed debates to proceed until they degenerated into unproductive name-calling. Nevertheless, the backbone of The English Mechanic, beyond the flurry of theoretical controversy, was always the mechanic, and the journal's comprehensive articles on the lathe were eventually collected and reprinted in book form as "The Lathe and Its Uses."[69] Illustrations and photographs were a regular feature of the periodical's technical presentation. So much was at stake and The English Mechanic acknowledged that a balanced view requires many approaches: science needed philosophy,

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[67] See for example, v.60-61 (1895), 52.
[68] See for example, v.19 (1875), 40, 70-71; volumes 13 and 14 (1871-72), passim on antiquity and theories of the Deluge; v. 57 (1893), passim ; v.60-61 (1895), 557 on "Java Man."
[69] The English Mechanic, v.120 (1924), 321.

technical expertise, and plenty of discussion if the facts were ever to be found.

The National Reformer (1860-1893)

For fans of Charles Bradlaugh and secularism, The National Reformer could be purchased for 2d. Predominantly guided by a republican secularist mandate, with the occasional hint of socialism in the late 1870s and early 1880s, it was edited by Charles Bradlaugh from 1860-63 and 1866-91, and co-edited variously by the secularist Charles Watts from 1866-77 and Annie Besant from 1877-87.[70] After Bradlaugh's death in 1891, J.M. Robertson took control until the journal's dissolution in 1893. Additional contributors to the journal included political economics professor J.H. Levy and Dr. Edward Aveling [1851-98], prominent socialist and lecturer on comparative anatomy.[71] With an approximate circulation in the 1870s and 1880s of

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[70] The National Reformer was edited briefly by John Watts when, in 1863, Bradlaugh was forced to step down due to illness (DLB, v. VII, 19) This periodical offers a wealth of information about the variety of information seen by working families such as Ben Turner's (Turner, About Myself, 27,51)

[71] Edward Royle, Radicals, Secularists and Republicans: Popular Freethought in Britain, 1866-1915 (Manchester: Manchester University Press, 1980) 4, 105-106, 157-58.

6,000, this freethought journal brought a wide selection of radical views to a substantial audience.[72]

Typically, articles were concerned with politics and religion but science, literature, current events, economics, and poetry each had a place in its issues. In its presentation of scientific information, this popular iconoclastic publication offered simple articles on common topics such as fog or clouds (see Figure 5, Appendix); however, much of the scientific content served the journal's potent secularist polemics, which were fundamentally connected to the periodical's advocacy of republican democracy. In The National Reformer, the dominant ideological themes supplanted the quantity of science trivia and discussion in favour of a highly specialized application confined mainly to the biological and geological controversies over the origin and future of humanity.

In its assault on superstition, The National Reformer employed biological arguments and geological evidence in

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[72] Royle, Radicals, 157-58. Royle's statistics on secularist membership show that 22.7% were craft or skilled workers and 25.8% were semi-skilled or unskilled labour (128). The National Reformer was one of the main periodicals of the secularist movement and had a substantial following in the provinces (156).

its fight against "priestcraft" as early as 1864, and this trend continued for the remainder of the century.[73] Bradlaugh's struggles with the government during the 1880s over the mandatory Parliamentary oath and his attempts to generate public discussions on birth control during the 1870s and 1880s are well known in Victorian history.[74] The public trials that ensued made Bradlaugh a superstar of the radical and secularist community, and The National Reformer provided a forum for his views attacking the formidable alliance of Church and State in support of a secularist democracy.

It was Bradlaugh's intention that the periodical would treat political, social, and theological questions equally, and in the latter, science was the means provided.[75] Science confronted priestcraft in articles such as "Musings on Miracles," "The Mosaic Account of Creation Looked at from a Natural Standpoint," "The Natural History of the Pulpit," and "The Sunday School of the Future." Poems such as "The Future of Man" and "The Geological and Theological

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[73] Royle, Radicals, x.
[74] Royle, Radicals, Chapters 2 and 3.
[75] Royle, Radicals, 5.

Wars," and published letters such as "Genesis and Geology" hammered away at Biblical mythology.[76] Secularists replaced the pews and altars of the churches with the Halls of Science where lectures on everything from "Evolution" and "Physical Astronomy" to "John Stuart Mill" to "The Poems of Alfred Tennyson" were held for the benefit of the working class.[77] At the centre of the secularist movement, and with Bradlaugh as its main attraction, The National Reformer kept the flock aware of these opportunities to learn and confront the obstacles to knowledge and democracy.[78]

The National Reformer provides an example of the general intellectual and philosophical approach of the freethought and secularist movements. Scientific theories could be difficult to understand so science needed to be simplified for a popular audience. The National Reformer's approach relied upon popular knowledge of the Bible and discontent with religious authority, and then confronted common knowledge with geological evidence. Popular geology

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[76] 2 April 1864, 33; 6 July 1873, 5; 29 March 1874, 203; 5 April 1874, 211; 13 July 1884, 26; 16 March 1864, 6; 26 March 1864, 23; 14 December 1873, 379.
[77] See, for example, December 14, 1873, 380 and January 6, 1884, 15.
[78] For a description of Bradlaugh's leadership, see Royle, Radicals, Chapter 1.

took its place beside other forms of common knowledge. Beginning in the 1870s and 1880s, evolutionary arguments were incorporated; the struggle for existence was language everyone could understand and the simple metaphors of natural selection merged with the language of the working-class movement. In The National Reformer, Bradlaugh "used Darwin as a stick to beat the Bible with."[79] Popular science was a natural companion of popular religious and political discontent.[80]

As part of the radical republican tradition, the future of democracy was intimately connected to this assault on religious authority, and science provided the weapons. In an excerpt from "The Future of Man," the means by which freedom and truth would be realized was made clear: "With a free press to teach and unshackle our mind/And science to lend us her aid."[81] The poem urged readers to "fling the mystical legends" and "get knowledge in time" with the help of the cornerstones of progress: the

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[79] Susan Budd, Varieties of Unbelief: Atheists and Agnostics in English Society, 1850-1960 (London: Heinemann, 1977), 138.
[80] Royle's chapter on propaganda provides very useful information on the press, lectures, and publishing ventures of the secularist movement. See Radicals, Chapter 9. For an intellectual discussion of these ideas, see Budd, Varieties, Chapters 4-6, especially, 84-93 and 138.
[81] 19 January 1864, 6.

free press and science. Freedom and equality were only possible if "dark superstition" was replaced by "faith in the future of man," a future guided by scientific authority rather than theological fictions. Moreover, this rejection of religious superstition was only one example of Bradlaugh's materialism. The National Reformer's front page for 2 April 1864 carried a lengthy two-column article written by William Maccall that refuted all notions of vital forces in nature, asserting that science required protection from vitalists as much as humanity needed safeguarding against the mystical legends of priests (see Figure 6, Appendix). With this strict materialism, a strong political message, and the writing talents of Bradlaugh, Besant, Robertson, and Aveling, The National Reformer helped to popularize radical connections between science, society, and emancipatory ideology.

Reynolds's Newspaper (1850-1967)

Reynolds's Newspaper took a broadminded center-left republican position, overtly defending the working class

and serving as a fierce critic of its enemies.[92] Edited by G.W.M. Reynolds until his death in 1879 and by his brother Edward until 1894, contemporary sources place this paper among the most popular of the working-class press.[93] Sitting at the hub of the working-class movement, this paper, described by David Vincent as "aggressive insubordination," was a friend to secularists, democrats, unionists, socialists, republicans, and within limits, capitalists.[94] The main theme of the paper was the improvement of the living and working conditions of working men and women, and science was a consistent feature of its broadminded approach. Not one for lengthy discussion of scientific theory, Reynolds's Newspaper integrated scientific facts into its news format. Its position on science was to uphold the inviolability of fact once fact had been established: this was not always in agreement with professional scientists. With respect to evolutionism, Reynolds's Newspaper rejected the ruthless implications of natural selection in favour of a pro-worker articulation of

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[92] David Vincent, Literacy and Popular Culture, England 1750-1914 (Cambridge: Cambridge University Press, 1989), 252.
[93] DLB, Reynolds, v. III, 149-50. W.M. Thompson assumed editorship after 1894.
[94] David Vincent, Literacy, 256.

social progress leading to greater equality and better conditions for ordinary Britons.

In Reynolds's Newspaper, science had to share column space with politics, fiction, and sports, but this mass circulation penny weekly acknowledged the presence of science in several important ways.[85] Scientific facts can be found in Reynolds's Newspaper in several forms including small tit-bits of information, and in reviews and notices of general science lectures and educational initiatives. In January 1892, the discovery of the "influenza bacillus" by Dr. Richard Pfeiffer of the Koch Institute was announced along with a substantial discussion of possible causes and cures.[86] Medical science and medical controversy appeared occasionally, these having to do with people rather than abstractions; Reynolds's Newspaper was rarely abstract.[87]

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[85] See also, Anderson, The Printed Image, 91-4, 159-79; Berridge, "Content Analysis," 211-17 and also "Popular Sunday papers and mid-Victorian society," Newspaper History from the Seventeenth Century to the Present Day, eds. G. Boyce, J. Curran, and P. Wingate (London: Constable, 1978), 247-64. The treatment of science in Reynolds's Newspaper is similar to that of The Star during T.P. O'Connor's editorship in 1888-1890.

[86] 10 January 1892, 5.

[87] In the medical sciences, a notice in 1889 of some relevance for working-class families appeared concerning the "Anti-Vaccination" disputes, stating that they would not be prosecuted for having refused vaccination for their children.

In addition to general information, the lecture reviews were a lively source of science news, and examples illustrate the paper's response to science and science education.[88] In early 1889, a series of lectures under the heading "The People's Lectures" was publicized in Reynolds's Newspaper. The second of these was on "The Atmosphere and its Relation to Health," and the paper's review reported attendance of eight hundred.[89] In the 18 January 1888 issue, an article next to the Sunday Lecture list boldly advertised "Popular Science for the Young." The report stated that the theatre at the Institution was filled with children listening to Sir Robert Ball explain basic physics, and the reviewer provided some of the important details of Ball's lesson.[90] Furthermore, in the first issue of 1892, on the front page, Reynolds's Newspaper printed a review of a lecture for children on physiology given at the Royal Institution.[91] Professor McKendrick's "Life in Motion, or the Animal Machine" was

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[88] Reynolds's Newspaper frequently announced exhibitions of interest to the working class. See for example notices of industrial exhibitions in Hungary, Paris, Brussels, and Ireland (27 May 1888,1,3) and an electrical exhibition at the Crystal Palace (10 January 1892).
[89] 13 January 1889, 5.
[90] 18 January 1888, 8.
[91] 3 January 1892, 1.

part of a series of Christmas lectures for children, and it included demonstrations of the effect of electricity on muscles and a microscopic view of muscle tissue. The placement of this article on the front page indicates an enthusiastic response to science education, and the cultural importance of science education can be inferred. This emphasis on event rather than theory is in keeping with the popular appeal intended by the editorial staff and their ongoing support for improved conditions through intellectual and political awareness. Moreover, the tone of Reynolds's Newspaper included a sense of fun, and it is evident that science was not necessarily lashed to the boulder of serious scholarship, but had also the potential to be amazing and pleasurable.

In areas of potential dispute, Reynolds's Newspaper was insubordinate. Ridiculing the political views of leading scientists while promoting socialist natural scientist Prince Kropotkin, Reynolds's Newspaper revealed its ideological position. T.H. Huxley was criticized for labeling Cardinal Manning a socialist simply because he defended the poor, and in a bit of New Year's science

gossip, scornful mention was made of William Thomson's recently acquired knighthood. Reynolds's Newspaper failed to understand what "one of the greatest scientific men living" would want with a peerage, which merely entitled him to sit with "blackguards, adulterers, gamblers, debtors, and thieves." The notice expressed sorrow that Sir William Thomson had succumbed.[92] Conversely, Prince Kropotkin, socialist natural scientist, made the pages of Reynolds's Newspaper during his socialist lecture tour in London in January 1889. Socialists and their views were given ample space in the paper, and Kropotkin served as both political hero and scientific authority for the Victorian Left. The paper summarized Kropotkin's main achievements and his "successful" lectures, and commented respectfully on the calm he displayed when writing the "history of the Glacial Period during his incarceration in the dismal dungeons of St. Peter and St. Paul."[93] For less controversial scientists, mention of significant events or

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[92] For the article on Cardinal Manning, see 18 January 1891, n.p. and for the Thomson jibe, see 3 January 1892, 8.
[93] 20 January 1889, 5.

achievements was noted, as in the death of a local professor of chemistry, Dr. Albert Bernays.[94]

One of the additional services provided by Reynolds's Newspaper was a weekly list of London-based Sunday lectures. These lectures frequently referred to the natural sciences and were mainly given by radical, secularist, and socialist speakers including Fabians, the Secularist Federation, the Social Democratic Federation (SDF), the Socialist League, Workingmen's Clubs, and even the occasional Anarchist. In some issues, SDF and Secularist lectures were listed separately; in others, the list was divided geographically and the many lecturing groups were listed together.[95] This inclusion of socialists was of some importance: Reynolds's Newspaper claimed with pride to have been "the first newspaper in England, outside the recognized Socialist organs, which gave any encouragement and assistance to Socialism in this country."[96] These lectures often dealt with scientific topics and their social contexts.

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[94] 17 January 1892, 3.
[95] Compare, for example, 20 May 1888 and 3 January 1892.
[96] 20 January 1889, 3.

Lectures listed for the general assortment of radical London Workingmen's Clubs in the late 1880s and early 1890s included topics such as "The Solar System," "Phrenology, with Public Character Reading," "Psychometry," and "The Marvels of Modern Photography."[97] The London Secularist Federation and National Secularist Society frequently offered lectures with clearly demarcated scientific titles such as "Evolution Proved," along with more suggestive titles such as "A Higher Authority than Religion."[98] In February 1889, the topics "Science, the only True Religion" and "Two Freethought Martyrs: Galileo and Bruno" linked science directly to the secularist cause.[99] The issue for 3 January 1892 listed four secularist lectures relating to science, two of which were overtly connected to scientific theory: "The Origin of Life," and "Religion in Relation to Evolution." Closely related topics included "Is there a Moral Governor of the Universe" and "The Bible and Science."[100] The next week a similar list appeared with the

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[97] 18 January 1888,8; 20 May 1888, 8; 10 February 1889, n.p.; and 3 January 1892, 6.
[98] 20 May 1888, 8.
[99] 10 February 1889, n.p.
[100] 3 January 1892, 6. The likelihood that "Is there a Moral Governor of the Universe" being related to science is high because it was a

addition of lectures on "A Trip to Other Worlds" and "The Origin of Species," both delivered by members of the London Secular Federation.[101] In some cases, natural science was the primary focus, but it is apparent that conclusions in the natural sciences were linked frequently to social issues.

Finally, in keeping with the fictional format of the paper while engaging the evolution debates, an anonymously written short story appeared in 1889 titled "The Adventures of a Soul."[102] This four-part story was divided by subtitles such as "My Birth," "I Become Cain," "The Early World," "My Experience as a God," "I Pass into the Bodies of Insects," "Now a Theosophist." The narrative begins with the "dreamy consciousness" of "my existence on other planets," and follows the "evolutions of a primeval world to a world finished, polished, and men peopling it in form and mind like demigods." From descriptions of dinosaurs and reptiles to biblical imagery, the development of sacred and political institutions, the world of modern science,

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Secularist Society lecture. Another lecture from this group, "An Oration on the Heavenly Bodies," was most likely astronomical rather than spiritual.

[101] 10 January 1892, 6.

[102] Reynolds's Newspaper, 13 January 1889, 2.

and a growing awareness of science's limitations, the adventures of this soul encapsulated the history of humanity. In the final paragraph, the soul yearns for a "higher life on another planet, or, under different conditions, on this one," and having proceeded from "mollusk [sic] stage to that of the theosophist," the soul concludes that "health, cleanliness, competence, moderate work, equality of rights, morality, temperance are all that is needed for the re-establishment of the earthly paradise." This evolutionary account of history leading towards a new society based on equal rights and humanist ethics was typical of the ideology emanating from the late Victorian working-class movement.[103]

In total, the scientific content of Reynolds's Newspaper was both varied and significant. From 1846, when he first began Reynolds's Miscellany of Romance, General Literature, Science, and Art until his death in 1879, G.W.M. Reynolds was an advocate of "democratic progress and general intelligence," as was clear from this subtitle of

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[103] For more on socialist ethics and evolution, see John Laurent, "Science Education, Evolution Theory and The British Labour Movement, 1860-1910," diss., Griffith University, 1984; Mark Pittenger, American Socialists and Evolutionary Thought 1870-1920 (Wisconsin: University of Wisconsin Press, 1993).

early issues of Reynolds's Newspaper.[104] Between 1879 and 1894, when the paper was edited by Reynolds' brother Edward, there was no discernable shift in this mandate.[105] Providing the stimulus for political and intellectual discussion among an estimated 350,000 readers, Reynolds and his staff helped to popularize science as an aspect of personal development and participation in national social debates, both of which were crucial components of working-class emancipation.

The Star (1888-1960)

With an average daily circulation of approximately 125,000, The Star was the most successful of the daily papers.[106] During T.P. O'Connor's editorship (1888-90), The Star remained open to a broad range of viewpoints concerned with the improvement of working-class conditions. Even though Liberal politics and Home Rule dominated ideologically, in the opening "confession of faith," the

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[104] The full title was Reynolds's Weekly Newspaper, A Journal of Democratic Progress and General Intelligence, DLB, v. III, 146-151.
[105] DLB, v. III, 150. See also Reynolds's Miscellany, (1846-1868) 20 June 1868, 4,14; 27 June 1868, 23-24; 4 July 1868, 37,45; 11 July 1868, 52. These issues include scientific articles on astronomy, birds, alchemy, and the microscope.
[106] Goodbody, "The Star," 147-48.

editor declared that "every policy must first be regarded from the standpoint of the workers," and that "as to remedies styled Socialistic, we shall not either accept or oppose them because of any epithet that is applied."[107] Instead, the paper intended to "judge all such proposals on their own merits; and even if unable to agree with them, shall insist that they receive that ample and equal discussion, by which alone truth and falsehood can be finally separated."[108] Accordingly, The Star supported the Labour Movement, the Dockers' Strike, the Match Girls' Strike, and some of the programmes of the Fabians, Social Democratic Federation, and the Socialist League.[109] O'Connor's left-leaning views brought about his dismissal in 1890, and thereafter the paper became increasingly "Gladstonised."[110]

The Star presented science in several formats including a regular column with short bits of science

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[107] 17 January 1888, 1. The anniversary issue on 17 January 1889 discusses the "democratic army" which supports Gladstone but still appreciates moderate socialism. This review of a year's worth of activities follows the same lines as the "confession" a year earlier.
[108] 17 January 1888, 1.
[109] The Match Girls' Strike reports ran throughout July 1888, and the Dock Strike commentary ran through July-September 1889.
[110] Goodbody, "The Star," 155-57.

information, articles and reviews of lectures, listing for the London-based Sunday lectures, and correspondence. In the regular column "Science Notes," written by Dr. J. K. Taylor (F.G.S.), readers were treated to a mixture of humour, gossip, and trivia on topics such as electricity, photography, geology, science exhibits, science journals, and anthropology. On occasion, Dr. Taylor used science in political satire, as when he reminded politicians that in the "blood of a healthy person all the animalcule are quiet and peaceable; but in the blood of a diseased person they are furious, raging, and preying upon each other."[111]

In addition to feature columns, The Star offered articles on various science-related topics. An investigation of Bethnal Green's library established that working-class readership was varied in its interests and that "science has many votaries in Bethnal-green who are willing to work hard for the attainment of their object." It was noted in particular that the illustrated astronomical lectures were popular and the article reminded

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[111] 21 February 1888, 4. See also 31 January 1888, 4. Additionally, reporting on the American anthropologist Dr. Cope who claimed to have discovered the missing link that established the collective descent of most mammals including man, Dr. Taylor quipped, "not woman, of course!"

readers that free lectures were part of the educational programme of the library.[112] On the front page of the 18 July 1888 issue, a brief article appeared remonstrating the self-serving anthropologists of "civilized nations" for the hubris of treating aboriginal peoples as "savage." In July 1889, the article "Why I Became a Theosophist," written by Annie Besant, put evolutionism, psychology, and mysticism into the store of common knowledge. These articles addressed issues of some relevance to the cultural and intellectual life of the nation, and they were treated with the same skepticism applied to political news.

