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Just before *Nature*: The Purposes of Science and the Purposes of Popularization in some English Popular Science Journals of the 1860s

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Summary
Popular science journalism flourished in the 1860s in England, with many new journals being projected. The time was ripe, Victorian men of science believed, for an ‘organ of science’ to provide a means of communication between specialties, and between men of science and the public. New formats were tried as new purposes emerged. Popular science journalism became less recreational and educational. Editorial commentary and reviewing the progress of science became more important. The analysis here emphasizes those aspects of popular science which have been identified by Frank Turner as ‘public science’ and by Thomas Gieryn as ‘boundary-work’. The religious, intellectual, and utilitarian values claimed for science by editors and contributors in their tasks of persuading the public to support science and of distinguishing science from what they often called ‘applied science’ are discussed. These values are shown to vary among editors and, for the editors examined here, Shirley Hibberd, Henry Slack, James Samuelson, William Crookes, and Henry Lawson, to differ significantly from those of T. H. Huxley, John Tyndall, and Norman Lockyer, on whom much study of the popularization of science in the 1860s has focused.

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1. Introduction
Much writing on the publicists for and popularizers of science in the 1860s has focused on T. H. Huxley, John Tyndall, Norman Lockyer and friends, ‘leaders of Science in London’ as they called themselves,¹ and *Nature*, the journal which they founded in 1869. However, detailed studies by Susan Sheets-Pyenson and W. H.

Brock have revealed a broader culture of science publishing, identifying the range of professional affiliations among editors, the varied social locations of audiences, and the ways in which science was adapted to audience. More recently Bernard Lightman has argued that popularizers who were professional writers rather than professional scientists gave nature a ‘different voice’ than that given to ‘her’ by Huxley and the scientific naturalists.

Because Huxley was such a good publicist, for science, for Darwin, and for himself, and because history is written by the successful, it is easy to take Huxley and his friends as representative of the popularization of the mid-Victorian period. Norman Lockyer’s own history of science journalism, in the anniversary edition of Nature in 1919, did this, seeing its origins in Huxley and Tyndall’s columns in the Saturday Review in 1858 and carrying it on through Huxley’s editorship of the Natural History Review in the early 1860s, and Lockyer’s own collaboration with Huxley and friends on the Reader in 1863–4. Roy MacLeod’s pioneering article on the centenary of Nature followed Lockyer and interprets many of the additional journals as belonging to the same young guard—including William Crookes’s Chemical News and Quarterly Journal of Science, and the more obscure Scientific Record and Scientific Opinion. More recently, Frank Turner, suggesting lines to follow in the investigation of public science at the end of the nineteenth century, characterized the popularization of the mid-Victorian period as the project of Thomas Huxley, John Tyndall and others to identify science with methodological naturalism and to forge a ‘self-conscious professional scientific community’. Certainly the advocates of scientific naturalism were powerful and effective popularizers, having great ‘authority with the public’ which even scientific opponents had difficulty undermining. My analysis here follows Brock, Sheets-Pyenson, and Lightman in emphasizing the diversity of the mid-Victorian popularizers.

The decade of the 1860s was a high point in popular science periodical publishing in nineteenth-century England. On Susan Sheets-Pyenson’s figures the total number of popular science periodicals was practically unchanged from the 1820s to the 1850s, but the number doubled from the 1850s to the 1860s. This growth was not something


7 The number of popular science journals created peaked in the 1820s and 1860s; the total number publishing peaked in the 1860s, with a fall-off in numbers in the 1870s for natural history journals although not for general science and mechanics’ magazines. See Sheets-Pyenson, ‘Popular Science Periodicals’ (note 2), 551, and for more detail see her ‘Low Scientific Culture’ (note 2), 50–5.
peculiar to science but was related to the conditions of publishing. Technical changes in printing and paper-making, abolition of taxes on advertisements and of duty on paper, and cheaper postage all reduced publishing costs and led to an increase in periodical publications of all kinds in the 1860s. But there were also changes in the form and content of popular science journals which suggest changes in the status and nature of the scientific community.