Lecture announcements and reviews were a large part of the paper's science component, sometimes accompanied by lengthy articles.[113] In December 1888, The Star announced a series of demonstrations on "Mental Magnetism," given by M. de Meyer. The Star recommended the performance in part because M. de Meyer provided an open forum for audience

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[112] 31 January 1888, 4.

[113] The issue for 18 January 1888 reported on a Mrs. Ayerton's lecture series on electricity and the same section also announced enthusiastically the opening of a Technical School for Women, noting also that many of the instructors would be women. Also in this issue was a list of "Doings for Today" in which meetings at various scientific societies were announced, and a lecture by Annie Besant for the Socialist League on "Evolutionary Aspects of Socialism" was listed.

questions (see Figure 7, Appendix). The article gave detailed information on M. de Meyer and the history of hypnotism, and both mesmerism and hypnotism were treated as legitimate sciences.[114] Three months earlier, a conference of the British Association was reviewed with summaries given for each of the conference divisions, including economics, geography, physics, technology, chemistry, and zoology. Noteworthy speakers included George Bernard Shaw (economics) and Sir John Lubbock (zoology).[115]

In addition to lecture announcements and reviews, The Star carried listings for the Sunday lectures. First printed as "Doings for Today," this list was quickly expanded by October 1888 to a long column under the heading "Lectures, etc., at the Clubs"; a full range of polemical and technical issues was included. Samples from three weeks in October 1888 and July 1889 dealing either directly on indirectly with science include "Socialism" (George Bernard Shaw), "Myths" (Annie Besant), "Physiology," "Man," "Karl Marx," "Giordano Bruno," and "Science and

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[114] 8 December 1888, 4.
[115] Conference reports were given on 7 and 8 September 1888.

Religion."[116] Both The Star and Reynolds's Newspaper publicized the lecture activities of a large assortment of working-class advocates, and science was an important component of radical, secularist, and socialist ideology and strategy.

Reader response to science news can be deduced from the daily column "People's Post Box." Letters addressed a wide assortment of topics that touched upon scientific issues. In a series of letters debating the merits of Christianity, science was pitted against faith with no clear winner and, for some, no need for conflict.[117] In 1889, a letter was printed from the secretary of the Anti-Vivisection Society against the use of animals in medical experiments. The letter charged that M. Pasteur's inoculation system was "not scientifically sound," and that his claim to painless experimentation failed to recognize

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[116] 6 October 1888, n.p.; 6 July 1889,4; 13 July 1889, 4. Additional lectures on topics such as "Man," "Creation" "God," "Freethought" and "Law" (E. Belfort Bax) and similar themes would likely have had some form of scientific component if the contents of related articles and pamphlets can be taken as indicators of the general message of the speakers and writers of the working-class movement. For more on pamphlets and lectures, see Chapter 5.

[117] 22 September 1888, 4.

the ongoing suffering of his animal subjects.[118] In a further criticism of medical science, the radical M.P. Auberon Herbert wrote to The Star protesting against the medical use of toxic drugs without proper investigation.[119] Controversy and critical analysis were fundamental to The Star, and science was not shielded from scrutiny especially where the welfare of the disenfranchised and downtrodden was in jeopardy. Like Reynolds's Newspaper, The Star was not inclined to abstract intellectual debate, preferring the more solid ground of news reporting and social commentary. In keeping with a news format, scientific knowledge, as much as book and theatre reviews, was offered as a matter of general interest. The Star did not make a fuss about science, nor did it ignore it; they simply entered the relevant facts into the store of common knowledge. In itself, this was a radical gesture without respect for intellectual boundaries and class.

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[118] 15 July 1889, 4.
[119] 20 August 1889, 2.

Conclusion:

Although these publications differed ideologically, each claimed that their political and social considerations did not preclude objective evaluation of scientific fact and controversy. The secularist viewpoint of The National Reformer was as objective to its staff as the pacific democratic sociology of Science Siftings was to Charles Hyatt Woolf. This pattern of incorporating scientific and social ideas reflected larger events in Victorian life, and publications participating in the contest for cultural authority typically framed their arguments in the ostensibly objective language of fact, science, and natural law. Tapping into cultural trends in science education, rational recreation, and self-improvement, the penny press assisted in bringing scientific information to the labouring sector along with varying interpretations.[120] Whether it was an article on electricity, evolution, heredity, the latest technology, hypnotism, or geological refutations of the Bible, it was all science by nineteenth-century standards.

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[120] On science education, see David Layton, Science for the People (New York: Science History Publication, 1973).

For the working-class community, the basic primers of modern science and the debates emanating from controversial theories and social science were made available to both serious and general readers. For over 500,000 workers with a spare moment and a spare penny, opportunities existed each week to participate in the emergence of a scientific and technological culture. Presented in simple language as entertainment, information, or ideological argument, the penny press entered science into the store of common knowledge. Acknowledging that a modern world required modern citizens; the issue was whose science would survive, and the boundaries of elitist science were regularly trespassed. The sometimes intellectually playful, sometimes severe working-class press encouraged the pursuit of scientific knowledge for personal improvement and increased participation in the life of the nation, both of which were pre-requisites of intellectual enfranchisement or class emancipation, whichever the case may be. Accordingly, even science trivia and recreational science in working-class culture must be taken seriously from an

historical perspective: setting aside the boundaries of elitist intellectual property is a political act.

Chapter 5: Science as Propaganda: The Siege on Scientific Capitalism

In 1884, the socialist periodical Justice printed excerpts from Prince Kropotkin's "An Appeal to the Young."[1] Kropotkin, an exiled Russian anarchist and natural scientist, adopted England as his permanent residence in 1886 after having spent three years in a French prison. During the 1870s and 1880s, Kropotkin developed a socialist sociology in conjunction with a theory of mutual aid as the next stage in social evolution, and he urged Britain's youth to devote its energies to studying science in a world so clearly dominated by scientific ideas. His status as a professional scientist lent authority to scientific socialism and the working-class movement's struggle to combat Darwinian natural selection with a model of natural cooperation. Furthermore, the "Appeal" spoke out for a non-elitist dissemination of scientific information,

[1] Justice, 30 August 1884, 3. See also 2 February 1884, 2. The "Appeal" was first published in Kropotkin's newspaper La Revolte in 1880 and subsequently went through many printings, including a 1904 pamphlet published by Henry Mayers Hyndman's publishing company, Twentieth Century Press. I would like to thank Dr. Alvaro Giron, who is currently writing Revolutionary Anarchism and Evolution: Peter Kropotkin and Darwinism, 1860-1921 (Spain: forthcoming), for details on Kropotkin's activities. For a discussion of Kropotkin and T.H. Huxley, see Adrian Desmond, Huxley: Evolution's High Priest (London: Michael Joseph, 1997) Chapter 9.

asserting that "we need above all to spread the truths already mastered by science, to make them part of our daily life, to render them common property." Kropotkin was advocating the extension of a collectivist economic ideology to intellectual property, and his assertion that scientific ideas should be widely diffused found resonance in late-Victorian working-class periodicals, lectures, and penny pamphlets as science news and theory were entered into the store of common knowledge.

For the Victorian Left, however, popularizing science was not enough; it had to be the right kind of science.[2] Would it be a collectively owned science based on the principles of mutual aid or science as an "appendage to luxury" that remained "inaccessible to the bulk of mankind"

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[2] In this chapter, the Left refers to socialists, labour socialists, and labourists who advocated class emancipation and were affiliated with at least one of the following: the Social Democratic Federation, the Socialist League, the cooperative movement, the Labour Church, and the Independent Labour Party. Many of the publications and educational activities of the unions and political groups remain to be examined for their scientific content. Additionally, I have excluded the Fabians because they were not strictly speaking advocates of working-class emancipation. For more on the various factions of the Victorian Left, see Logie Barrows and Alan Bullock, Democratic Ideas and the British Labour Movement, 1880-1914 (Cambridge: Cambridge University Press, 1996); Stuart Macintyre, A Proletarian Science: Marxism in Britain, 1917-1933 (Cambridge: Cambridge University Press, 1980): E.P. Thompson, Morris: Romantic to Revolutionary, 2nd ed. (London: Merlin, 1977); Henry Pelling, A History of British Trade Unionism, 5th ed. (London: Penguin, 1992).

while supporting the sociology of the "capitalist robbers"?[3] Kropotkin had warned that science needed to be "recast" in order to place it in "harmony with the new principles."[4] Which science would survive: a socialist science shared by the millions or capitalist science enjoyed by the few? Recognizing the importance of science as a cultural authority, the Victorian Left aligned their interests in science with their advocacy of class struggle and emancipation. Unlike the less ideologically intrusive, large-circulation general press such as Reynolds's Newspaper and popular science periodicals such as Science Siftings, the content of socialist and labour journals such as Justice was ideologically charged, and therefore restricted and specialized. Consequently, circulation was low in comparison with the moderate press.[5] Nevertheless,

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[3] "Appeal to the Young," II, Justice, 30 August 1884, 3.
[4] "Appeal to the Young," I, Justice, 2 February 1884, 2.
[5] The publications and their circulation noted in this chapter are: Justice (2000/weekly/2d), Commonweal (2000/monthly 1885, weekly 1886-90, monthly 1890-92/1p), The Labour Prophet (5000/monthly/1d), Labour Co-partnership (circulation unknown/monthly/1p), The Clarion (40,000-80,000/weekly/1p). These figures represent average circulation. There is some disagreement over whether the original price of Justice was one penny or twopence. My copy of the first issue was taken from microfiche at the London School of Economics, and it clearly shows twopence as the correct price. Circulation figures for Justice and Commonweal were reported in E.P. Thompson, Morris, 414, 523. Circulation for The Labour Prophet was provided by Caroline Sumpter in

in conjunction with pamphlets and lectures, the Left's propaganda network was extensive, and science was an essential aspect of ideology and rhetoric. Moreover, by presenting an alternative to naturalized capitalism, the Left created a democratic forum for the discussion of scientific ideas by providing a counterweight to the intellectual monopoly of leading liberal scientists.

Kropotkin was an important scientific celebrity for the Victorian Left. His advocacy of collective ownership of science and his association of science and socialist ethics made him an outstanding spokesman. In the evolutionary debates so crucial to class conflict in the final decades of the century, Kropotkin challenged the Darwinist orthodoxy in a series of articles on the theory of mutual aid. The articles were printed in the Nineteenth Century beginning in 1890, and all seven were published in

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her paper "Making Socialists or Murdering to Dissect? Natural Science and Child Socialisation in the Labour Prophet and Labour Leader," delivered at the SciPer Conference, University of Leeds, England, April 2000. I have not located the numbers for Labour Co-partnership but given that it survived for twelve years, sales must have been sufficient to survive in the competitive environment of late-Victorian publishing. Figures for The Clarion were reported in Robert Blatchford, My Eighty Years (London: Cassell, 1931) 196.

1902 as Mutual Aid: A Factor of Evolution.[6] Inspired by Huxley's article in the Nineteenth Century (1888) on the "Struggle for Existence and its Bearing upon Man", Kropotkin set out to compose a refutation of its "very incorrect representation of the facts of Nature."[7] In Huxley's article, the animal world had been likened to a "gladiator's show," and Huxley described the human condition in similarly bleak terms,

> So long as unlimited multiplication goes on, no social organization which has ever been devised, or is likely to be devised, no fiddle-faddling with the distribution of wealth, will deliver society from the tendency to be destroyed by the reproduction within itself, in its intensest (sic) form, of that struggle for existence the limitation of which is the object of society. And however shocking to the moral sense this eternal competition of man against man and of nation

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[6] James Knowles, editor of Nineteenth Century, encouraged Kropotkin to submit his optimistic interpretation of evolution. See Adrian Desmond, Huxley: Evolution's High Priest (London: Michael Joseph, 1997) 182, 193-4.

[7] Petr Kropotkin, Mutual Aid: A Factor of Evolution, foreword by Ashley Montagu (Boston: Extending Horizons Books, 1955) xiv. First published as a series of articles beginning in 1888 in the Nineteenth Century and released as a book in 1902. Huxley's article was re-titled for publication in Nineteenth Century as "The Struggle for Existence in Human Society" (Desmond, Huxley, 177).

> against nation may be; however revolting may be the accumulation of misery at the negative pole of society, in contrast with that of monstrous wealth at the positive pole; this state of things must abide.[8]

Socialism was not mentioned in the article, but the dangerous fertility goddess Ishtar and the fallen city of Atlantis figured as prominent symbols. Adrian Desmond has interpreted Huxley's competitive biology and fearful Malthusianism as a reaction to socialism's attack on elitist science and society, made all the more urgent by an accidental encounter with a rioting mob on "Black Monday."[9]

Naturalized capitalism was, for Kropotkin, a misreading of both Darwin and Nature.[10] In his introduction

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[8] Thomas Henry Huxley, "The Struggle for Existence in Human Society," reprinted in Selections from the essays of Thomas Henry Huxley, ed. A. Castell (New York: F.S. Crofts, 1986). First printed in 1948.

[9] Adrian Desmond, Huxley: Evolution's High Priest (London: Michael Joseph, 1997) 166, 177-78. Other factors in Huxley's reaction cited by Desmond were Darwin's death and the death of Huxley's daughter Mady. Desmond added that " On the Natural Inequality of Men" (1890) was a more direct assault on socialism, and that Huxley reinvigorated his Malthusianism in response to left-wing agitation and the migration of workers towards socialism (256-59). "Black Monday" refers to a demonstration protesting importation of foreign goods. It was held in Trafalgar Square with a march organized to Hyde Park. During the march, riots began and damage to shops was sustained. Four socialist leaders were arrested and later acquitted. For more, see Tom Mann's Memoirs (1968, preface by Ken Coates) Chapter 4.

[10] Kropotkin stated that Darwin included the larger sense of animal relations which included progressive evolution towards sociability. He

to Mutual Aid: A Factor of Evolution, Kropotkin stated that two aspects of animal life had impressed him during his childhood in Siberia and Manchuria: "inclement Nature" created a struggle for existence and, despite this, he had not observed a struggle within species as the predominant survival strategy. On the contrary, Kropotkin had observed that those "who learn to combine so as to mutually support each other" were the fittest in the struggle for existence. Kropotkin looked to Charles Darwin's emphasis on competition between species rather than between individuals for corroboration of intra-species mutual aid, and he criticized Darwinians and "economists" for "vulgarizing Darwin's theories and applying the narrowest possible definition of intra-species competition."[11] Kropotkin admitted that internal competition was a factor of evolution but a far less important one than mutual aid. Consequently, Huxley was accused by Kropotkin of extreme exaggeration of the least important factors of evolution, ironically blundering into the same mistake as that of

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based this on Part I, Chapter V of Darwin's The Descent of Man and Selection in Relation to Sex (1871).

[11] Kropotkin, Mutual Aid, 3-5.

Rousseau, Huxley's foil in "The Natural Inequality of Men" (1890).[12] Huxley's capitalist struggle in Nature was countered by Kropotkin's natural sociability and the obvious advantages of mutual support.[13]

Kropotkin was not alone in his socialist critique of natural selection. Dr. Edward Aveling asserted that the theory of natural selection was compatible with anti-capitalist interpretations of evolution precisely because socialism was "the logical outcome of evolution."[14] The vicious struggle of natural selection, along with its economic corollary, was merely a phase humanity passed through on its way to higher forms of social organization. At the same time, the co-discoverer of evolution, Alfred Russel Wallace, placed limits on natural selection in human evolution, asserting that the development of the intellect circumscribed the influence of natural selection. Once mind and morality were sufficiently developed, man stood as "a being apart" from the "great laws which irresistibly

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[12] Kropotkin, Mutual Aid, 5.
[13] Kropotkin, Mutual Aid, 5-6.
[14] "Charles Darwin and Karl Marx: A Comparison," The New Century Review, March and April 1897, 11; reprinted as a pamphlet by Twentieth Century Press, n.d., 2p.

modify all other organic beings."[15] This higher stage in human evolution removed the necessity of struggle, and the fittest became the community that demonstrated benevolence and justice, providing assistance to the weak and the sick."[16] In the debates over natural selection, Victorian sociological theory became a struggle between scientific socialism and scientific capitalism, or socialist science and capitalist science, depending on the emphasis. Either way, by the final two decades of the century, the contest for cultural authority once played out between the Anglican-Tory natural theological community and the Liberal scientific naturalists shifted to a new level: the heterodox Darwinists of the 1860s generation were now the entrenched elite defending the establishment against the onslaught of evolutionary socialists.[17]

Socialist agitators seized upon the scientific authority of Kropotkin, Aveling, and Wallace in their opposition to scientific capitalism. In the Marxist

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[15] Alfred Russel Wallace, Natural Selection and Tropical Nature, Essays on Descriptive and Theoretical Biology (London: Macmillan: 1891) 182.
[16] Wallace, Natural Selection, 199; Adrian Desmond and James R. Moore, Darwin, 2nd ed. (London, Penguin, 1992) pp.467-68, 521-22.
[17] For Huxley's confrontation with socialism, see Desmond, Huxley, 194-96.

tradition, socialist theory was based on historical and scientific laws that served as proof of its factual rather than utopian nature. Capitalist science had to be shown for the sham, elitist ideology that it was, and scientific socialism had to be accepted as the logical alternative. Education and organization along scientific lines were imperative if socialists were to persuade workers that class emancipation was not based on mere utopianism but was the natural outcome of physical and historical laws. To that end, Kropotkin's "Appeal to the Young" served two purposes. As a popular writer and lecturer, Kropotkin served as an excellent advocate of socialism, but perhaps more to the point, he brought science into the territory of the Victorian Left. Along with Alfred Russel Wallace's socialist evolutionism and Dr. Edward Aveling's Marxist Darwinism, the Left had their own scientific executive ready to do battle with the defenders of scientific capitalism, T.H. Huxley and Herbert Spencer. Justice regularly advertised Alfred Russel Wallace's book on land nationalization and continually put forward Kropotkin and

Aveling as authoritative spokesmen for naturalized socialism.

For the community of political thinkers and intellectuals that operated the propaganda journals such as Justice (Henry Mayers Hyndman and Harry Quelch), Commonweal (William Morris), and To-day (E. Belfort Bax), Huxley and Herbert Spencer were common targets of left-wing wrath, regularly treated to polemics and mockery.[18] In 1885, To-day printed a serialized story of a bumbling, pompous scientist named Professor Herbert Hoaxley. This amalgam of Spencer and Huxley approached a gathering of Rabelaisian poets, artists, and spiritualists with the calm assurance that, having eliminated the soul scientifically, he was wiser than the company he kept.[19] A close associate of the

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[18] Henry Mayers Hyndman (1842-1921) was the driving force behind the Social Democratic Federation (SDF) and its publications during the 1880s and 1890s. Harry Quelch (1858-1913) was a prominent proletarian intellectual who worked closely with Hyndman and co-edited Justice. William Morris (1834-1896) and E. Belfort Bax (1854-1926) split from the SDF in late 1884, along with Edward Aveling (1849-1898) and Eleanor Marx (1855-1898), forming the Socialist League. The Socialist League produced the journal Commonweal until 1890, when it was taken over by anarchists. E. Belfort Bax edited To-day in 1884 and 1885. For more on the SDF and Socialist League, see pp.16-18 of this chapter. For more on the growing antagonism between Huxley and the Victorian Left, see Desmond, Huxley, 192-96, 260.

[19] "The Story of Today" ran in 1883, and there is a good deal of commentary on science in this periodical. See To-day, A Monthly Gathering of Bold Thoughts, edited by E. Belfort Bax, 1883-85. It was not included in this study because it was priced at 6d.

staff of To-day, William Morris (1834-1896) had less to say about Huxley or Spencer, but managed to squeeze in a comment in his segment on "How I Become a Socialist." Morris lamented the fact that "the place of Homer is to be taken by Huxley."[29]

Huxley was an important adversary for the Left in that he defended the ceaseless struggle for existence, but a more relevant target for socialists was Herbert Spencer and his Malthusian individualism. In one exchange, Henry Mayers Hyndman (1842-1921) and Spencer traded barbs over the limits of freedom under capitalism and socialism. The dispute was, typically, more social than scientific, but sociology was the much-contended ground upon which scientists and political economists mixed their facts and theories in varying proportions; intellectual territorial disputes were common. In this instance, Spencer had blustered into the Left's terrain with naturalistic denunciations of socialism and a direct attack on Hyndman

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[29] E.P. Thompson, William Morris, 125, 129. "How I Became a Socialist" was originally published by Justice in June 1894. For an identification of Spencer with an erroneous defence of individualism, see "The Dull Level of Life," Justice, 26 April 1884, 4, reprinted in Nicholas Salmon, ed., Political Writings: Contributions to Justice and Commonweal, 1883-1890 (Bristol: Thoemmes Press, 1994) 28-31.

and the Social Democratic Federation for contributing to "political intoxication."[21] In "The Coming Slavery," Spencer pitted the evils of human nature against the socialist programme. Human behaviour, governed as it is by love of power, selfishness, and dishonesty would demand increasing escalation of government intervention, culminating in "forcible suppression" and "grinding tyranny."[22] For Spencer, competition was a crucial component of progress, and socialist governments would necessarily have to limit freedom and competition through collective ownership and diversion of wealth to the weak.[23] Elsewhere he referred to socialism as "compulsory co-operation, "biologically fatal," and "psychologically absurd."[24]

In his reply, Hyndman ruthlessly ridiculed Spencer's interpretation of evolutionism along with his social theories, denouncing Spencer's anti-socialist attack as the

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[21] Herbert Spencer, "The Coming Slavery," Contemporary Review, April 1884, (461-82), 473, 480-81.
[22] Spencer, "The Coming Slavery," 482.
[23] For Spencer's rationale on progress and evolution, see "Progress: Its Law and Cause," Essays: Scientific, Political, and Speculative (London: Williams and Norgate, 1891) I, 8-62.
[24] Spencer, "Introduction," A Plea for Liberty: An Argument Against Socialism and Socialistic Legislation, ed. Thomas Mackay (New York: Appleton, 1891) 7, and Principles of Sociology (New York, Appleton, 1897) II-3, 582.

"piteous wail" of Herbert Spencer "at the overthrow of his ill-founded theories."[25] Spencer's assertion that "freedom of contract" and competition create the conditions for progressive evolution was inverted by Hyndman, who described evolution as "going on all around us" with "anarchical competition" being a phase soon to pass into "organized cooperation."[26] Evolution was not subject to control but could be accepted peacefully or foolishly resisted.[27] Moreover, in case Spencer truly dismissed socialism as absurd, Hyndman pointed out that despite socialism's reputation as a utopian dream of building "up little oases of loving co-operators amid a desert of anarchical competition," scientific socialism was a distinctly "scientific, historical theory, based upon political economy and the evolution of society."[28]

Hyndman countered Spencer's charges of socialist slavery with the reminder that in his "prophecy of

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[25] Henry Mayers Hyndman, Socialism and Slavery, Being an Answer to Mr. Herbert Spencer's attack on the Social Democratic Federation, (London: Twentieth Century Press, 1899, 1p) 2nd ed, first printed in 1884, preface. Robert Blatchford criticized Spencer's "The Coming Slavery" in The Clarion. See notes 36 and 86 of this chapter.
[26] Hyndman, Socialism and Slavery, 4, 14-15.
[27] Hyndman, Socialism and Slavery, 15.
[28] Hyndman, Socialism and Slavery, 4.

hypothetical slavery in the future," Spencer not only failed to recognize the "palpable slavery" everywhere around him but he had neglected to account for the cruel conditions that existed "before the enactment of the measures he [Spencer] holds to be so harmful. Slavery, according to Hyndman was defined by how much the labourer is "compelled to labour for other benefit than his own"; in Hyndman's view, the class inequality of liberal capitalism was the real taskmaster. In addition, Hyndman attacked Spencer's laissez-faire criticisms of education and factory reforms, asking how it could be considered disastrous to educate children and regulate their exploitation as workers."[29] This scurrilous attack on so prominent a member of the scientific community was distributed to the working-class community for one penny and passed through several editions.[30]

Hyndman pressed his attack beyond this pamphlet. He and other contributors to the socialist press regularly sharpened their wit at Spencer's expense. Referring to

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[29] Hyndman, Socialism and Slavery, 5. An example of legislation that troubled Spencer was, according to Hyndman, the Factory Acts (7).
[30] The second edition was printed in 1899 and the last edition I have found is the sixth, published by William Reeves, n.d.

Spencer's fourteen-volume study of Nature and society subsumed under the heading "Synthetic Philosophy," Justice claimed that Karl Marx did "what Herbert Spencer pretended to do."[31] In another reference to the great tome, Justice offered this satirical epitaph,

> "In six days the Lord made the Earth, and on the Seventh, Herbert Spencer wrote it down."[32]

Commonweal described Spencer as an "ignorant demagogue" in an article reviewing the socialist opinions of mathematician Karl Pearson, and J.L. Joynes poked fun at Spencer for having put the "weight of his authority" behind the theory that class inequality is a permanent condition; Joynes estimated Spencer's weight as extremely light.[33] In Australia, Tom Mann's second wife Elsie Mann wrote an article for Mann's Melbourne Socialist in which she accused Spencer of having missed the real goal of evolution: a revolutionary reorganization of society along socialist

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[31] Justice, 26 January 1884, 3.
[32] Justice, 20, September 1884, 5.
[33] Commonweal, May 1885, 34.

lines.[34] Additionally, in the large-circulation Clarion, the ruthless individualism of natural selection was described as "Gradgrind's favourite argument," "another name for Anarchy," and the absolute opposite of the basic structure of society, the family.[35] Herbert Spencer was treated as the main spokesperson for natural selection, and he was criticized for his ruthless individualism and his failure to understand socialism.[36] The muted social implications of Darwin's theories helped to preserve his status as an objective scientific thinker, but this was not the case with the overt social theorizing of Spencer. Though not always united in their methods and goals, the Left was united in its identification of the enemy, and working-class readers were treated to daily, weekly, and monthly servings of arguments favouring scientific

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[34] John Laurent, Tom Mann: Social and Economic Writings, ed. John Laurent (Nottingham: Spokesman, 1988) 29-30. I wish to thank Professor Laurent for his assistance in locating information on Tom Mann and his interest in science and scientific socialism.

[35] Robert Blatchford, Merrie England (London: Journeyman Press, 1977) 59-61, 64. First printed as a collection of articles from The Clarion in 1893.

[36] Robert Blatchford, Merrie England, 66, 76. Blatchford referred to "The Coming Slavery" in this indictment of Spencer's anti-socialist views.

socialism, along with warnings against false prophets and unnatural selection.[37]

The goal of making scientific socialists was part of a large campaign that included diverse political and economic visions and a multi-faceted information network built upon the daily press, propaganda periodicals, lectures, and pamphlets.[38] Factions formed around assessments of the uses and abuses of capitalism, and when and how it might pass into the socialist future.[39] Would there be a revolution, or was a revolution of sorts already occurring? Should parliamentary reform be sought and if so, was political organization a legitimate socialist strategy? For the unionists, the question concerned trade union organization and the softening of the rough edges of individualist

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[37] This was also true of The National Reformer during the period in which Annie Besant served as co-editor and articles by Aveling began appearing in support of evolutionary socialism. See for example "Mental Evolution in Animals," 30 March 1884, 210.

[38] Inexpensive books were also part of the socialist syllabus but analysis of this large topic is confined in this study to the reading interests of working-class intellectuals noted in their autobiographies as outlined in Chapter Three. See also Macintyre, Proletarian Science, Chapter 3.

[39] A comparison of the approach taken in Justice, The Labour Prophet, and The Labour Standard serves as an excellent example of conflicting responses to capitalism. Also, see Thompson, Morris, 331-65; Stuart Macintyre, Proletarian Science, 51-56; and James Hinton, Labour and Socialism, A History of the British Labour Movement, 1867-1974 (Sussex: Wheatsheaf Books, 1983) Chapters Two and Three.

capitalism: in that case, should union organization take precedence over parliamentary action? In each version of theory and practice, science was employed to persuade and justify. Socialists, labour socialists, and labourists each used scientific ideas and authority in conjunction with their respective critique of capitalism.[40]

For socialist agitators with expectations of an impending revolution, Marx had already foreseen the emancipation of workers resulting from the inevitable dialectical breakdown of capitalism followed by a natural progression towards socialism.[41] For this group, workers needed to be ready to seize power. Socialist education in Marxist economics, history, and science would prepare workers for the revolution; accordingly, propaganda was the central concern.[42] For the labour socialists, revolution was less appealing than the gradual progress of an evolutionary socialism based on equal parts of Darwinism

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[40] Macintyre, Proletarian Science, 49-55.
[41] Friedrich Engels, Socialism: Utopian and Scientific (New York: International Publishers, 1989) 45-53.
[42] Macintyre, Proletarian Science, 71-74. See also, Hinton, Labour and Socialism, 30, 42, 57.

and Lamarckism.[43] Nature moved in gradual transformations and society was slowly progressing towards improved sociability: natural cooperation would inevitably replace natural selection. This interpretation of evolutionism informed both the ethical mandate and reformist political goals of this faction.[44] Their programme included education, social reform, and parliamentary action, all of which provided the means to prepare for and assist the evolutionary process. On the more conservative end of the spectrum, labourists were largely trade unionists and advocates of cooperation who borrowed from Darwinism to naturalize collective action and defeat the "apostles of the 'survival of the fittest' doctrine."[45] They supported

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[43] Macintyre, Proletarian Science, 49. The Lamarckian side of evolutionary socialism can be detected in the appeal to create environments that could assist the evolution of society towards socialist ethics. The emphasis on socialist schools for children is one example.

[44] Hinton, Labour and Socialism, 62. Hinton points out that the ethical dimension of labour socialism appealed to non-conformist traditions in Lancashire and Yorkshire, making the Independent Labour Party popular in this region.

[45] Macintyre, Proletarian Science, 55. There is some evidence that speakers at annual meetings of the Trade Union Congress used Darwinian metaphors to describe the struggle between capital and labour, and that they evoked scientific authority in various arguments in support of labour legislation. See for example, Report of the Thirty-First Annual Trades Union Congress (Bristol), 1898, in which phrases such as the "struggle for existence," the "scientific" methods of the capitalists, and "adaptability of structure to environment" are enlisted to bolster trade union morale (32-33). A fuller indictment of natural selection

evolutionary socialism only inasmuch as it meant that workers would have control over their living and working conditions through the power of their organizations.

These ideological disputes reveal an interesting parallel between the scientific and political components of the working-class movement. Despite the prevalence of socialist ideas and rhetoric throughout the working-class community, it can be argued that the foundation of the various programmes had more to do with anti-poverty humanist ethics, the rights of Britons to security and independence, and faith in a broadening of the democratic process than it did with anticipation of a Marxist revolution.[46] Political inequality and the extremes of poverty and wealth had long been targets of working-class

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was recorded in the Report of the Thirty-Second Annual Trades Union Congress (Plymouth) in 1899, 48-49, in which it is asked when unemployment befalls the worker through no fault of his own, what do the "apostles of the 'survival of the fittest' doctrine say on this point?" Conversely, in a brief survey of records from ILP congresses 1895-99, no evidence of scientific fact or rhetoric was found.

[46] Barrows and Bullock, Democratic Ideas, Chapter 1. Barrows' and Bullock's contend that democratic ideas provided the foundation for the programmes of the Social Democratic Federation and Labour Socialists. See, for example, the front-page design of Justice that lists twelve points in their programme including "adult suffrage," "annual parliaments," "payment of members," and "nationalization of the land." The SDF programme was consistent with the traditional working-class demands for independence and control over living and working conditions associated with bread riots, Chartism, Luddism, republicanism, secularism, and trade unionism.

protest, and the socialist and scientific arguments of the late Victorian period provided a new articulation of an old problem.[47] This helps to explain left-wing doctrinal disputes over the revolutionary or gradual potential of both socialism and evolutionism by placing them in the context of unfulfilled plebian democracy confused with European articulations of revolution.

If the majority of the organized Left were interpreting European revolutionary ideas as a way of reviving the struggle for democratic reform, then emancipatory programmes and their sociological presentations would have been contested ground as the labour movement sorted out its real goals and strategies from inflammatory rhetoric.[48] In this event, the abandonment of revolutionary evolutionism towards a gradualist plebian evolutionism does not represent a weakening of political zeal or capitulation but rather the acknowledgement of achieved goals through the establishment

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[47] Hinton, Labour and Socialism, 8-24. See also, Edward Royle, Radicals, in which Royle suggests that it may have been "the method more than the content that had changed" (167).

[48] For a discussion of this in the German context, see Alfred Kelly, The Descent of Darwin: The Popularization of Darwinism in Germany, 1860-1914 (Chapel Hill: University of North Carolina Press, 1981).

of strong trade unionism and labour organizations such as the Independent Labour Party (1893) and the Labour Party (1901).[49] In addition, it suggests that British socialism was less of a foreign import than an outgrowth of plebian democracy, and that scientific ideas were part of a new language of protest consistent with working-class emancipation. Towards that end, it was agreed that science was the key to cultural authority and that a massive propaganda effort was the key to success.[50]

Unlike the more moderate democratic, republican, and secularist critiques of science, the Victorian Left turned up the rhetorical heat in the battle between capitalist and socialist science. In the early 1880s, Reynolds's Newspaper noted increasing recourse to science as radicalism increased: "like so many Anarchists and Socialists, born or made, [Kropotkin] had a strong love for

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[49] This is not to suggest that there was nothing revolutionary in demanding control over living and working conditions: from the perspective of the middle and upper classes, political equality and a partial relinquishing of control to labour groups would have seemed an echo of the Paris Commune. It certainly did to Huxley and Spencer, who both spoke out against the "coming slavery." See Spencer's "The Coming Slavery," Contemporary Review, April, 1884, and Adrian Desmond, Huxley: Evolution's High Priest (London, Michael Joseph, 1997) 256-59.

[50] Thompson, Morris, 366-426.

natural science."[51] Publications came in many forms with The Clarion (1891-1932), a general socialist newspaper, faring better in circulation than the more specialized contents of Justice (1884-1933), Commonweal (1885-92) and The Labour Prophet (1892-98) or the eclectic trade news and literature reviews of pro-union, cooperative periodicals such as Labour Co-partnership (1894-1906).[52] For socialist readers, the doctrine-laden Justice would have appealed to a smaller audience of serious socialists, but the overall distribution of ideas—both scientific and political—in the periodicals, pamphlets, and lectures of the Victorian Left contributed significantly to familiarization of workers with basic scientific theories and language.

Turning up the level of polemics did not increase the general scientific content; it rooted science firmly in the larger sociological debates common to the Victorian period. On the Left, science was a tool of class emancipation with an expectation of systemic change rather than a means by which greater participation in an unreformed system could

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[51] Reynolds's Newspaper, 20 January 1889, 5.
[52] The dates given are for the full run of periodicals but this chapter cites issues from the 1880s and 1890s only.

be achieved. Scientific socialism and evolutionary socialism confronted capitalism, its excesses, and the scientific slogans and theories upon which the capitalist edifice rested. Using the press as the central dispatcher in the left-wing information network, lectures and meetings were announced regularly along with recommended reading lists and advertisements for political and sociological pamphlets. Added to the press, lectures and pamphlets presented a formidable presentation of socialist views and science was a regular feature of this three-pronged information network.

The lecture circuit formed a crucial wing in the campaign to agitate, educate, and organize; science was included in both direct and indirect ways.[53] Celebrated socialists and radicals most often used science as part of a polemical strategy, leaving the undiluted scientific lectures to those with the interest and inclination.[54] A

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[53] T.A. Jackson stated in autobiography that taking a "turn at the stump" was expected of SDF members and that many lectured several times in one day. See T.A Jackson, Solo Trumpet: Some Memories of Socialist Agitation and Propaganda (London: Lawrence and Wishart, 1953) 70, 78.

[54] Lectures on scientific topics given by conventionally qualified personnel occurred rarely, as was the case for Dr. Perfitt's lecture on "Physiology" announced in The Star, 6 October 1888. More often the speakers were neither celebrities of the Left nor of science, and but

notable exception to this was Tom Mann who incorporated his love of science with his love of socialist oratory.[55] Attendance is difficult to calculate; however, Justice regularly printed a Lecture Diary and Reports on Branch Meetings, the latter offering some indication of attendance, which varied from dismal to impressive.[56] The array of speakers affiliated with SDF included William Morris, Harry Quelch (1858-1913), and E. Belfort Bax (1854-1926), along with Fabian speakers and an impressive assortment of labour leaders, anarchists, and middle-management socialists. Lecture contents were sometimes discussed in reviews but much of the inferential data must come from surviving pamphlets, which often began as lectures or debates.

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were members of one, or several, of the leftist factions. For example, T.A. Jackson, interested in science throughout his life, claimed to have lectured on Darwinism as part of his regular lecturing duties for the Socialist community. See Solo Trumpet, 91.

[55] Mann lectured and wrote on a wide assortment of political, economic, social, and scientific topics. See Laurent, Tom Mann, 23.

[56] Sometimes audiences were described as a good crowd or bad crowd. Thompson provides a numerical translation, indicating that numbers could be as low nine for Socialist League meetings and as high as 500-2000, up to 1000 for open-air meetings, and as high as 3000 for lectures with much lower numbers also likely. According to Thompson, a lot depended on the speaker and the state of branch organisation. See Thompson, Morris, 414-421, 439, 461, 474. On the other hand, T.A. Jackson gave as an explanation for good attendance numbers the fact that Sunday morning meetings in particular were popular because men were forced out of their homes by wives and the pub had yet to open. See Jackson, Solo Trumpet, 70.

Penny pamphlets advocating the rights of working men, women, and children were churned out in enormous quantity. Each of the leftwing factions had their own publishing arrangements: The Rationalist Press Association had Watts and Co; the SDF operated the Twentieth Century Press; Robert Blatchford's group had the Clarion Press; and The Independent Labour Party and Fabian Society each supported their own printing facilities. With these publishing capabilities and a steady supply of passionate writers, pamphlets issued forth from the presses out to the working-class community. As a major source of information, the penny pamphlet was the natural companion to the lecture circuit.

Analysis of these pamphlets helps not only to understand the spread of general scientific ideas through the working-class information network, it also provides written testimony as to the probable contents of lectures for which only titles survive. Much of leftwing polemics was concerned with poverty and ways to remedy it, and scientific authority brought a factual tone to arguments favouring equality, independence, protection, and

collective action whether they were couched in ethical or economic language.[57] Polemical invocation of scientific authority as opposed to the direct inclusion of scientific ideas in the pamphlets varied in degree and form, depending on the writer. Resembling the content style of journal articles, science might simply adorn revolutionary polemics as an imported cultural authority or it might form the basis of a sociological analysis. Either way, the tracts were an integral component of the working class communication network, and they helped to popularize a science on the Left.

Scientific Socialism entailed bringing emancipatory programmes under the purview of science and then exporting them as apolitical sociological theories. In so doing, a humane system of government and distribution could be seen as logical and possible. This meant recognition of the inherent inequalities of competition and the acceptance of cooperation as the basis for civilized society. The natural world could be made to validate collectivism just as reasonably as Herbert Spencer had naturalized

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[57] See for example, the National Secularist Society's Poverty: Its Cause and Cure (London, 1885, 1p).

capitalism. Scientific observations were subject to interpretation, and the Left exploited this flexibility, using science to persuade and validate where possible.