Sheets-Pyenson classified Victorian popular science journals into general science, mechanics magazines, and natural history. General science periodicals emphasized mechanical inventions and industrial processes, as was suggested by the combination of 'science and art' in most titles. Mechanics magazines, which were usually cheap weeklies, also emphasized utility. They stressed that their artisan readers could educate themselves, improve technical processes, and rise through perseverance, and were often critical of theory and speculation. Natural history journals also encouraged amateur activity, but appealed to those higher in the social order. They were more expensive and better illustrated, contained more original articles rather than extracts and summaries from other sources, appeared monthly or quarterly rather than weekly, and were often denigratory of interest in mere utility. By the 1860s these categories began to break down. For example, both Recreative Science and the Popular Science Review, which Sheets-Pyenson classifies as general science periodicals owing to their broad content and interest in utility, had many characteristics of natural history journals. In frequency and in cost they match natural history journals, being 1s. monthly and 2/6d. quarterly respectively. Half the contents were natural history (approximately 60–70% initially in Recreative Science, and 45–50% in the Popular Science Review), and from 1862 both titles included colour illustrations. In the 1860s these and other journals combined the breadth of the previous cheaper general science weeklies and the middle-class audience of the well-illustrated natural history journals. Natural history and utility came together. Mechanics magazines also broadened in content. The English Mechanic (founded 1865) took over a number of unsuccessful general science periodicals, and by the early 1870s, while still appealing to mechanics, became much more science oriented. This broadening of content was associated with shifting definitions of science and of the scientific community. From the 1820s to the 1850s popular journals had espoused an experiential, inductivist science to which all their readers could contribute. Sheets-Pyenson found that this participatory, republican image of the scientific community began to disappear in the new journals of the 1860s when popularizers sought not participation from amateurs, but support for professionals.

The editors of the 1860s described their new periodicals as 'organs' of science, or means of communication between 'Science' and 'The Public'. To the Victorians a 'newspaper or journal which serves as the mouthpiece of a particular party, denomination, cause, movement or pursuit' was an organ. Every group had its

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9 'Popular Science Periodicals' (note 2), 553–4 and 'Low Scientific Culture' (note 2), ch. 2.

10 For percentage contents see the Appendix and for costs see Sheets-Pyenson, 'Popular Science Periodicals' (note 2), Appendix.


12 Oxford English Dictionary, 'organ (7e)'.

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English Popular Science Journals of the 1860s

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organ, ostensibly to form public opinion or, more realistically, to interpret the world for its readers. The Quarterly Review and the Edinburgh Review were the organs of the Tories and Whigs respectively. So William Crookes in the Chemical News at the end of 1860 wanted to be a 'veritable organ of Scientific and Chemical News', to give a 'notice of all events of interest which occur in the scientific world'. This news was intended for 'that class of men, who, without being engaged in such subjects professionally desire to be kept informed on their progress'. This was broadening the role of Chemical News which had previously represented the interests of chemists and druggists. Gradually a smaller proportion of the content was devoted to material relevant to practising chemists and druggists and a larger proportion given to topics of general interest and commentary on policy issues, from lectures on 'volcanoes' and 'the antiquity of the human race', reports on debates over atomism, to commentary on the 'oxygen deficiency in the tunnels of the metropolitan railway'.

Three features became important in the various 'organs of science' projected in the 1860s: providing scientific information on matters of general interest across a wide range of topics; urging public recognition of the benefits of science; and providing a medium of communication between scientists in different specialties. These aims are most fully expressed in the advertisement for Scientific Opinion, a weekly which started in November 1868, just a year before Nature:

Each class and profession has, first of all, found the convenience, and soon the necessity, of possessing a special organ of its own in periodical literature; and it is the intention of the conductors of Scientific Opinion to render their journal not only a focus into which is gathered the multitude of isolated facts and opinions scattered throughout the range of current literature, but also to constitute it the advocate of the cause of Science and the interests of scientific men in England. . . .

To enforce with vigour and persistence the claims of Science upon the general public, to secure her followers their proper need of recompense and social distinction, and to help them in their daily pursuits, will constantly be the aim of this journal.