Henry Mayers Hyndman, who exercised tight control over the Social Democratic Federation (SDF), Justice, and the Board at Twentieth Century Press, continually produced large and small works on socialism.[58] Hyndman was one of the key popularizers of scientific socialism. Advertisements for his pamphlets and books, along with those of fellow socialists, Fabians, and assorted revolutionaries, appeared in each issue of Justice.[59] The

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[58] T.A. Jackson in Solo Trumpet (52-57, 64-66), E.P. Thompson in Morris (331-365, 572-79) and C. Tsuzuki in H.M. Hyndman and British Socialism (Oxford: Oxford University Press, 1961, 62-69) make it clear that Hyndman's control over the SDF and its publications was inflexible to the point of alienating many of those who would have followed willingly if he had been less controlling.

[59] The political programme of the SDF was a controversial and ambiguous mix of Marxism, reformist socialism, and evolutionism. Its leader, also the editor of Justice for the first two years, was Henry Mayer Hyndman, by all accounts a controversial and ambiguous socialist, never to be endorsed by Marx or Engels. Hyndman, according to T.A. Jackson (Solo Trumpet, 56), leaned towards reform or revolution depending on the argument put to him. After Hyndman left in 1886, Harry Quelch took over editorship. Quelch was a London meat-porter described by E. Belfort Bax as a "remarkable" example of a "self-educated man," and this kind of praise was voiced by several of Quelch's contemporaries, see E. Belfort Bax, Reminiscences and Reflexions of a Mid and Late Victorian , 2nd ed (New York: Kelley, 1967) 112; Thompson, Morris, 298. Generally, as outlined on the front page of Justice, the SDF brand of socialism supported democratic reform, collectivization, and Home Rule. These kinds of reforms were expected to undermine elitist capitalism while retaining the parliamentary system. See also, H.M. Hyndman,

pamphlet "A Summary of the Principles of Socialism" is described on the front page of an 1884 issue as a "scientific survey." In the editorial of this same issue, socialism is said to have a "definite, scientific, historical, and economical basis."[60] Though his leadership was a key factor in the split between William Morris and the SDF, Hyndman must be recognized for his contribution to the socialist propaganda network and the articulation of scientific socialism in England.[61]

Hyndman's scientific socialism often drew upon Marxist historical analysis. This was the case in A Summary of the Principles of Socialism, co-written with William Morris in 1883.[62] This 63-page pamphlet on "the history of mankind" passing through "inevitable modifications," offered a "careful study of each link in the chain of this development."[63] From the onset, Hyndman and Morris located

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Social Democracy: The Basis of its Principles and the Cause of its Success, (London: Twentieth Century Press, 1904).

[60] Justice, January 19, 1884, 1,4,7.

[61] For more on Hyndman's leadership and the problems of left-wing factionalism, see Thompson, Morris, 331-65, 572-79; Tsuzuki, Hyndman, 62-69; Macintyre, Proletarian Science 51; and T.A. Jackson, Solo Trumpet 52-57, 64-66.

[62] H.M. Hyndman and William Morris, A Summary of the Principles of Socialism (Twentieth Century Press, 1912, 6d). First published by the Democratic Federation in 1883.

[63] Hyndman and Morris, A Summary, 7-9.

man in the animal world, having progressed from "primeval man" through "ages on ages of slow growth" onwards towards a Socialism based on "the sure ground of science and political economy."[64] What followed was a lengthy historical treatment of human progress towards socialism, ending with a re-statement of the developmental model and the scientific basis for socialist theory.[65]

This pattern holds for similar works, as seen in the 28-page pamphlet, Social Democracy: The Basis of its Principles and the Cause of its Success. Taken from a speech delivered in London in 1904, Hyndman claimed that socialism "is the science of sociology," and before proceeding to economic discussion, he added that the "scientific point of view" must conclude that the development of humanity leads to socialism.[66]

Commonweal mirrored many of the ideas and strategies of Justice but it was more intellectual and friendlier to the European Socialists.[67] William Morris was the editor and Edward Aveling was the sub-editor. Regular

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[64] Hyndman and Morris, A Summary, 8-9, 44.
[65] Hyndman and Morris, A Summary, 63.
[66] See for example, comments on socialism, sociology, and the scientific point of view in Hyndman, Social Democracy, 4-5.
[67] Thompson, Morris, 366-85.

contributions came from members of the Socialist League such as Eleanor Marx (1856-1898), Friedrich Engels (1820-1895), E. Belfort Bax, and at the other end of the social spectrum, Tom Barclay.[68] The rhetorical application of science was identical to that of Justice, with frequent references to the "scientific basis of Socialism," and "scientific socialism."[69] Moreover, the cultural authority of science was enlisted in a limited and reconstituted form to allow for both naturalistic models and socialist revision. The main distinction between the two journals was that Commonweal was more intellectual, artistic, and international in its articles, but Marxist deployment of evolutionary theory linked to historical, scientific socialism followed similar lines.[70]

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[68] See Signatures of the Provisional Council, February 1885 issue for a list of the prominent socialists on the Executive of the Socialist League who also contributed to Commonweal. Started in opposition to Justice after a split between the Socialist League and the Hyndman-dominated SDF, William Morris and his friend Belfort Bax kept this eclectic journal afloat until 1890 when Morris' leadership was challenged by the young anarchists who had come to dominate the Socialist League (Thompson, Morris, 566-70).

[69] Commonweal, February 1885, 1, 5.

[70] See for example the series of articles "Socialism from the Root Up" that ran between 1886 and 1888. This series outlined in Marxist terms the evolution of western civilization from primitive to modern industrial society. It was co-authored by William Morris and E. Belfort Bax. For the full text, see Salmon, Political Writings, 497-622.

Guided by William Morris' eclectic interests, Commonweal devoted less column space to Marxist dogma, opting instead for a broader international approach that included art, ethics, current events, and even poetry. Science was a constant companion in all categories, and the poem "Towards Revolution" claimed that the "Power behind Evolution has decreed the thing we strive for."[71] The passionate, witty staff of Commonweal gave scientific socialism a lively appeal with articles on "Social Ethics in Natural History" and "The Physiological Basis of Society." In the former, animal and human society are caricatured with Labour represented by ants, co-operatives by bees, and the aristocracy by the cuckoo bird. The article's conclusion suggested that humanity exceeded animal limitations by becoming a shaper of social conditions rather than the passive recipient of natural law.[72] In the latter article, a two-column approach to the development of the cell, or individual, is pursued in natural and social terms reaching the conclusion that if any member of the whole seeks to "enrich itself at the

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[71] Commonweal, 31 March 1888, cited in The Labour Annual, 1895, 131-33.
[72] Commonweal, 5 June 1886, 78.

expense of the rest," agitation will necessarily progress until the evil is recognized and stopped.[73] Similar points of view inform articles such as the series "Scientific Socialism," written by Aveling as a declaration of faith in Darwin and Marx, or "What's To Be Done- Agitate, Educate, Organise" by Andreas Scheu, which employed revolutionary evolutionism as part of its recruitment strategy.

In a periodical aimed at socialist families, The Labour Prophet united the cause of labour with a non-violent, humanist religion in an attempt to emancipate the workers physically, intellectually, and spiritually. The Labour Prophet was edited by John Trevor on behalf of the Labour Church, and science was a key component of this late-century post-Darwinian twist on natural theology that was both non-sectarian and mildly socialist. Celebrities from the Labour Movement frequently contributed articles that linked political theory to humanism and science, and each month a feature article by working-class advocates such as Tom Mann, Ben Tillett, Keir Hardie, and Bruce

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[73] Commonweal, 26 June 1886, 98-99

Glasier was presented with a photograph of the author.[74] This places The Labour Prophet in the community of left-wing agitators.

In the first issue of The Labour Prophet, Trevor's editorial comments explained that what was "most necessary to life" was healthy living conditions, but what was "most important was "the exercise of… human faculties, knowledge, enjoyment, fellowship, love, active interchange of thought and feeling with man, joyful communion with nature and with God."[75] All efforts must be directed to the peaceful emancipation of the masses because humanity had developed beyond its "animal nature" and must leave behind the "struggle for existence" associated with our "animal stage." Now, it would be the "laws of God" that would set the masses free.[76]

These laws, emanating from "the unseen ruler," were part of an ordered universe that could be shown in the physical sciences as much as through the progressive stages

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[74] See for example, Commonweal, January 1892, 5; April 1892, 29; September 1892, 65; August 1893, 69.
[75] The Labour Prophet, January 1892, 1. The Young Socialist followed similar lines of argument but was produced by the Sunday School Union.
[76] The Labour Prophet, April, 1892, 36.

of human development.[77] The names of Newton and Darwin were evoked as authorities on universal law and order, and the Labour Church writers extended this into the political and moral realms, offering a socialist alternative to the irreligious tone of scientific socialism.[78] Trevor's evolutionary humanist natural theology reached beyond The Labour Prophet's readership in a series of letters published in The Clarion between John Trevor and "The Doctor" over the validity of theological deductions arising from the natural sciences, and so there can be no doubt that these arguments would have been familiar to a great many working-class readers.[79] In addition, The Labour Prophet was especially concerned with providing a scientific education for children, supporting a curriculum beyond the "three R's" with the intent of "drawing out of his observation, the quickening of his interest, the development of his reason, and the ordering of his mind." Despite the gendered pronoun, this was directed to both

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[77] The Labour Prophet, October 1892, 77; March 1893, 23.
[78] Science was also used as an argument against atheism. See The Labour Prophet, "Atheism," March 1893, 23.
[79] The Clarion, 10 November 1894, 7, and 17 November 1894, 8.

girls and boys.[90] After the turn of the century, the work of The Labour Prophet was taken up by the Young Socialist, which repeated many of The Labour Prophet's strategies.[91]

While these publications were content to rely on scientific laws once they had been cleansed of capitalist interpretations, one important left-wing publication stood out as a skeptic among the faithful. The Clarion, the most influential and most successful of the late Victorian socialist newspapers, advocated not only a critical assessment of would-be scientific authorities but also a restricted role for the utility of science in matters dealing with human nature.[92] Science news and discussion appeared in The Clarion in several formats—tit-bits,

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[90] The Labour Prophet, January 1893, 6.

[91] The Young Socialist, edited by Lizzie Glasier, was funded by the Socialist Sunday School Union. As part of its ethical philosophy and emphasis on scientific education, articles were designed to combat superstition, unjust authority, and ignorance. The monthly column "Our Teacher's Aid Corner" exhorted instructors to learn and teach science as part of a socialist national curriculum. In early 1912, Glasgow District lessons included "Astronomy," "Nature Study," "Eugenics," and "Steel," and similar lessons were listed in the Union Notes throughout 1912. The Labour Prophet, representing the Labour Church and The Young Socialist reported regularly on their Sunday Schools and carried stories for children with a naturalistic and socialist message. See for example The Young Socialist's editorial for January 1912, 2-3, and The Labour Prophet article on "Socialists and Education" from January 1893, 6.

[92] Sales for The Clarion were approximately 60,000 by 1894, and Blatchford was lionized by contemporaries. See for example, T.A. Jackson, Solo Trumpet, 63; Bax, Reminiscences, 90; Hyndman, Record of An Adventurous Life (London: Macmillan, 1911) 360-65.

sociology, and general news—but as with all theories—political, economic, or intellectual—The Clarion was a hard sell.[83] Blatchford refused to assign priority to science as source of knowledge. Accepting that the laws of nature were irresistible, Blatchford cautioned readers not to "mistake the hasty deductions of erring men for the unchanging and triumphant laws of Nature."[84] Furthermore, in arguments resembling the critical tone of Charles Dickens' Hard Times, Blatchford assailed the complete identification of useful facts with science. Hope, for example, was also a fact, as was "laughter and music" and also "love." Science, according to Blatchford, was "only one branch of knowledge." Literature, history, and geography equally provided important and interesting facts."[85] Blatchford restricted the cultural authority of

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[83] The Clarion printed articles on general science, reviewed books on science, and ran a children's column that dealt with nature and topics of interest such as astronomy. See for example, "How the World Will Come to an End, 13 May 1893, 6; "Our Clarion Book Review" of Robert Cromie's Crack of Doom, a science fiction novel, 29 June 1895, 207; "Our Children's Column" on "The Stars: What They Are," 6 July 1895, 210.

[84] Robert Blatchford, Merrie England (London: Journeyman Press, 1977) 60. First printed as a collection of articles from The Clarion in 1893.

[85] Blatchford, Merrie England, 4-6.

science because it offered only a partial glimpse of a complex world.

Nevertheless, even Robert Blatchford was drawn into the confrontation between scientific socialism and capitalism's naturalistic rationale. In a series of articles with the provocative title "Merrie England," Blatchford commented on natural law, Darwinism, Herbert Spencer, scientific authority, economics, and human nature; these articles represent the densest concentration of science in The Clarion.[86] Published as a book in 1893 and priced at one shilling, Merry England was re-issued in 1894 as a penny edition; book sales and The Clarion's circulation quickly reached unprecedented levels.[87] Merrie England was significant because it presented counterviews to capitalism and Darwinism in simple language and in terms that drew upon the democratic sentiments of its working-

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[86] Criticism of Herbert Spencer in Merrie England included a critique of "The Coming Slavery (66-69), a warning to readers to reject Spencer's authority in economic and political discussion (44) and to recognized the inaccurate "dogma" of Spencer that would portray society as "a concourse of independent atoms" (76-77). In addition, on 27 May 1893 The Clarion reviewed an ongoing dispute between Henry George and Herbert Spencer over land nationalization. The Clarion supported George's accusation that Spencer suffered from "moral cowardice"(6).

[87] Sales of the book reached 750,000 after the penny edition was released and circulation of The Clarion jumped by 20,000. See Barrow, Democratic Ideas, 43-45; Vincent, Literacy, 257.

class audience. Addressed to John Smith of Oldham, Blatchford challenged "the favourite arguments of the Gradgrinds in support of competition…the theory of the Survival of the Fittest," by reminding readers that struggle in Nature depends on condition: the conditions of Victorian society had long since passed out of brutal competition.[88] The instinctive behaviour of beasts had been replaced in human society with language, intellect, imagination, reason, and community; for the "Gradgrinds to invoke the laws of Nature is odd." The "law of prey" had no business in the "courts of humanity."[89] Blatchford's attacks on naturalized capitalism were central to the arguments in Merrie England, and in book and article form, his message was heard throughout the working class. General science had a place in The Clarion, but it was in the socialist critiques of natural selection that Blatchford's interest in science was the most passionate.

For many left-wing writers and speakers, Darwinism most succinctly embodied the threat to working-class emancipation by defending unrestrained competition in

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[88] Blatchford, Merrie England, 59.
[89] Blatchford, Merrie England, 60-61.

society. As a result, direct confrontation at the rhetorical and theoretical level was a crucial component of left-wing polemics that transcended sectarian interests. Whether it was in defence of cooperative schemes or socialism, Darwinism provided capitalism with the blessing of Nature, and it made class inequality a permanent condition. The cooperative periodical Labour Co-partnership criticized natural selection, taking the view that the once "barbaric struggle for life" had given way to a "union for life," and that in the current stage of development "co-operation" was the most "fitted" to work out social equity.[90] Capitalism was fundamentally acceptable but competition and social inequity were not. Spencer's opinions, along with those of prominent liberal social commentators such as W.S Jevons and Benjamin Kidd, were criticized and even ridiculed as "a monument to that attitude of mind among the propertied classes" that gets more vehement in its protests as it realizes that change is coming.[91]

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[90] Labour Co-partnership, August 1894, 1-2.
[91] Labour Co-partnership, December 1894, 59; January 1895, 73; January 1896, 19-20; October 1896, 189; December 1896, 219. The Labour Standard also rejected a natural competitive model for society but did

The progress cherished by capitalist apologist Herbert Spencer had little to offer the struggling millions, and his fear that improving working-class conditions threatened to weaken the herd was an insult to left-wing ethics and their experience with poverty. Lamarckian evolutionary arguments in support of secular democracy were taken up by radical artisans of the Paineite and Chartist era, but the toppling of the traditional elite had only led to its replacement by a capitalist elite.[92] By the 1880s, secularism and democracy had failed to secure the rights of labour, and socialist Darwinism rose to meet the new Malthusians led by Spencer, funded by capitalism. Natural selection had to be replaced by natural cooperation. Competition had to give way to mutual aid, and individualism had to succumb to combination; if not immediately, then at least in time, as promised by history and evolution.

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so on the basis that it was unscientific and would be supplanted by the true science—political economy—that supported trade unionism. See 7 May 1881 and 13 August 1881.

[92] For early-century traditions in political applications of evolutionism, see Adrian Desmond, "Artisan Resistance and Evolution in Britain, 1819-1848," Osiris 31 (1987) 77-110. See also Desmond, Huxley, 192-96.

Morris' pamphlet Art, Labour, and Socialism described the progressive development of British culture from the Middle Ages to a socialist future. In the opening statements, Morris declared that he was a Socialist, hence a person who was certain that "evolution in the economical conditions of life will go on" and that "competition between man and man is beastly and that of association, human."[93] The tone of the pamphlet was encouraging, as Morris set forth his promise that better days were ahead. Morris made frequent allusions to evolutionism and the importance of scientific methodology in his socialist propaganda, as in the pamphlet he co-authored with Hyndman, A Summary of the Principles of Socialism (1884), which traced Marxist historical evolution with supporting references to scientific authority and biological language. This pattern, consonant with periodical contributions from the authors, was present in some of the speeches and lectures that followed similar ideological lines and were frequently re-printed as pamphlets, as is the case for Hyndman's 1904 sociological lecture reprinted as Social

[93] William Morris, Art, Labour and Socialism (c.1885), re-issued by the Socialist Party of Great Britain (1911, 1p) 3-4, 22-24.

Democracy: The Basis of Its Principles and the Cause of Its Success.[94]

Countless examples of biological language appear in the tracts. Pamphlets such as Evolution and Revolution by Elisée Reclus, Harry Quelch's Malthusianism v Socialism, A Debate, Jack London's What Communities Lose by the Competitive System, or Art and Life by Herbert Burrows drew upon naturalistic theories in their advocacy of a socialist evolutionary model. For instance, reforming Darwinism in support of a 'mass over class' equation, Reclus answered in the affirmative his own question: "Must not revolution necessarily follow evolution, as action follows the desire to act?" [95] Harry Quelch leaned on the socialist model of evolution to demonstrate that human had progressed beyond the animal subsistence struggles in his debate with secularist, Malthusian lecturer Arthur B. Moss. [96] Similarly, Jack London set out a theory of ascending developments in social organization that increasingly

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[94] Published by the SDF-operated Twentieth Century Press, several references to evolution and science frame the early rationale of the lecture. It was delivered at Queen's Hall, Langham Place.
[95] Elisée Reclus, Evolution and Revolution (London: International Publishing Company, 1885, 3-4, 15.
[96] Harry Quelch and Arthur B. Moss, Malthusianism v Socialism, A Debate (London: Twentieth Century Press, 1903) 3-5, 11.

necessitated the restriction of competition in order to reduce the harmful "friction of its units."[97] Taking a different approach, Herbert Burrows (1850-1927), SDF lecturer and close friend of Annie Besant, brought evolution into the study of art. Defending a crucial role for art in the coming socialist society, Herbert Burrows saw human evolution as moving increasingly away from "antagonism" towards "the striving after the beautiful." Though employing a biological theory to validate his future vision, Burrows nonetheless took an opportunity to limit science's importance, claiming that "scientific genius is rather a general capacity than an innate and special talent." Burrows' model for progress was evolutionary but, following Marxist logic, science was also the herald of its own demise.[98] In each of these pamphlets, science was made to serve socialism while refuting scientific capitalism.

In the vast stable of leftwing writers, some ventured into the details of biological theory with confidence.

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[97] Jack London, What Communities Lose by the Competitive System (London: Twentieth Century Press, n.d., 1p) 4-5.
[98] Herbert Burrows, Art and Life (a lecture delivered to the South Place Ethical Society, in September 1901, there is no indication of publisher or date. It can be found in the Howell Collection at Bishopsgate Library in London) 4-5, 9.

T.D. Benson, a member of the Independent Labour Party (ILP) who wrote for The Young Socialist, produced a pro-socialist pamphlet for the ILP laden with biological analogies.[99] The title, Socialism and Service, gives no indication of the ample scientific content, nor does the title of the simplified version in The Young Socialist, "*Ich Dien.*"[100] Benson began his pamphlet with a quotation from Benjamin Kidd whose Social Evolution had been panned by Labour Co-partnership in 1894 for its rejection of cooperation, but which nevertheless provided some useful statements on science and society: "All departments of knowledge which deal with social phenomena have their true foundation in the biological sciences."[101] Typically, Benson imported this as his primary rationale for socialist evolutionary

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[99] Benson also edited Uses, a Swedenborgian journal of "Evolutionary Reform. For more on Benson, see Peter d'A. Jones, The Christian Socialist Revival, 1877-1914 (Princeton: Princeton University Press, 1968) 364-66.

[100] T.D. Benson, Socialism and Service (London: Independent Labour Party, n.d., 1p); "Ich Dien," The Young Socialist, March 1912, 64-65. A brief description of Uses can be found in The Labour Annual (Manchester: Labour Press Society, 1897) 58.

[101] Benjamin Kidd's Social Evolution (London: Macmillan, 1894) was criticised by Labour Co-partnership (December 1894, 59) for its defence of competition. Benson's citation does not indicate approval or Kidd's economic views any more than his citation of Spencer demonstrates approval for Spencer's social vision. On the contrary, Benson took what he needed with respect to biological analogies and reformed them to suit socialist goals.

theory, followed quickly by equally mutable supporting evidence from Darwin and Spencer re-constituted according to Engels and Marx.[102]

In each section of the pamphlet, Benson found pertinent analogies to convey and support his meaning, as he did in the section "Body as a Type of Society" in which the bodies organizational units such as cells, organs, and tissues are likened to social units.[103] Further, the section on "Municipalisation and Rationalisation" drew on a functional analysis of the body's circulatory, respiratory, and digestive systems.[104] In each of these, the central point is that just as evolution has produced "more highly organized" species, society, in a similar way, progresses towards greater organization where individualism will evolve naturally into altruism.[105] Benson's pamphlet is a good example of left-wing interpretations of Darwinism, and it indicates the type of scientific material that lurked behind political lecture and pamphlet titles.

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[102] Benson, Socialism and Service, 1-7.
[103] Benson, Socialism and Service, 6-7.
[104] Benson, Socialism and Service, 13.
[105] Benson, Socialism and Service, 14-15. Benson also compares this goal with Christ's message of brotherhood, revealing the Christian Socialist component of his philosophy.

Adding a touch of Lamarckian biology to his Darwinism, labour leader and MP Ben Tillett produced a pamphlet with a suggestive biological title: An Address on Character and Environment.[106] Tillett began by describing the "philosophic Socialist" as one who is attempting to "bring to his science and his system the same methods of comparison, analogy and analysis which in other sciences have given such practical, systematic and constructive arguments."[107] Confronting opposing forces that manipulated science on behalf of the rich and powerful, Tillett claimed that environmental factors, applied automatically to the development of "all types and species" had been deliberately overlooked with respect to the "human organism."[108] Furthermore, Tillett declared that:

> My object in this short pamphlet is to show that the same laws of Nature which operate with relentless definiteness and directness in other phases of being, operate in the social and

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[106] Benjamin Tillett, An Address on Character and Environment (Labour Press Society, Manchester, n.d., 1p)
[107] Tillett, Character and Environment, 3.
[108] Tillett, Character and Environment, 3-4.

> human organism with even greater effect.[109]

Applying Darwinian metaphors and theories on organic adaptation, Tillett explained the complex role of the social and natural environments as they exerted pressure on the individual. Environment, for Tillett, was both the cause and effect of human action, capable of modification or degradation.[110] It was a complex idea that included "climate, race, society, habits, heredity, education, language, dialect, colour, and greed," and all of these were brought into play in determining social conditions and the individuals they produced:

> Our very laws are the development of a peculiar environment, our literature is shaped by it, our religions, our social and educational institutions, our civic, industrial and economic life are all circumscribed by the conditions of environment.[111]

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[109] Tillett, Character and Environment, 4.
[110] Tillett, Character and Environment, 11-12.
[111] Tillett, Character and Environment, 6.

Extending this to organic life, Tillett emphasized the development of the individual within hostile or hospitable environments, and asked why it was that botanists and naturalists easily admitted the importance of environment on plant life, giving great attention to the "care and nourishment of any plant." Yet, the same care was little afforded to human beings, who were by far "the most complex and most beautiful of all expressions of animate nature."[112] Proper care for all living beings was the "law of life," and just as this law "operates in the meanest flower, so the laws of organic being operate with more fatal, or beneficial effect with regard to the individual."[113] All that was needed to bring about the socialist remedy for physical and moral degradation was acceptance of social responsibility and recognition of the simple truths of Nature so readily comprehended by botanists. Ben Tillett, primarily a spokesman for socialist and labour groups, also contributed to the one-penny lessons in sociology.[114]

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[112] Tillett, Character and Environment, 7.
[113] Tillett, Character and Environment, 7.
[114] For more on secularist and freethought literature, see Royle, Radicals, 164-74.

No matter the topic--Quelch's debate with Arthur Moss, Hyndman's 1904 speech in Queen's Hall, and Herbert Burrow's lecture to the Ethical Society--the same ideological components were mixed and re-mixed, spreading the gospel of science in the service of the labouring sector. Variations in presentation demonstrate the versatile nature of science ideas and language, while also suggesting that some speakers or writers were comfortable with scientific theory, others with scientific rhetoric. Despite these differences, the presence of science in the propaganda was both abundant and informative. In assessing why Hyndman was mainly polemical in his use of science while Benson and Tillett explored biology in greater detail, no clear pattern emerges: the explanation is most likely personal inclination. Hyndman's autobiography emphasized his reliance on Marxism, while Ben Tillett wrote in his memoirs of a conversion to science during his teen years.[115] In their own way, each of these social theorists made important contributions to the popularization of science in

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[115] H.M. Hyndman, The Record of An Adventurous Life (London: MacMillan, 1911), see especially Chapter XVI; Benjamin Tillett, Memories and Reflections (London: John Long, 1931) 77.

the labouring community despite their political differences.

Many of the pamphlets began as lectures and in these cases, it is clear that science functioned in the lectures in much the same way as it did in the press and tracts. Burrow's Life and Art, Quelch's debate with Arthur Moss, and Tillett's lecture on "Character and Environment" are excellent indicators of the public presentation of evolutionary socialism.[116] The common culture of the pamphlets and periodicals extended to the lectures, and together they formed the three-part propaganda network of the Victorian Left. This can be crosschecked with lectures that have been reviewed as in Justice's summary of an SDF-sponsored lecture by Helen Taylor on "Democracy and Socialism" in January 1894. After having expressed her belief that a "great change was certainly coming," she described Socialism as "the perfection of human existence" resulting from evolution.[117] Using data from the left-wing press and bearing in mind the array of scientific topics in the penny pamphlets, partial conclusions about the content

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[116] Tillett's lecture was part of the Talks to the Toilers Series.
[117] Justice, 19 January 1894, 6.

of socialist lectures and the popularization of science can be made.

Socialists were expected to take a "turn at the stump" with many lecturing several times a day.[118] Even non-celebrated members lectured, and T.A. Jackson recalled lecturing on Darwinism as part of his regular duties.[119] Lecture attendance varied from a dismal nine to as many as 500-2000. Open-air meetings might attract 1000 listeners and, depending on the speaker and the topic, huge events might attract as many as 3000.[120] Secularist lecturers similarly had good days and bad, but Edward Royle describes their efforts as having done "much good work."[121] Lectures were given in secularist halls, ethical society halls, branch meeting rooms, radical clubs, and in the parks and open grounds stretching out from London to the provinces. Added to the lecture format was the "most spectacular form of propagandism": the set debate.[122] These debates often continued for several days and Royle compared their appeal to the "temporary excitement" of a football match that, in

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[118] T.A. Jackson, Solo Trumpet, 70, 78.
[119] Jackson, Solo Trumpet, 91.
[120] Thompson, Morris, 414-21, 439, 461, 474.
[121] Royle, Radicals, 149-54.
[122] Royle, Radicals, 154.

addition to being "entertainment," offered an "opportunity for a little vandalism on the part of the hooligan minority." This format along with the indoor and open-air lectures conveyed scientific and political information to a large working-class audience into the twentieth century, indicating a need to return to Gareth Stedman Jones' assertion that radical working-class politics was sacrificed to music halls and sports in the final decades of the nineteenth century.[123]

In January 1892, SDF speakers were lecturing on topics such as "Revolution: Its Causes and Effects" and "Ring out the Old. Ring in the New. Ring Out the False. Ring in the True."[124] Both of these lectures would likely have referred to scientific theory and authority if the contents of pamphlets are taken as indicators of the general patterns in SDF propaganda. For example, the lecture "Ring out the Old. Ring in the New" was delivered by Herbert Burrows. Burrows drew on evolutionary ideas in his pamphlet on art and socialism, and as a member of the SDF

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[123] Gareth Stedman Jones, "Working-class Culture and Working-class Politics in London, 1870-1900," Popular Culture: Past and Present, eds. Bernard Waites, Tony Bennett, and Graham Martin (Kent: Croom Helm, 1982).

[124] Reynolds's Newspaper, 10 January 1892, 6.

propaganda team, scientific socialism and evolutionary socialism were part of his general ideological arsenal.[125] Similar titles appear in the lists from Reynolds's Newspaper for the Fabians and the Socialist League. In February 1889, a Fabian lecture was given on "Evolution and Revolution," by Frank Padmore [sic], while at another venue, the Socialist League's E. Belfort Bax lectured on the "Marxian Theory of Value."[126] The probable content of Bax's lecture can be inferred from his association with Commonweal.

In 1888, Bax contributed an article on the "New Ethics" in which he challenged Comte and Spencer. Additionally, articles with Marxist content such as Aveling's "Scientific Socialism- I. Value" and the next installment on "Exchange Value" each framed their economics with historical and evolutionary models of development.[127] Where comparisons can be made, lecture contents reflected the ideology and propaganda published in pamphlets and periodicals, and it is clear that science was used as a

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[125] Burrows, Art and Life.
[126] Reynolds's Newspaper, 10 February 1889, n.p. Reynolds's Newspaper must have meant Frank Podmore, the Fabian lecturer.
[127] Commonweal, 4 February 1888 (weekly) 38; April 1885 (monthly) 21, and May 1885, 33.

means to both validate and explain working-class emancipation in two ways. First, the socioeconomic history of humanity was treated as a science in complete agreement with the natural sciences, with both clearly demonstrating an evolutionary trajectory away from the Darwinian struggle towards increasingly cooperative systems of social organization.[128] Second, Lamarckian environmental factors were invoked in support of improvements in the education, political status, and living conditions of workers who, given proper environmental factors, stood to inherit their fair share of cultural authority.

The majority of the lectures were concerned with social questions, and science provided the skeleton on which to hang a theory of class emancipation. Given the substantial attendance for secularist and left-wing lectures, and the popular base for the press and pamphlets, it is clear that the fundamental ideas of biology, geology, and astronomy were widely available. Socialists, labour socialists, and labourists set forth programmes according

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[128] See Tillett, Character and Environment; Benson, Socialism and Service; Malthusianism and Socialism: A Debate between Harry Quelch and Arthur B. Moss (London: Twentieth Century Press, 1899, 1p).

to what they envisioned as the best possible route out of working-class poverty and political marginalization towards equality and control over life and work. That each faction adopted a scientific rationale is an important point, but that each adapted science to suit ideological programmes sets this group squarely in the context of Victorian trends in sociology. Just as scientific naturalists such as Huxley and Spencer had exported their social theories on the wings of scientific fact, so working-class social theorists seized scientific fact and exported it on the underbelly of their political and economic reforms.

One additional feature of the propaganda network that assisted the popularization of anti-capitalist science was the mutual endorsement among the writers and lecturers of the Left. Advertisements recommending each other's journals, books, and lectures were a standard feature of the periodicals and tracts. Celebrated works such as Aveling's pamphlet on Darwin and Marx, or Ernst Haeckel's Last Words on Evolution were given ample space in the front

and back pages of pamphlets.[129] Similar advertisements in T.D. Benson's Socialism and Service listed Enrico Ferri's Socialism and Science, along with books by J.R. MacDonald and Jean Jaurés, Keir Hardie's The Labour Leader, and the series "Tracts for the Times," which included Benson's pamphlet. In Justice, the final pages of each issue were devoted to socialist literature of all kinds including periodicals such as To-day, Psyche, and The Christian Socialist.[130] Praise for effort in the service of working-class emancipation was common among the periodicals, and typical examples appeared in The Young Socialist, which spoke warmly of George Lansbury's The Daily Herald, Keir Hardie's Labour Leader, and Blatchford's The Clarion. Similarly, Labour Co-partnership praised The Labour Prophet, and The Labour Prophet endorsed The Clarion and Fabian News. Reciprocal promotion that served to authenticate the sociology of the Left can be found in most of the periodicals in some form, and was often extended to

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[129] Edward Aveling, Charles Darwin and Karl Marx: A Comparison, (Twentieth Century Press, c.1897, 2p), and Ernst Haeckel, Last Words on Evolution (London: Watts and Co., 1912, 1d). For advertisements see the series Tracts for the Times and Pamphlets for the Millions, published by the ILP and RPA, respectively.

[130] Justice did not allow commercial advertising but did promote socialist literature and events.

the books and pamphlets of the different factions. Whatever their ideological disputes were, this group knew how to promote its own.

The late Victorian contest for cultural authority was between labour and capital, and each side naturalized their social and political theories as part of a nineteenth-century style of debate first popularized by the Darwinian assault on upper-class privilege. Ironically, just as scientific capitalism was blossoming into an era of middle-class reform and philanthropy in the 1860s and 1870s, the disgruntled ex-Chartists, fiery radical republicans, and indignant secularists were joined by trade unionists and socialists in a renewed challenge to the Victorian elite. However, the elite of 1880 was not the paternalistic, creationist, undemocratic class of aristocratic parasites from the Chartist era: it was a specimen-wielding, nature-hoarding, class of smug capitalist fact-finders. Obviously, the strategies of the 1840s were hardly equal to the task, and the boundaries of science were crashed as socialist intellectuals and self-taught proletarians grabbed the facts and dragged them into a new vision of the

future. Evolution could not stop with capitalist society; Marx had said it and Kropotkin, Aveling, and Wallace had proved it. It was up to the Left to tell this to workers, and they did just that. Through their propaganda network, the fundamental ideas of science were made public property, and in conjunction with the general working-class press and the low road to science, many scientific ideas became, by the late century, common knowledge.

Chapter 6: Conclusion - Highways, By-ways, and Crossroads

So what did a coalminer want with Darwin? The fact is that it depended upon the coalminer. Flora Thompson recalled that everyone, even "simple country people," were aware of the scientific and technological revolution taking place in late Victorian England: "all times are times of transition, but the eighteen-eighties were so in a special sense, for the world was at the beginning of a new era, the era of machinery and scientific discovery."[1] Despite financial hardship and lack of formal education, curiosity and intellectual appetites endured, and individuals inclined towards scientific thinking and self-improvement did not have far to go to obtain materials and a forum for discussion. Within working-class communities, information on the natural world, technology, and the social sciences was available at varying levels of economic and intellectual expenditure. Flora made a point of correcting erroneous accounts of her community, asserting that "modern

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[1] Flora Thompson, Lark Rise to Candleford, A Trilogy (London: Penguin, 1973) 68.

writers who speak of the booklessness of the poor at that time must mean books as possessions; there were always books to borrow."[2] New books and scientific equipment were difficult to obtain; however, secondhand, inexpensive, or shared resources provided access to scientific material for both general and serious readers.

If not books, then newspapers, but regardless of the level of scientific engagement, there was always something to read, someone to chat with, and a club to join. For the local naturalist, the Sunday paper reader, the aspiring science teacher, the inquisitive intellectual, or the political iconoclast, scientific information was available in many formats ranging from manageable tit-bits to lengthy texts. Moreover, scientific ideas mingled freely with political, social, and cultural topics in the press, lecture halls, clubs, pubs, reading rooms, institutes, and workplace revealing an intersection of science with other activities and interests in working-class communities. In this way, the fundamental principles of modern science were

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[2] Flora, Lark Rise, 416.

entered into common knowledge, and at more theoretical levels, science figured into the serious philosophical and ideological quests of working-class intellectuals. The provision of informal and shared access to information was one of the defining features of working-class communities, and the low road to science was busy despite its pitfalls and potholes.

In the context of the labour movement, science had a special importance. The utility of secularist and evolutionary arguments as leverage against religious and political authority was no less appealing for the Victorian Left than it had been for middle-class economists and scientific naturalists contesting the cultural authority and political privilege of the British clergy aristocracy in the middle decades of the century. As economic law and human progress became identified with biological processes, theories of evolution arose to challenge the stagnant cosmology of the Anglican-Tory fixed world order governed by Divine Will. Pre-Darwinian evolutionism supported bourgeois demands for a re-distribution of power, but after

the publication of Darwin's theory of natural selection, capitalism was enshrined as the most advantageous system for fostering the health and continuing progress of the nation.[3] Like their bourgeois predecessors, labour activists and socialists in the 1880s and 1890s "subscribed to a positivist scheme of specific historical stages in what Philip Snowden called the 'social evolution of mankind.'"[4] In contrast to liberal middle-class Darwinians, the Left insisted that bourgeois theories were unscientific apologies for capitalism and as such were biased. Alternatively, socialists claimed to speak not for privilege but for the people, and so their approach to science and natural law was marketed as more objective.

Socialists took evolution one-step further than the Darwinian struggle for existence towards a more sophisticated theory of mutual aid. Most notably articulated by Prince Kropotkin, it was widely dispersed to working-class audiences by the Left's writers and

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[3] For more on this see, Robert Young, Darwin's Metaphor: Nature's Place in Victorian Culture (Cambridge: Cambridge University Press, 1985).
[4] Logie Barrows and Alan Bullock, Democratic Ideas and the British Labour Movement, 1880-1914 (Cambridge: Cambridge University Press, 1996) 109.

lecturers. Denouncing Darwinian natural selection as unnatural selection and a disguise for social selection, evolutionary socialists foretold of an ethical, collectivist future in which economic and political power would be equitably distributed. Couched in the language of traditional working-class demands for independence, security, and the right to decent working and living conditions, scientific authority was enlisted as a final validation of the class struggle.[5] The Left's ambassadors—men and women such as Besant, Aveling, Mann, Tillett, Blatchford, Hyndman, and Morris—drew upon the authority of Nature, popularizing science while agitating on behalf of revolutionary change.

In the opening decades of the twentieth century, many of these features of Victorian working-class culture survived. Science, moving increasingly into professional seclusion, still maintained a sturdy grip on the daily lives of Britons as new theories and inventions transformed

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[5] Barrows and Bullock, Democratic Ideas, Chapter 1. See also James Hinton, Labour and Socialism, A History of the British Labour Movement 1867-1974 (Wheatsheaf Books, Sussex, 1983) 8-37; and Stuart Macintyre, A Proletarian Science, Marxism in Britain 1917-1933 (Cambridge University Press, 1980) 48-71.

the world, resounding through the political rhetoric of propagandists and journalists and captivating the popular imagination through science lectures and science fiction.[6] Newspapers such as the Daily Herald promoted the interests of labour and offered an eclectic package that included scientific ideas linked to radical social reforms. In particular, the 1929 discussion of Ernst Haeckel's monistic philosophy in the Daily Herald provides an example of post-Victorian continuity, and similar instances can be found in the Clarion after 1900.[7] As part of the Victorian legacy, science provided the authority for a rational critique of social inequity and the assertion of working-class self-improvement and class emancipation. Walter Haydn Davies (1903-1984, miner and author) recalled in his autobiography,

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[6] For more on serialized science fiction novels, see Paul Fayter, "Strange New Worlds of Space and Time: Late Victorian Science and Science Fiction," Victorian Science in Context, ed. Bernard Lightman (Chicago and London: University of Chicago Press, 1997) 256-80. See also Royle, Modern Britain, Chapter 5.