A year on at the beginning of 1870 it looked back on its leading articles as discussing all those topics of the day 'which related to Science in its politico-social aspects'.

These goals manifest the growing independence of science as an institution and its growing significance to the broader society. In an age of Great Exhibitions, public health reform and submarine telegraphy science was becoming an issue of public policy. In the decade of The Origin of Species and Man's Place in Nature the implications of science for religious belief became a focus of public interest. Also, this was the period in which science was becoming increasingly relevant to industry and empire. Chemists, for example, were widely employed in industry, naturalists and physicists were employed by the state. Thus fewer men of science were amateur

13 'To Our Readers', Chemical News, 2 (15 December 1860), 313 and 3 (5 January 1861), 1–2.
15 'Our Past and Our Future', Scientific Opinion, 3 (5 January 1870), 1.
16 On employment see The Patronage of Science in the Nineteenth Century, edited by G. L'E. Turner (Leyden, 1976), especially W. H. Brock, 'The Spectrum of Scientific Patronage', pp. 173–206, reprinted as article 1 in Science for All (note 11). The growing importance of science to industry has been argued by a number of economic historians; see, for example, Peter Mathias, The Transformation of England: Essays in
gentlemen with secure status and income. The new professionals were seeking, in the words of *Scientific Opinion*, 'proper recompense and social distinction'. As specialists they required means of communication with scientists in other disciplines. Outsiders, the public, had to be told of the achievements of science, and they were interested because it was becoming increasingly apparent, as the *Quarterly Journal of Science* reminded them, that science had implications both for their 'material interests' and for their 'eternal happiness'.  

*Scientific Opinion*'s concern to bring 'the claims of Science' before the general public and to secure appropriate salaries and status for the followers of Science is an expression of the goals of 'public science' as identified by Frank Turner. He defines public science as the 'body of rhetoric, argument and polemic' produced by scientists when justifying their activities 'to the political powers and other social institutions upon whose good will, patronage, and cooperation they depend'. Persuading state and civic authorities to support scientific institutions and research was essential for the growth of professional science. Distinguishing science from other activities was an important aspect of this advocacy process. Separating science from religion and from engineering, manufacturing, and other so-called 'applications' of science was important in claiming autonomy and status for science and its practitioners, although to claim at the same time that science was important because it had immense practical benefits created tensions which required resolution. The railways, telegraphs, and printing presses, said Huxley in 1866, were but 'the ripples and the bubbles' on the surface of a 'great spiritual stream' arising from a new ethical spirit by which he characterized science.

Thomas Gieryn’s insightful concept of ‘boundary-work’ aptly captures many aspects of this process. Scientists were careful to define science as different from engineering and technical know-how, while at the same time claiming that science was the foundation of technological progress, in order to claim support and autonomy for scientific research, support which they did not want to share with engineers and other technicians. They defined science as essentially different from religion in order to extend scientific authority. The boundary between professional and amateur also required definition. Professionalization has received considerable attention from historians of science but the obverse of this is, as Anne Secord points out, that the category of amateur was also being created. This operated as a class barrier, keeping out artisan botanists and many who had previously seen themselves in participatory political terms as part of a republic of science, as a gender barrier, keeping out women, and as a religious barrier, keeping out clergy. Many of the claims about the purposes and benefits of science, which are the focus of my attention, are boundary-

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18 Turner (note 5), 589.


22 Frank Turner's 'The Victorian Conflict between Science and Religion: A Professional Dimension', * Isis*, 69 (1978), 356–76, is the classic statement about professionalization excluding clergy; Sheets-Pyenson (note 2) has emphasized the use of republican metaphors by lower class amateurs and shown how this
work. My analysis here investigates the direct claims made about the purposes and benefits of science and also the more indirect messages about what is included within the boundaries of science and who is included within the scientific community.