[7] Macintyre, A Proletarian Science, 107. This was true in other labour papers, and an excellent example of the exportation of British evolutionary socialism can be found in Australia's Barrier Truth, with which Tom Mann had a great deal of contact.

> The conveyor face down the Number 2 pit was a university…Night after night in this Alma Mater, well-read, intelligent, clean-minded men discussed the burning topics of the day, the changing religious trend, the theory of evolution, the nature of spiritualism, Christian Socialism, Communism, and all the other isms that then did abound. The ideas expressed by Charles Darwin, R.J. Campbell, Sir Oliver Lodge, Keir Hardie, Ramsay Macdonald, Karl Marx, Noah Ablett were treasure in their minds as well as in the books they carried in their pockets.[8]

Davies had much in common with Frank Hodges (b.1887), the young coalminer who read Shakespeare and Darwin in the pit.[9] However, despite these important continuities, a number of new variables were introduced in the twentieth century. As a result, this investigation ends with 1900, and offers

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[8] Walter Haydn Davies, The Right Place - The Right Time (Llandybie: Llyfrau'r Dryw, 1972), cited in Macintyre, A Proletarian Science, 103.
[9] See Chapter 3 of this study.

suggestions for additional research on the post-Victorian working-class and the fate of the low road to science.

One important area of change was the British school system. After 1902, educators intensified their efforts to expand the role of the schools in all sectors of society.[10] This was part of an overall restructuring that included the gradual reform of elementary, secondary and evening schools. Working towards a standardized school system, educators held onto their students longer and even offered subsidized secondary school placements to exceptional children who were unable to afford the fees but whose families were willing to delay their entrance into the workforce. It took several decades before secondary schooling was standardized, but the interim stages were bound to have affected working-class intellectual culture.[11] At the same time, concern over provision of technical training increased, and though England fell behind many of its European counterparts, by 1912, "something of a

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[10] Edward Royle, Modern Britain: A Social History, 1750-1997, 2nd ed. (London: Arnold, 1997) 355-71; and Vincent, Literacy and Popular Culture, England 1750-1914 (Cambridge: Cambridge University Press, 1989) 91-93.

[11] Royle, Modern Britain, 372.

national system was created."[12] Extended exposure to formal schooling for a growing number of working-class children and the option of obtaining science training at state-sponsored technical schools may have significantly altered contact with scientific ideas in both the form and content of that information; however, an assessment of this has yet to be done from the perspective of the working class.[13]

The relationship between workers and schooling is most often evaluated from an institutional perspective, and it is now clear that the overall effect of educational reform cannot be assessed properly unless the unofficial education of the working-class community is included in the analysis.[14] By limiting studies to official education, historians ignore the local, independent character of

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[12] David Vincent, Literacy and Popular Culture, England 1750-1914 (Cambridge: Cambridge University Press, 1989) 117; and David Thomson, England in the Twentieth Century, 3rd ed. (London: Penguin, 1991) 21, 27.

[13] Thomas Kelly, A History of Adult Eduation in Great Britain from the Middle Ages to the Twentieth Century (Liverpool: Liverpool University Press, 1962) 200-230.

[14] Vincent, Literacy, 272. This also needs to include examination of the labour colleges that, according to Tommy Jackson, continued to advocate independent working-class education and class struggle in the early twentieth century. See T. A. Jackson, Solo Trumpet: Some Memories of a Socialist Agitator and Propagandist (London: Lawrence & Wishart, 1953) 149-55.

working-class communities. It may be safe to assume that the marketing of information as a mass-produced commodity would have had serious repercussions for both recreational learning and work skills, but the limits of this ostensible monopolization of knowledge have yet to be examined within the context of subversive science and early twentieth-century counterculture. Following the low road to science into the twentieth century as it intersects with official forms of schooling, expanded access to information, and media technology is essential for the study of working-class leisure, learning, and work.

In popular culture, advances in literacy and improved access to material continued to move towards the creation of a mass reading public during the first third of the twentieth century. Although many positive benefits arose, not all news was good news. As David Vincent has noted, popular literacy did more, not less, to segregate the various sectors of society. With the recognition of trends in popular reading came manipulation of information by educators, the commercial press, advertisers, and

politicians. Book learning and the authority that comes with higher education were commodities in a capitalist information marketplace: the scaled down version was more appropriate to manual labourers. At the institutional level, class-segregated education provided working-class children with only limited instruction that often failed to be of much use outside the school system. For adult labourers, the gap between mental and manual labour widened, and many workers found themselves increasingly under the supervision of "paper-qualified engineers, architects, surveyors, and accountants." A separation of brains and body was the net result of the information revolution that began in the Victorian period. Even with the persistence of working-class radicalism and self-improvement strategies, market forces threatened to turn working-class readers into low-income consumers.[15] However,

[15] One important historical argument that needs consideration comes from Gareth Stedman Jones' claim that the 1890s saw the de-politicization of an intellectually apathetic working class. Realizing that Chartism was finally dead, the once radical workers succumbed to music hall and other capitalist recreations. Stedman Jones' argument fails to account for the changing context of cheap reading material and free libraries that may have created opportunities for independent. Furthermore, his strict definition of radicalism as Chartism and the language of class

despite the obvious seductions of the market, Vincent and other historians of leisure caution against projecting an ultimatum of class war or class conciliation onto the early twentieth-century working class, noting that unofficial education, the penny press, political groups, and trade unions served as counterbalances to the pressure exerted by middle-class officials and entrepreneurs.[16]

Another important twentieth-century shift that requires detailed evaluation is working-class response to the ideological factionalism of the labour movement in England in conjunction with revised interpretations of scientific ideas.[17] By 1900, the Left had reached a theoretical and political crossroad. Little in the way of

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fails to see the underlying radicalism of labour socialism and the language of evolution. His study is mainly concerned with the 1890s but it colours analysis of twentieth-century working-class culture by depicting it as a quiescent, conservative, capitalist-dominated culture of "consolation." See Gareth Stedman Jones, "Working-class Culture and Working-class Politics in London, 1870-1900," Popular Culture: Past and Present, eds. Bernard Waites, Tony Bennett, and Graham Martin (Kent: Croom Helm, 1982) 117.

[16] Vincent, Literacy, 273-74; Hugh Cunningham, "Class and Leisure in Mid-Victorian England," Popular Culture: Past and Present, eds. Bernard Waites, Tony Bennett, and Graham Martin (Kent: Croom Helm, 1982) 78-79; Gareth Stedman Jones, "Class expression versus social control," Languages of Class: Studies in English Working Class History, 1832-1982 (Cambridge: Cambridge University Press, 1983) passim.

[17] Stuart Macintyre outlined the ideological disputes, but this has not been linked sufficiently to local response.

concrete planning had come out of the passionate and subversive 1880s and 1890s. Left-wing evolutionary arguments dwindled into vague anti-poverty polemics or deviated into more radical propositions such as anarchism and communism. Evolutionary socialism merged with labour socialism to form a gradual and reformist programme that depended on immediate political organization and, for some, trade unionism. For the more extreme agitators connected to the larger European socialist community, preparing the workers for the coming revolution relied upon scientific socialism and Marxist historical materialism. From the vantage point of the early twentieth century, both options seemed plausible, and opposing forces with the Left argued bitterly over the realities of capitalist democracy. At the centre of the disputes were questions concerning the speed and next phase of evolution.

In 1907, Keir Hardie contributed to a collection of essays on socialism along with James Ramsay MacDonald and

Philip Snowden.[18] Hardie's essay synthesized many of the intellectual, political, and philosophical components of late Victorian socialist theory. Drawing on Marx, Darwin, and remnants of the Labour Church, Hardie outlined the evils of society and the improvements to come, but typically he offered no mechanism. After having cited Karl Marx's call for workers of the world to unite because they had nothing to lose but their chains, Hardie summarized the progress of humanity so far:

> From Amoeba to Man there has been a steady and or less continuous progress….Evolution may explain the process which has been at work; it does not explain the motive power which set the process in motion. That still remains hidden from our ken, but that it exists is no longer denied by even the most materialistic scientists…[that which] for lack of a better term, we call Divine life…. Combination and Co-operation, not

[18] This untitled collection included "From Serfdom to Socialism," (Hardie), "Labour and the Empire," (MacDonald), and "The Socialist's Budget," (Snowden). It was first published in 1907 by George Allen, London, and re-issued in 1974 by the Associated University Presses, New Jersey, with an introduction by Robert E. Dowse.

> Individualism and Competition, are the means by which progress from the lower to the higher forms of life is achieved, a fact now admitted by all leading scientists and naturalists, and by none more so than Darwin himself….Socialism we believe to be the next step in evolution….[19]

Darwin and Spencer figure prominently in this essay as Hardie extracted the fundamental theory of progress and adaptation, rejecting the "pitiless struggle for existence" theorized by the "Darwinian apologists for capitalism."[20] The struggle for existence had been "emphasized" while the "greater fact that life did not depend upon struggle but upon adaptation" had been "slurred over." Hardie pointed to the development of social systems from serfdom to socialism, assuring readers that if mutual aid and cooperation proved harmful to society, then it would "give way to one more adapted to the needs of the race."[21] As to

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[19] Hardie, "From Serfdom to Socialism," 1974 edition, issued by Associated University Presses, 87-89.
[20] Hardie, "From Serfdom to Socialism," 92-93.
[21] Hardie, "From Serfdom to Socialism," 89.

what kind of society readers could anticipate under socialism, Hardie was suggestive rather than explicit, declaring that "to dogmatise about the form which the Socialist State shall take is to play the fool. This is a matter with which we have nothing to do. It belongs to the future, and is a matter which posterity alone can decide."[22]

James Ramsay MacDonald was not so vague. In 1906, MacDonald's Socialism and Society outlined the early strategies and reasoning by which he would become a major force in the Labour Party.[23] In his evolutionary account of socialism, MacDonald gave a representative account of the late Victorian working-class drift towards gradualist reformism. Not content to leave reform up to posterity, he advocated immediate infiltration of the political machine as something constructive that could be done while humanity progressed towards higher forms of social organization. Drawing upon theories of historical progress, biological development, evolutionary socialism, republicanism,

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[22] Hardie, "From Serfdom to Socialism," 96.
[23] James Ramsay MacDonald, Socialism and Society (London: Independent Labour Party, 1906). Signs of MacDonald's anti-strike platform can also be detected in this publication.

Marxism, and nationalization of the land, MacDonald reduced social conflict to the problem of poverty, and he offered a simple solution: vote Labour.[24] There was no need for class war because the Labour Party could direct legislative reforms to address the demands of labour. There was nothing revolutionary about it, and according to MacDonald's logic, labour socialism did not advocate a "wiping-out" of the old but a "transformation" and a "fulfillment" of the democratic promise: equal representation. If only the workers would join their votes, the democratic deed would be done. The social, economic, and political structure would not be eradicated but eased into more productive forms. As scientific proof, MacDonald invoked the "Law of Continuity" and the "Laws of Variation," meaning there will be change but not too much.[25] Despite criticisms from radical socialists and those who suspected MacDonald was politically ambitious rather than altruistic, there was a kind of shrewd logic to MacDonald's

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[24] Tommy Jackson was critical of MacDonald's self-serving reformism. See Solo Trumpet, 81, 97, 165.
[25] MacDonald, Socialism and Society, 110, 186.

advocacy of a labour-dominated democracy with quasi-socialist goals.

Twenty years of scientific socialism and revolutionary rhetoric had grounded the modern labour movement in economic law and social science, but it was time to sober up and get back to essentials. For many labourers and their advocates, democracy and trade unionism had been and still were the preferred strategies in the defence of working-class rights. Socialism stepped in when political and unionist strategies had failed to protect workers against economic downturns. The revolutionary agitators had done their job but it was time for action, not talk. With the Independent Labour Party, the Labour Representation Committee (1900), the formation of the Labour Party in 1906, and the wider circle of socialist and unionists, labour was becoming a social force. The political legacy of the Victorian Left was the appending of a scientific rationale to the democratic and collectivist elements in working-class protest, and this rationale served to validate the defence of working-class rights well

into the twentieth century. Culturally, the Victorian Left helped to popularize scientific ideas at a time when many labourers were making the connection between scientific knowledge and cultural authority.

The issue of cultural authority is an important one for working-class studies. At a time when working-class activists rejected religious, political, and economic authority, scientific authority was acceptable. In the late Victorian period, this made sense because scientific ideas still appeared to be part of public debate, hence contested territory. If conscripted to serve socialism, science was thought by many to offer a panacea for social ills. Unfortunately, science was never as malleable as socialists perceived, and no alternative line of reasoning was pursued. For example, reliance on natural law may have been a strategic error because too little responsibility was assigned to the complex nature of humanity and human action. In a 1905 pamphlet critiquing capitalism and outlining general proposals for a future socialist society, Tom Mann wrote that those "who are disposed to try and

understand the numerous questions involved in such a study, should first try and realize that this science of Sociology should be approached as impartially and as deliberately as the exact sciences say of Astronomy or Geology."[26] In England and Australia, Mann preached the message of a scientific reorganization of society until his death in 1941.

As consumers of science, Victorians such as Tom Mann and Ben Tillett employed scientific clichés such as not an "atom of food."[27] Similarly, the word "scientific" was frequently affixed to politically approved theories and activities such as scientific socialism, scientific training, and scientific farming.[28] The autobiographies of working-class intellectuals map out the ways in which individuals such as Tommy Jackson, Tom Bell, Ben Tillett, Will Thorne, Ben Turner, Margaret Bondfield, Tom Barclay, and Rowland Kenney continued to envision social change

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[26] Tom Mann, Socialism, 79. First published by Tocsin, Australia, and reprinted in John Laurent, Tom Mann, Social and Economic Writings (Nottingham: Spokesman, 1988) 79-133.
[27] Examples of this metaphor can found in the autobiographies of Tillett (29) and Mann (100).
[28] See Tillett, Memories and Reflections (London: John Long, 1931) 20, 76-77, 99, 208, 233, 239, 278-79.

through the lens of scientific reasoning and evolutionary theory. The propaganda network and the penny press emphasized the centrality of science in the task of forging a just society, and it was clear that thinking scientifically was the means by which power would be appropriated. Once scientists began to draw away from the public forum and state funding for research increased, on what did socialists base their rhetoric and how did this affect the autonomy of the labour movement in the twentieth century?[29] These important questions have only begun to be addressed.

There were exceptions to the empirical approach. Ethical labour-socialist groups of the kind that funded The Young Socialist, advocates of cooperation, and to some extent, Robert Blatchford's Clarion placed more emphasis on

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[29] Alfred Kelly has done this for Germany and Stuart Macintyre has begun analysis for Britain after 1917. See Macintyre, A Proletarian Science, passim; and Alfred Kelly, The Descent of Darwin: The Popularization of Darwinism in Germany, 1860-1914 (Chapel Hill: University of North Carolina Press, 1981) passim. Similar issues raised in gender studies of science in the 1980s may assist analysis of the problematic appropriation of bourgeois-dominated science in class struggle. See for example, Evelyn Fox Keller, A Feeling for the Organism: The Life and Work of Barbara McClintock (New York: W. H. Freeman, 1983); Donna J. Haraway, Primate Visions: Gender, Race, and Nature in the World of Modern Science (New York: Routledge, 1989); and Sandra Harding, The Science Question in Feminism (Ithaca: Cornell University Press, 1986).

the essential goodness of the human spirit, especially as personified in the working-class family. Science provided the means to combat ignorance and understand human development, but it was not an end in itself. Percy Redfern and F. J. Gould serve as examples of working-class intellectuals who took this approach, in that they both held humanity responsible for its troubles and achievements.[30] Human nature held the keys to ethical behaviour; science and religion were tools with which to cultivate latent potential. For Gould, humanity was god, and for Redfern a higher power existed that could be loosely identified with basic Christian ethics and the cooperative movement. Either way, no dogmatic, authority-wielding doctrine could be held accountable for human action, and both men tended to use science to de-frock religious authority and religion to deflate scientific authority.

Ethical humanism combined many elements of socialist and pro-labour ideology, but its special tasks were to

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[30] For more on Percy Redfern and F. J. Gould, see Chapter 3 of this study.

address the emptiness that came with over-reliance on scientific thinking while offering a faith that would not reproduce the ignorance and apathy wrought by religious dogma. Whether they wrote of love or reformed Christianity, positivism or evolutionism, a primitive past or a promising future, humanity reached ever upward and took the blame for sinking into depravity. They did not offer a panacea but a hopeful programme of mutual respect, social justice, and cooperation that relied on reason, ethics, and faith in the human spirit. In the early twentieth century, the ethical and empirical forces of working-class emancipation were joined by increasingly assertive advocates of political permeation, who synthesized the ideas of previous factions into a scientific, pragmatic, gradualist political programme. How far this affected the low road and to what extent ordinary Britons participated in these factional disputes has yet to be evaluated.

Beginning in the 1880s, the question of science and cultural authority was no longer a contest strictly between the middle and upper class. Science and technology were everywhere part of Victorian life, and this did not go unnoticed by the large mass of British workers. Utilizing an eclectic assortment of resources from within their communities and from elite culture, the low road offered simple science and complex theory. Middle-class intellectuals and educators made, for better or worse, important contributions to the intellectual life of the labouring sector, but it must be recalled that these contributions were not always received or utilized in the spirit in which they were given. Thomas Henry Huxley's lectures to the workingman are a prime example. In sum, the cultural landscape of the late Victorian working-class was neither barren nor sparse, neither autonomous nor controlled. Whether at home, in the neighbourhood, or at one of the many meeting places, working-class communities provided opportunities for a wide range of scientific material as recreation, self-improvement, and political

discussion. For the casual dabbler, easy tit-bits of science—no more than entertaining trivia—passed quickly into common knowledge. For the more serious intellectual, lectures, clubs, libraries, classes, and reading material provided opportunities to tackle some of the most difficult and controversial subjects of the day. Far from being segregated from knowledge and intellectual hobbies, those with the interest and dedication found ample occasion to indulge and improve. Science was, in accordance with larger trends in Victorian society, big news.

The low road to science may not have been a bustling thoroughfare at all times, but it was active, lively, and creative. Moreover, it survived the commercialization of information, enduring well into the twentieth century. The discovery of science as a central feature of the low road changes the analytical framework for science studies and studies of the working class. In the history of science, popular culture has become an important topic, and it will now have to be expanded to include Victorian labourers and, of course, coalminers. For the history of the working

class, science as a fundamental feature of cultural, social, and political activity will have to take its place alongside such standard topics as religion, unionism, industrialization, franchise reform, leisure, radicalism, and class relations. By bringing together the skills and methods of historians from science studies and working-class studies, important research on science and the workplace, cooperative women's guilds, local community responses to evolutionary socialism, working-class faith and unbelief, and even working-class humour and science may be forthcoming. The framework is beginning to take shape.

APPENDIX

List of Figures

Figure 1. Science Siftings, April 23, 1892, cover

can be struck in 10 seconds of time. Several army officers and naval experts have investigated the method, and say that the blow can certainly be struck within a foot or two of the point intended. General Edward W. Serrell, the inventor of this electrical system of auxiliary harbour defences, was, during the civil war, chief engineer of the department of the South, United States Army; he is the inventor of the hydraulic vertical gun lift, for Barbette guns; he also planned and personally superintended the construction of the world-renowned "Swamp Angel" batteries during General Gilmore's seige of Charleston.

The Ethics of Chastisement

are dealt with in a very interesting manner, *apropos* of the Montague manslaughter case, by our contemporary the *Lancet*. Position and education afford no sufficient guarantees for moral goodness. The inner nature, in spite of these external influences, may remain hard and passionate, and the chastisements which have their origin there will be like in character. The ethics of punishment were clearly and briefly summarised by the Solicitor-General in his speech on this occasion, as allowing a "right of giving chastisement (to children) for their moral culture, but the exercise of it must be reasonable, having regard to the age and health of the child." This will be generally accepted as a fair statement of the matter. A parent's will, fancy, or feeling has little to do with it, and indeed severity should not be entirely shunned, if only it be exercised with reason. It is the moral culture which gives to the whole system its keynote. For its fittest and most fruitful method we must rely upon educative more than upon punitive measures. An understanding of the highest moral rule, quite apart from mere maxims of expediency, with a zeal for improving the character, inspired and guided by the great moderating force of love involved, or if this be lacking, as occasionally happens, a sense of duty, instructed by dispassionate wisdom, furnish us with the means of truest success. Thus viewing the matter we recognise a reason for patience, and may fairly hope that the exhibition of its power in trial will prove attractive to those we teach, and will justify and impress on their minds the occasional use of measured and resolute chastisement. Children are very observant, however, and will immediately notice if the chastisement be inflicted in the heat of passion; therefore, we should wait until all anger has subsided before meting out punishment of any description. It will be more effective, and less likely to be brutal.

The Investigation of Clouds

from the summit of the Rigi and Pilatus has recently engaged the attention of Mr. John Aitken, the well-known meteorological investigator, to whom we are indebted for the discovery of several fundamental facts in connection with the formation of fogs and dew. He now finds, as in former observations, that fog is intimately dependent on the presence of dust particles in the air, each of the invisible granules forming the nucleus of a tiny head of water, these vesicles constituting in the aggregate clouds, mists, and their kindred. At elevated situations the air is comparatively free from dust, while lower down it is full of it. But while clouds are passing over a peak the number of particles varies considerably. This, he discovers by a series of carefully compiled data, is due to the fact that the air entering into the clouds has forced itself up from the valley below. Hence the mountain air is pure or impure in exact accordance with the amount of the lower current which has reached it. When the cloud vanishes, the ether resumes its old condition.

Another Curious Fact

just discovered by the same indefatigable observer is that the moment a cloud forms, it begins to discharge its contents in the shape of a steady shower of minute drops. These drops are not capable of being appreciated by the unassisted senses; but by the "fog counter," an instrument of Mr. Aitken's invention, the exact number falling on a given space can be readily noted. What is still more curious is that, though the air is in such circumstances saturated with damp, seats, stones, and other large objects near the earth are perfectly dry, the drops being evaporated by the radiant heat of the ground; but a pin's head or other small object, not offering the same area, is in these circumstances often covered with a minute globule of water. The fact of a cloud thus beginning to rain small drops whenever it is formed, may account for the disappearance of these vaporous masses by gradual exhaustion, without any change in the wind or temperature.

A Believer in Evolution.

who hails from Italy, imagines that he has made the discovery that St. Augustine's theory of the creation was in reality similar in many respects to Darwin's. That there should be some resemblance is not surprising, for there is nothing in the latter to interfere with any creed on the question of a first cause, dealing, as it does, only with the circumstances attending subsequent development. Signor Fogazzaro, who claims to have made the discovery, has written a book on the reconcilement of science with religion, in which he attacks the author of a prize essay on the same subject, dwelling upon the differences instead of the points of agreement between St. Augustine and Darwin. The discussion is not of very great importance, for in nearly every age the Mosaic account has been freely handled, even by the orthodox, and nobody is now called upon to accept it as literally true. Geology dealt it a more severe blow than even evolution has done.

Physiognomy

has ever been an interesting study. It is indeed one of the oldest sciences, and it is certain that it was carefully studied in ancient Egypt and India, and in China to-day the rules practised by legal officers for judging the countenances of criminals have come down from very early times. The oldest extant writings on the subject are those of Aristotle; but he was not the first, since in his work he refers to others who preceded him in that line. He was followed by Theophrastus, who wrote a book, entitled "Characters," containing thirty chapters, said to have been illustrated with portraits, and if this statement is true, this was probably the first book with illustrated pictures. Many authors followed, whose names are more or less familiar: Polemo, Adamantius, Giovani Jugegneri, Albertus Magnus, Pietro Montagnani—so many, in fact, that one authority gave a list of forty-one authors who wrote on physiognomy and expression. The chief authors of modern times were: Lavater, who made physiognomy his life study; Camper, a Dutch anatomist, who wrote on comparative physiognomy of men and animals; Gall, Spurzheim, and Darwin, the last of whom, in his book, "The Expression of Emotions in Men and Animals," made a contribution of considerable value to the subject.

The Cardinal Points Without a Compass

may be told by country dwellers by the following simple observations:—The side of a tree on which most of the moss is found is the north. If the [illegible]

Figure 2. Science Siftings, April 23, 1892, p. 2

GLEANINGS OF THE GLOBE.

ACCORDING to Herschell, the sun advances though space with a velocity of 154 million miles per annum.

RECENTLY invented wire-drawing mechanism has made it feasible to produce silver and platinum wire so fine as to be thinner than a human hair.

IT has recently been proved that when cast and malleable iron are used in the same structure, a galvanic action is set up between them, and the malleable iron is corroded.

BLOOD travels from the heart through the arteries ordinarily at the rate of about 12 in. per second; its speed through the capillaries is at the rate of $\frac{1}{1000}$ of an inch per second.

A DISCOVERY of great importance to South Africa is a stone capable of being burned into a natural cement of good quality. The deposit covers 1,000 acres, and varies in thickness from 10 to 20 feet.

THERE are now 120 women in the Berlin telephone exchanges. It has been decided to employ only women in the future, as their voices are much more audible than men's, owing to the higher pitch.

A "TWO HOUSE POWER" electric motor and battery is being introduced by the Electro Novelty Co., 9, Knapp-street, Boston. The little machine is said to be a perfect working model of the Edison dynamo.

THE syllabus of the vacation studies at the University Hall, Edinburgh, has reached us. The course includes science and sociology, combined with many interesting features, that should certainly prove attractive to students.

THE Editor of *Pearson's Weekly* is organising a splendid scheme to give London children a breath of fresh air in the coming summer. Those who would like to help the "Fresh Air Fund," either with money or personal service, should write to Mr. C. A. Pearson, Temple Chambers, E.C.

THE red colour of the markings on Jupiter is believed by an astronomer to be an indication of their age, the spots of markings (other than the white spots) being dark or black on first appearance, but afterwards becoming red. The great red spot seems to be no exception to the rule.

IT is computed that a cubic inch of air taken 4,000 miles above the earth's surface would expand sufficiently to fill a sphere 2,000,000,000 miles in diameter. By the same law, if a well could be dug to the depth of 46 miles, the density of the air at the bottom would be as great as that of quicksilver.

MR. G. H. BURGESS writes from Folkestone that on the 10th of February he saw flying and caught a large white butterfly (*P. Brassicæ*); and on February 25th, he saw a Brimstone (*G. Rhamni*). Although he did not see any tortoiseshells (the commonest butterfly in Folkestone) till the first week in March.

DEW may be derived from moisture from the ground, or from excess of moisture in the air near the earth, coming in contact with vegetable or other substances that have become cold by radiation. Dew falling upon metallic roofs is free from the influence of moisture, and is due to saturation of the air by cooling of both air and metal by nocturnal radiation.

SOME experiments in connection with the artificial production of clouds by burning cases of resinous matter were lately made in the Jardin d'Acclimation, Paris, under the auspicies of the Société des Agriculteurs de France, but were only partially successful on account of the wind carrying the clouds away as soon as formed. The promoters of the idea contend, however, that in the absence of the exceptionally unfavourable meteorological conditions which attended the experiments, thick and permanent clouds may be formed for protecting too forward crops against late frosts, and covering military operations.

IT is inferred by Prof. Wesendonck, of Berlin, that dustless air, in friction with metals, does not generate electricity. But in the course of some experiments he found that carbonic acid, under like conditions, readily gave a charge, and this was thought to be due to cloud-formation in the gas streaming out of the vessel which had held it in liquid form, the small water particles charging the metal by friction. Further experiment has seemed to confirm this view. Prof. Wesendonck concludes that gaseous carbonic acid is not capable of generating electricity by mechanical friction on metal.

AMERICANITE is the name of a new explosive of great power. The principal ingredient is nitro-glycerine; the other component parts are secret. It is said to be insensible to shock, and explosive at will. It withstands friction, and if ignited with a match, simply burns like a candle. An American expert reporting upon it state that the advantages of being able to use with safety an explosive of a force equal to nitro-glycerine fired from any gun in existence and with terrific effect at a long range is evident. With so powerful an agent, the problem of coast defence is able almost to resolve itself into one of range, and sea-coast cities may be made comparatively safe with very little expenditure.

MOST of the big spiders of the New World are of the sort which build nests with trap-doors, lining a hole dug in the ground with silk, fitting it with a door so artfully made as to hinge, bevelled edge and spring that it is almost impossible to detect the fact that there is an opening, and, in some cases, actually planting seeds on this dainty portal for the purpose of concealing it with growing plants. Some of the largest spiders catch birds, and individuals have been known to capture good-sized fishes, lying in wait for them at the border of a stream.

LOOK at the Pleiades with the unaided eye and you may see six or seven or a dozen stars; look at it through a three-inch telescope and you may, perhaps, see 300; study it through a telescope for three years, as M. Wolff has done, and map the stars and their places, and you may record 600 to 700 stars on a strange background of nebulous light; expose a sensitive plate for an hour, and more than twice that number are revealed; lengthen the exposure to four hours and you have a picture of 2,326 stars, with a different and more extensive background of nebulosity.

Figure 3. Science Siftings, April 23, 1892, p. 4

EVOLUTION AND PHYSICAL DEVELOPMENT.

The public is beginning to realise that the physique is something more than a matter of great interest to scientific observers; that it is, in fact, a subject of practical importance to each one of us. It is, doubtless, pretty generally known that, broadly speaking, the difference in the physique of man in the highest centres of civilisation and that of man in a savage—or, to be more accurate, in a lower state of civilisation—is, with the exception of parts of the brain, greatly in the favour of the latter; that is to say, we have obtained the advantages of civilisation, with the above exception, at the expense of the body; and inasmuch as we are continuously making further advances in knowledge, and applying that knowledge in the ordinary routine of daily life, the tendency of this progress still is to the further detriment of the body. This is not an agreeable fact to contemplate, and the reminder that the "fittest" will survive neither affords us compensation for the injury, nor points out the means by which it may be obviated; for the class of the fittest for the circumstances of a generation ago is not the class of the fittest for the circumstances of to-day, and the class of the fittest for the circumstances of to-day will not be the class of the fittest for the circumstances of the next generation. Hence this most important question arises, How can we obtain for civilised man a physique equal, at least, to that of man in a lower state of civilisation, and make the further advances of knowledge tend to the advantage of the body? The answer to this question, we are told by Mr. Godfrey Hambleton, lies in the ascertainment of the effects of the conditions of our habits and surroundings upon the body, and the application of that knowledge to our own protection and advantage.

Nearly twenty years ago he commenced the investigation of this subject, and the result of that research he laid before the British Association in 1886-87. Then he showed that the size and shape of the chest varied as he varied the conditions to which it was subjected. For example, when he submitted a chest to conditions that tended to develop it, that chest increased in size, and its form or type changed accordingly. When he submitted a chest to conditions that tended to decrease it, that chest decreased in size, and changed its form or type accordingly. He ascertained that those results were absolutely invariable, and could be carried out within such wide limits that, on the one extreme, they embraced the class of the non-survivors, through consumption, and on the other, the finest physique of the class of the survivors or fittest. He also pointed out the fact that we had an example of one type of chest forming a series of types that have varied precisely as the conditions to which it was subjected have varied. At birth the male child of all classes has the same type of chest, but at maturity he has that of the class to which he belongs. We have the same relationship between conditions and type; on the one hand, in those who use wind instruments, or who by their occupations require to greatly use their lungs; and on the other, in those who spend a great portion of their time in a stooping position, or who compress their chests either by the instrument they use in their work or by a corset. The great development of the muscles of the trained athlete, and the wasted muscles of the paralytic, are due to the conditions of their use and disuse respectively. We know that the head has been altered in shape by direct pressure, and that the greater size and the more complicated arrangement of the brain of a European to that of an aborigine of Australia is produced by the greater mental training of the former. The difference between the hands and fingers of a pianist, and those of a man accustomed to lift heavy weights, is produced by the conditions of their occupations. Upon the presence and absence respectively of shoes depends the difference in the size and shape of the foot of a Chinese lady and that of a woman in the uncivilised state. The colour and thickness of the skin vary according to the conditions to which it is subjected, and there is the same relationship between the size and shape of each part of the body and the conditions to which it is subjected. Therefore, the type of man after birth is solely produced by the conditions to which he is subjected. Hence the formation of race by man's continuance under the same conditions, and its subsequent divisions into sub-races and families by his migrations into new conditions and the minor differences therein. Hence also the difference between the same species of animals under the conditions of nature and of domestication, between the products of the same seeds when sown in different localities, between the same plants when placed under different conditions, and the return of man, animal, or plant to former types when subjected to the conditions that produce that type.

It would be difficult to overestimate the immense importance of the facts just briefly referred to. They prove to us, beyond the possibility of a doubt, that man is what his habits and surroundings make him; that he is a member of the class of the survivors or fittest because the conditions, as a whole, of his habits and surroundings are favourable to him; that he is a member of the class of the non-survivors, those who prematurely disappear, because conditions, as a whole, of his habits and surroundings are unfavourable to him; and that he can so order his habits and surroundings that they shall tend to his advantage. A great work and a great future lie straight before us. We have to ascertain the tendencies of all the conditions to which our bodies are subjected by our habits and environment, in order to apply that knowledge to our own protection and advantage. And that is the sphere of true physical development.

An important step towards the attainment of this great object has been taken by the formation of the Polytechnic Physical Development Society, of which Mr. Hambleton is president, to apply the principles of physical development in the ordinary routine of daily life. Perhaps the best way to explain the practical work of the society is to describe what happens to a new member on joining it. He is placed in an erect position, his shoulders are brought well back, and his clothing so loosened over the whole of the chest, that it permits full and free movement. It is found in nearly every case the clothing is from one to two inches or more too tight. Then he is shown the simple movements that are necessary to throw the weight of the shoulders on the spine, he is taught to inhale and exhale deeply through the nose, and to use the spirometer and manometer. The conditions of his habits and surroundings tending either to his injury or to his advantage are explained to him. He is told to avoid those that tend to act injuriously, and where that is not possible or practicable, to ascertain their amount and to counteract their effects, and to place himself under those that tend to his advantage. His careful attention is requested to these conditions, and those that have to be avoided are emphasised. The habit of stooping, positions that cramp or impede the full and free movement of the chest, or a faulty carriage of the body, are very injurious. Habits that tend to the disuse of the muscles or to their excessive use are to be avoided. Breathing through the

Figure 4. Science Siftings, April 23, 1892, p. 7

SECULAR ESSAYS ON SCIENTIFIC SUBJECTS.

BY GEORGE SEXTON, M.A., M.D., F.R.G.S.

NO. I.—THE PHILOSOPHY OF A LONDON FOG.

—As a cloud along the sky,
Which will not let the sunbeams through, nor yet
Dissolve in rain, and ends; but spreads itself
Twixt heaven and earth, like envy between state
And man—and is an universal mist.—BYRON.

THE inconveniences occasioned by a London fog—resembling in its density that darkness of old which is described as being felt—are such as to invest the subject with a great amount of interest. Business is to a considerable extent brought to a standstill during its presence; shops are illuminated with gas at noonday; steamboats cease to ply upon the river; accidents in the streets take place in shoals; and link boys and thieves reap their harvest. Nor is this all; diseases of the air passages become terribly prevalent; a cough is an universal complaint, and inflammation of the eyes a general malady. The mind shares with the body in its derangements, melancholy pervades the face of society, suicide becomes common, and buoyant hope for a time takes its departure. There is plenty of work for the coroners, for the relieving officers, and for hospital surgeons, and for few else.

Familiar as all persons are, and must be, who reside in the metropolis, with a London fog, in its practical results, very few indeed have any clear notion as to its causes, or the laws which give rise to its existence. A few words on this subject may be, therefore, acceptable to our readers.

Water becomes ice by cold; it becomes steam by heat. In common language, steam is the name given to the vapour of hot water; but in reality, a vapour or steam arises from water at all temperatures, however low, even from ice. The expansive force of the vapour increases rapidly as the heat rises, so that when we reach the temperature of boiling water, it operates in a far more striking manner than when it is colder; but in all cases the surface of water is covered with an atmosphere of aqueous or watery vapour. Hence if that part of the atmosphere, which consists of common air, were annihilated, there would still continue an atmosphere of aqueous vapour, arising from the waters and moist parts of the earth; and in the present state of things this vapour rises in the atmosphere of dry air. The existence of water in such air is plainly proved by bringing a glass of cold water into a room on a hot day in summer, the outside of the glass becomes moist, resulting from the sudden condensation of the aqueous vapour in the air. Were it not for this provision of nature, nutrition in the vegetable kingdom would be arrested. The leaves of living plants appear to act upon this vapour in its elastic form and to absorb it. Unconnected with the soil, some vegetables thrive merely on the atmosphere—as, for example, the houseleek and aloe. In very intense heats, and when the soil is dry, the life of plants seems to be preserved by the absorbent power of their leaves. When the streets are watered in summer, the water soon disappears, and the question arises—What becomes of it? Clearly it is converted into vapour and mingles with the dry air. We cannot see the air itself, but we can easily see this portion of it, in the case of its condensation on the sides of the glass of cold water already referred to. Water, in the shape of vapour, is constantly passing from the human body by what is called insensible perspiration. We see such vapour condensed into water on the glass-panes of the rooms in which we reside in cold weather. In northern countries, where the cold is intense, if the window of a ball-room be suddenly opened, this vapour falls on the occupants in the shape of snow. If the entire atmosphere—whose height may be taken at 44 miles—were condensed into the density of water at the surface, the depth of the stratum would be about 36 feet only. Some idea may hence be formed as to its capacity for mixing with vapour in its natural expansion. In effect we find that air is capable of absorbing the 180th part of its weight in aqueous vapour at 32 deg., an 80th at 59 deg., and half more at every 27 deg. of its heat. So that in summer-heat at 86 deg. it absorbs a 40th, and in the torrid zone at 113 deg. a 20th. Here a striking fact must be noted. It is actually the pressure of the atmosphere that keeps all fluids in their state of fluidity. Remove this pressure, and just in proportion will such fluids turn into gas or vapour. The air-pump illustrates this fact. Now, it follows, that although the air dissolves and receives fluids at all temperatures, yet these are converted into gas or vapour only when their internal excitement overcomes that atmospheric pressure. The steam rushing from a kettle or a steam engine is a case in point. Heat is the efficient cause of this internal excitement. In the temperate zone, the annual evaporation is 37 inches, but in the tropics 90 to 100; and the mean quantity of rain (or condensed vapour) is in the same proportion. A cubic foot of air, in this climate, holds about 4 grains of water in the shape of invisible vapour. Aqueous vapour, when it is returning to a state of water, is a cloud, and a mist or fog; for there is no essential difference between them all depending upon condensation of the aqueous vapour. When vapour exists in the atmosphere if in any manner the temperature becomes lower than the constituent temperature requisite for the maintenance of the vapoury state, some of the steam will be condensed, and will become water. Thus the cool of steam from the boiling tea-kettle becomes visible, being cooled down as it rushes to the cold or colder air. The steam condenses into a fine watery powder, or into globules, in fact, solid or hollow (it is uncertain which), and these are carried about by the small aërial currents. Clouds are precisely of the same nature with such cools, the condensation being generally produced when air, charged with aqueous vapour, is mixed with a colder current, or has its temperature diminished in any other manner. Whilst they retain that shape, and float in the sky, clouds are of the most essential use to vegetable and animal life. They moderate the fervour of the sun in all climates—pleasant no less to vegetables than to animals. Duhamel says that plants grow more during a week of cloudy weather than a month of dry and hot. Vegetables are more refreshed by being watered in cloudy than in clear weather. In the latter the fluid is too rapidly carried off by evaporation. Clouds also moderate the alternations of temperature by checking the radiation of heat from the earth. The coldest nights are those which occur under a cloudless winter sky. In fact, they perform a similar office for the earth, that clothing does for man and the hair or fur of other animals for their bodies, which act by preventing the escape of heat. And with regard to the atmosphere, with its clouds, &c., we may say with Humboldt, that "it exercises a powerful influence on the whole animal and vegetable world, not merely by meteorological processes, as precipitations of aqueous vapour, and of the acids and ammoniacal compounds to which it gives rise; but also directly as an electric force acting on the nerves, and promoting the circulation of the organic juices."

Clouds and fog being the same thing, we may inquire what constitutes the difference between them? It is simply that we see the whole as a cloud at a distance in the atmosphere; but when the vapour sinks to the earth, or is not able to rise, we are immersed in it, and call it a fog. As there is every variety of fog, from the mere mist of a summer morning to the murky horrors of a London fog, we may briefly describe the different kind of clouds with which we are familiar.

When a cloud looks like a lock of hair or a feather, it is technically called a *cirrus*, rising like a gauze, veil to the height of from three to six miles; when its streamers point upwards it is, of course, falling, and indicates rain. In conical round heaps a cloud is a *cumulus*, generally much lower than the *cirrus*. This cloud is the veritable London fog. When this *cumulus* spreads out into shreds, and is raining, it is called a *nimbus*. A level sheet of cloud is a *stratus*, and this is the dew-fog or mist which hangs over fields. Clouds often mix their forms, and give rise to compound names, which need not be enumerated. In heavy weather, clouds are seldom more than half a mile high, but in clear weather from two to five miles, and the beautiful *cirrus* sometimes reaches the height of seven miles. The size of clouds is sometimes enormous, ten miles each way and two miles thick, containing 200 cubic miles of vapour, watery powder, globules, or small bladders of water, at not great distances from each other, usually not one-thousandth part of an inch in diameter, but doubtless of different sizes. It is thought that they rotate, and hence their distance and force as steam. Clouds float because they are lighter than the air in which they move, their interstices being warmed by the solar heat, and their vesicles or bladders enclosing various gases lighter than air.

This last observation leads us directly to the explanation of a London fog. We must bear in mind, however the

Figure 5. The National Reformer, 19 March 1864, p. 5

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"The past destroys." And why not destroy, whose destruction will liberate the good? What is the aim of what is called destruction? The destruction of tyranny is political freedom. The destruction of slavery is spiritual and mental emancipation. Positive and negative are mere terms. Creation and destruction, as we call them, are just one and the same work, the work which man has to do—the extraction of good from evil."—W. J. FOX.

VITAL FORCE.

I.

"COULD we really believe that the laws of nature can be once, in an arbitrary manner, overthrown by vital force, then must every inquiry into nature, every inquiry into the soul, cease," saith Ule.

Among those mystical ideas which confuse the clearness of investigations in natural philosophy, which a period profoundly unacquainted with the natural sciences generated, and which the more exact physical researches of modern times have thrown overboard, a prominent place is occupied by the idea of a so-called vital force. Scarcely has any notion existed that has done more harm to science than the recognition of that special organic force which, as the opponent of the inorganic forces,—gravity, affinity, light, electricity, magnetism,—appears on the scene, to create for living beings laws of exception, according to which it is possible for such beings to withdraw from the influence and operation of the universal laws of nature, to form a law for themselves, or to found a state within the state. If science were forced to recognise such a doctrine, then down must go our dogma of the universality of the laws of nature, and the unchangeableness of the mechanical order of the universe; we must grant that a higher hand interferes with the march of the Natural, and creates laws of exception that escape all calculation. A rent would be made in the structure of the universe—science must despair of itself, and, as Ule properly remarks, every inquiry into nature and the soul must cease. Fortunately science, instead of retreating before the unreasoning pressure of the Dynamists, has everywhere gained the most magnificent victories over them; and in recent times has brought together such a mass of brilliant facts, that the idea of vital force only moves now on the frontier of the exact sciences, like a shadow without a body, and finds a refuge only in the brain of those whom science has left far behind. All those who more profoundly occupy themselves with any branch of physical science that concerns the domain of the organic universe, are almost unanimous in the judgment they pronounce on vital force, and even the phrase has become so unsavoury when employed scientifically, that it is always and most unanimously avoided. How could it be otherwise? There can no longer exist any doubt about the fact that life obeys no laws of exception, that it cannot withdraw from the influence of inorganic forces, that on the contrary, it is nothing more than the product of the co-operation of those forces.

Before all things it was science which was first able to demonstrate beyond all doubt, that the fundamental elements of substance are everywhere perfectly the same in the organic and inorganic worlds—that both worlds therefore consist entirely of the same elements, and that life, in its material basis, is not able to exhibit one single atom of substance which did not likewise exist in the inorganic world, and which was not operative in the cycle of movements and changes which substance undergoes. Chemistry was able to analyse organic bodies or combinations of substances, to reduce these to their fundamental elements, and to depict and demonstrate each of these singly, exactly as in the case of the inorganic bodies. That so-called aboriginal slime from which it was thought, at an early period, that all organic beings must have arisen, is a complete chemical absurdity and nonentity. This one fact could have sufficed to banish from science every thought of a special vital force. We have seen that forces are nothing more than the attributes or movements of substances, and that every smallest particle or atom of a particular fundamental element of substance is bound to those forces in fashion unchangeable and inseparable. Consequently such an atom, wherever it was to be found, into whatever combination it may enter, whatever part it may come to play, whether it dwells in the organic or inorganic worlds, must everywhere and under all circumstances always do the same thing, develop the same forces, produce the same effects. The qualities of atoms are, as it has been more scientifically expressed, incapable of annihilation: for as much then as daily experience hath taught that all organisms consist of the same atoms as the inorganic world, that they are merely otherwise grouped, there can be no special organic forces, no vital force. All organic life, as Mulder triumphantly shows, is explained by the action of so-called molecular forces. It is an indubitable law that nothing is brought into nature, but that everything must be sought in, must be developed from nature. Mulder very ingeniously compares the notion of a vital force with the notion that in a battle where thousands fought, only a single force was active, a force by which the cannons were fired off, the sabres slew, and so on—whereas the total effect was not brought about by a single force, which we might call the battle force, but was the total sum of countless forces and combinations that were active in the whole clash and commotion. Vital force is consequently not a principle but a result. When an organic combination of substances appropriates inorganic substances which come near it, and brings them into the same circumstances in which it is itself placed, it does this not by means of a special force, but by means of an act of contagion, whereby it transfers the molecular relations of its own smallest portions of substance to the inorganic substances, exactly as in the inorganic world forces pass over from substances to substances. Without difficulty is, in this manner, explained the origin of the whole organic world from one or two points of commencement, and without the help of a vital force. How such a beginning could be, and could not but be possible, we have demonstrated in the chapter on Original Generation.

If, therefore, in accordance with the universal foundations of natural philosophy, it must appear impossible for laws of exception to exist in the organic universe, their truth seems to be made still more clear and manifest in particular cases and in concrete relations. Chemistry and physics were able to furnish the most victorious proofs that the well-known forces in living nature were active in exactly the same manner as in dead nature; they were able to pursue and to demonstrate in the vegetal or animal organism, the working of these forces in the finest and most inaccessible combinations. It is at present generally admitted that physiology, or the science of life, cannot now exist without chemistry and physics, and that no physiological process is possible without chemical or physical forces. "Chemistry," saith Mialhe, "has unquestionably both as cause and as effect a share in the creation—the growth and the continued existence of all living beings. The functions of respiration, of digestion, of assimilation, and of secretion take place only in chemical fashion; chemistry alone is able to unveil to us the secrets of these important organic functions." Oxygen, hydrogen, carbon, nitrogen, pass in the most manifold fashion into the chemical combinations of the body, and blend, separate, act exactly according to the same laws as when found apart from the body. Where various chemical elements form a conjunct body, the law is the same. Water, which must be regarded as the first and incomparably

Figure 6. The National Reformer, 2 April 1864, p. 33

THE STAR, SATURDAY, 8 DECEMBER 1888.

ACTORS AND ACTING.

"SPECTATOR'S" NOTES ON THE DRAMATIC WEEK.

"The Playgoer"—Free Programmes—A French Manager and a French Critic—Mr. Buchanan's New Comedy—Pictures.

The second number of the *Playgoer*, which makes its appearance this month, is a great improvement on the first. There is plenty of grit and grip and go in the new official organ of the Pit, especially in its crisp paragraphs, and it has at least one contributor (the essayist on "Stage Heroes" and "Stage Villains") who is a delightful humorist, but the theatrical notices strike me (very likely, I daresay, because I am a rival dealer in the same sort of wares) as a trifle "stodgy" and amateurish. Its chief shortcoming is in the matter of good taste. "Great Scott!" for instance, is an expletive that, for all I know, may effectively punctuate a smoking-room story, but does it (except, of course, when it appears on pink paper) adorn a newspaper paragraph? Besides, readers unfamiliar with Anglo-American slang, might suppose the *Playgoer* to be apostrophising a certain well-known dramatic critic as "great," a misunderstanding that would probably make the editor as "wild" as Mr. Toole in the farce. For you must know that the professional dramatic critic, the shameless hireling of a venal press, is the new journal's particular *bête noire*. It irks the editor sorely that these wretched hacks should indite their criticisms "under the insinuating influence of a comfortable but costless reserved seat;" and one of his correspondents has "always thought that the air of authority and censorship assumed by newspaper critics is absurdly impudent."

* * *

Then again: "Mr. Kendal succeeded in making himself very foolish last month, and we suppose that created envy in the breast of his elderly better half, and she determined to see if she could not cap him at it." Is not this sort of thing a little lacking in [illegible], to use George Herbert's—I suppose the *Playgoer* would say "[illegible] old" George Herbert—[illegible]? Moreover, is it not a little unworthy of a publication that (very commendably) takes such a lofty standpoint in regard to the drama, and holds high the banner of the Ideal, to be tripped up by such insignificant obstacles as an English grammar and dictionary? Yet it "repeats again" and talks of an actress's "misunderstandableness!"

* * *

I hope the *Playgoer* will take these carping criticisms of a hireling scribe in good part, because I have a sincere respect for its special constituency, the Pit, and a firm belief in the general soundness of the pit's judgment. *Nil faut opter*, said La Bruyère, *je [illegible] the people.* Well, *The Star* has, of course, from the first "opted" for the people, the two-shilling people, who come early and have to win their way to their seats, not the ten-and-sixpenny people who come late, tread on your toes as they squeeze by, talk out loud (after the pattern of their revered H.R.H.) during the performance, and look as if they didn't know such a place as the pit existed. And there are many questions relating to the playhouse that a publication like the *Playgoer* is in an exceptionally good position to deal with.

* * *

The free programme, for instance, a matter about which professional critics are apt to be hoodwinked. There is hardly a house in London at which the Press is knowingly charged for programmes. Yet I learn from the *Playgoer* that there are only six theatres at which the public is not asked to pay for these harmless, necessary, documents: the Court, the Gaiety, the Haymarket, the Lyceum, the Savoy, and the St. James's. At Terry's, and at Toole's programmes are, it seems, occasionally presented gratis on first nights. And observe that it is precisely at the six houses mentioned that the programmes bear away the palm for artistic merit. The Savoy programme, for example, is ablaze with gold and colors, while that of the St. James's, with its beautiful line engraving after a design by Mr. Bernard Partridge, is well worth framing. The fact is, at most houses the sale of programmes is farmed out to the refreshment contractor, and as this person has to pay an exorbitant rent (no less than £45 a week I am assured is paid by one of these gentry to the management of a theatre not a hundred miles from Oxford Circus), he cannot supply a programme for nothing, or an expensively got-up programme at all.

* * *

There has been a very pretty quarrel this week between Mr. M. L. Mayer, purveyor-in-ordinary of the French plays in London, and the London correspondent of the Paris *Figaro*, Mr. T. Johnson, who is probably best known outside journalistic circles as the hero—or victim—of one of Mrs. Weldon's innumerable libel actions. At the Royalty last Monday night I was much surprised to see Mr. Johnson seated in the pit instead of in his accustomed stall, but next day's *Figaro* supplied a key to the mystery. Mr. Johnson says that he has [illegible]

DE MEYER'S MENTAL MAGNETISM.

His Entertainment at St. James's Hall—The Impressions of a Subject.

M. Milo de Meyer is giving some wonderful performances in hypnotism at the St. James's Hall just now. Unlike some professors, M. de Meyer does everything openly, and is always ready to explain and to answer questions. He professes to do nothing but what has been proved by scientific experiments. He first calls for young men between 18 and 25, explaining that the percentage of good subjects after 25 diminishes. The professor asks the subjects to stretch out the muscles of their arms; he takes them by the hands, and then turns his wonderful eyes on to them. The subject must gaze fixedly at one of his eyes, which stand out prominently in his head and show a great deal of "white." The convergence of the sight and the concentration of the attention on the one particular point, affects the nervous system of the subject, the pupils of his eyes contract, his frame shakes, his mind becomes powerless, and all he sees is one luminous point—the professor's eye. Unconsciously the subject follows that point everywhere, and is

COMPLETELY IN THE POWER OF THE PROFESSOR.

There is nothing new or wonderful in this system of mesmerism or hypnotism, and it can be proved by oneself by keeping the eyes concentrated for a time on any bright object. M. De Meyer, however, hypnotises subjects at a distance

while they are sitting among the audience. He can also hypnotise them by placing his hand on their back, but in this case the subject remains perfectly awake and conscious, while the professor has complete control of any part of their body he chooses. He sends subjects through the audience with one arm outstretched and rigid. The muscles are contracted and all feeling gone. The subject will tell you that he has no power over it. Of course the professor makes his subjects think what he tells them and do anything he wishes. He paralyses their physical, and magnetises their mental, faculties. M. de Meyer told a *Star* reporter who had a short chat with him that he has

PRACTISED HYPNOTISM FOR FIVE YEARS.

He has given public performances in Belgium and Holland and held private séances in Paris. He regards hypnotism as quite a science. Much more prominence is given to it on the Continent than in this country. It is used in hospitals instead of chloroform, and is applied to the treatment of the insane. M. de Meyer has himself cured kleptomaniacs and those addicted to drink through mental weakness. He says that he finds the most sensitive subjects are those engaged in sedentary occupations, such as clerks, or those who are in the habit of concentrating their eyes on particular objects. Most good subjects are to be found amongst compositors. To be fully understood, M. de Meyer's performance must be seen. It will prove both interesting and amusing. A correspondent who went up from an audience, a perfect stranger to the Professor, and submitted himself as a subject for the first time, sends us an account of his experience. He writes: "Kneel down," said M. de Meyer, when it came to my turn, "stretch out the muscles of your arms firmly and look fixedly at the pupil of one of my eyes." I chose the left. For about four seconds the face wore its normal expression, and then, with startling suddenness, his fearful countenance fell on to mine. His face, or rather the left side of it, began to swell enormously, and the eye to

[illegible]

My body felt as if it was swaying violently to and fro, and my arms began to stiffen. I thought of all sorts of things, mostly that happened some months ago, and was wondering in a dreamy fashion what that great white moon-like thing with a bright eye [illegible] [illegible]

A GERMAN MISS GORDON-BAILLIE.

The Story of an Adventuress who, After a Chequered Career, Obtains a Title of Nobility, and is Made a Magistrate.

A series of singular adventures, of which the heroine is a certain Mademoiselle Bertha Rother, is just now the subject of a good deal of comment in social circles in Berlin and Vienna. This interesting young person, is an ex-actress, who has had engagements in a minor theatres in both the above-named cities, possibly not on account of her artistic talents, but probably in consideration of her personal charms, which it is said are remarkable.

On several occasions in her past life she had been called upon to answer for

CERTAIN LITTLE IRREGULARITIES

by the police authorities, who, if not quite satisfied with her explanations, were, however, reluctant to proceed to extreme measures against her, she evidently having powerful protectors ready to screen her beneath the ægis of their influence. But at last matters reached a high pitch of indecorum after she had joined her fortunes to those of a certain bold speculator, who opened a show of *tableaux vivants* on a system of realistic *déshabillé*, which, however attractive it might be from a mythological and classical point of view, was considered by steady-going officials as somewhat too primitive and academic to suit the serious, conventional taste of the Berliners. Added to this little irregularity there was another matter engaging the attention of the said officials wherein Mademoiselle Bertha Rother was acting a most important part. It appears she had had a *liaison* with a personage occupying a distinguished position in the diplomatic world, who had been so imprudent as to communicate by letters to the lady important secrets of his married life, which

PLACED THE WRITER IN HER POWER.

She had received at various times important sums of money from this admirer of hers, and finding that he had made up his mind at last to turn a deaf ear to her continuous exorbitant demands, she threatened unless he complied with her request to forward his letters to his wife. But distinguished personages occupying a high position in the diplomatic world have means of ridding themselves of importunate applicants which ordinary mortals do not possess. Mademoiselle Bertha Rother had to endure the inconvenience of a domiciliary visit, when the incriminating documents were easily secured. She received at the same time a summary order of expulsion. But the executive had evidently reckoned without the bright eyes of the charmer. The official charged with the execution of the order

WAS [illegible]

and was immediately relieved of his functions.

However, Mdlle. Rother managed to evade the order of expulsion, and she then turned her attention specially to a certain M. ———, a very rich man, with whom she subsequently went to Vienna, where she created quite a sensation on the stage at several minor theatres. It is to be assumed, however, that she did not devote her whole time to dramatic art, for on this occasion also the Viennese police politely requested her to leave the capital and transfer her charms and attractions to some other stage.

M. ———, who was head over ears in love with the seductive adventuress, now made up his mind to obtain social status for the object of his adoration; and to this effect he purchased for her a nobiliary estate in Mecklenburg at a few hours by road from [illegible]. This was no ordinary present, not only on account of the size and beauty of the domain of [illegible], but for the reason that singular ancient privileges are attached to it. In virtue of these prerogatives, the person in whom the estate is vested is empowered to assume

A TITLE OF NOBILITY.

Mademoiselle Bertha Rother, therefore, has blossomed into the "Burgfrau" of the locality.

It would not be a matter of much importance if the assumption of this title offered no other advantage beyond that of flattering the vanity of its possessor; but, in addition to this, there is a right of sitting in the Mecklenburg Chamber of Delegates, and if it be a woman who is in possession of the domain, she is entitled to delegate her authority to whomsoever she pleases. Here, then, we have a designing *demi-mondaine* a member of the ducal Parliament. But the advantages derived from the holding of the estate do not end here. By its old-fashioned clauses the Mecklenburg Constitution empowers the possessors of certain fiefs to exercise supervision in matters affecting the public health and morals. They are also empowered to exercise

MAGISTERIAL AUTHORITY

in cases of petty thefts and assaults. Bertha Rother can sentence people to 24 hours' imprisonment for [illegible]; and she is supposed to hold audiences once a week for the purpose of listening to complaints and giving advice.

It is reported that the Burgfrau has taken to her new duties quite seriously, and is delighted with her station. There is a fine smack of the spirit of opera-bouffe in the [illegible] theatrical style in which the [illegible] delivers her judgments to the intense wonderment of the country folk who are subjected to her jurisdiction.

She has sent as her representative to the ducal Parliament an individual whose past life would not bear the [illegible] inquiry, but to whose presence there no one can object, for it is covered by the authority of the possessor of a nobiliary estate.

Now who would have thought that such a strange state of affairs in connection with the tenure of land could have existed in Germany in the nineteenth century? But so it is, and this short sketch of the doings of a notorious adventuress is by no means an exaggerated fiction, but a [illegible] matter of fact story.

THE PEOPLE'S POST BOX.

Wanted, a Teachers Union.

SIR,—Your article of Tuesday is a step towards the supplying of a long-felt want, and one which teachers [illegible]

Figure 7. The Star, 8 December 1888, p. 4

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