Various types of periodical already in existence were tried out as models for the new organs of science. The *Popular Science Review* and the *Recreative Science* series broadened the content and role of natural history journals, just as Crookes had broadened the content and role of *Chemical News*. In 1864 Crookes, together with James Samuelson, took on the model of the pre-eminent organs of opinion with the aptly titled *Quarterly Journal of Science*. But quarterlies were going out of fashion and others tried the new weekly format which was more attuned to news and current comment. The *Reader* (from 1864), *Scientific Opinion* (1868), and *Nature* (1869) were all weeklies which claimed to represent the scientific community. The *Reader* joined science with literature and art in an effort to bring science to those outside the scientific community; *Scientific Opinion* and *Nature* were limited to scientific content but nevertheless asserted their intention of bringing the claims of science before the general public. The continuing difficulty was that the upper-middle-class general public, whose support was wanted, was unlikely to read a purely scientific journal.

Four general science periodicals started during the 1860s have been selected for analysis here. I include the three most successful of the general science journals identified by Sheets-Pyenson and one which although remarkable for its quality failed in the marketplace. *Recreative Science: A Record and Remembrancer of Intellectual Observation* was a monthly which published two volumes a year. Started in August 1859, it survived until 1871, although under changing names. Late in 1862 it reorganized its name and broadened its content to become the *Intellectual Observer: A Review of Natural History, Microscopic Research, and REcreative Science*. In 1868 it became the *Student and Intellectual Observer of Science, Literature, and Art*, broadening its content further to include 'literature'. The second title chosen, the *Popular Science Review. A Quarterly Miscellany of Entertaining and Instructive Articles on Scientific Subjects*, was more successful, lasting twenty years. Founded in 1862, it changed editors in 1864, changed editors again and began a new series in 1877, before ceasing publication in 1881. Third is the ambitiously named *Quarterly Journal of Science*, founded in 1864. It underwent a significant editorial change in 1871, became a monthly in 1879, and ceased publication in 1885. My fourth example is the weekly *Scientific Opinion: A Weekly Record of Scientific Progress at Home and Abroad*, which began publication in November 1868. At 4d. weekly it was in direct competition with *Nature*, started in November 1869, and *Scientific Opinion* survived only until June 1870. As a weekly it had a very different format from the other three titles which makes direct comparison difficult but it is included, briefly, because it was remarkable for the quality of its editorial comment and because it was edited by Henry Lawson who had also been editor of the *Popular Science Review* from 1864.23

The analysis here will focus on the decade of the 1860s.

All four journals had a middle-class readership although differences in format and participatory vision of the scientific community declined in the latter half of the nineteenth century; Secord (note 21) links these different exclusions together to note that the category of 'amateur' was produced along with the category of 'professional' (297).

23 Not included in this analysis are the *Scientific Review and Journal of the Inventors' Institute* (1865–83) and *The English Mechanic* (1865–1926), successful journals categorized as mechanics' magazines by Sheets-Pyenson, both of which had a broad scientific content. Also omitted are a series of failures, *Scientific Record* (1864), *Mirror of Science* (1864–5), *The Laboratory* (1867), *World of Science* (1868–9), and *Scientific Summary* (1870).
price suggest some variations in audience. The *Quarterly Journal of Science* was the most expensive at 5s. a quarter or double the price of the *Popular Science Review*, and had fewer colour illustrations than both the *Intellectual Observer* and the *Popular Science Review*, suggesting a serious, less recreational readership. It was losing money through the 1860s and had the lowest circulation of the three.\(^{24}\) The *Popular Science Review* had much longer articles than the *Recreative Sciences* series, suggesting a more educated readership. Alvar Ellegard identifies it as ‘highbrow’ and Sheets-Pyenson notes that it advertised itself as being read by both ‘middle and upper classes’. *Recreative Science* described itself as appealing to the ‘educated classes’ and Ellegard identifies it as ‘middlebrow’.\(^{25}\) Prices were similar—*Recreative Science* was 8d. monthly, the *Intellectual Observer* went up from 1s. monthly to 1s.6d. in 1865, the *Popular Science Review* was 2s.6d. quarterly.\(^{26}\)

2. *Recreative Science, the Intellectual Observer, and The Student and Intellectual Observer*

This series took the well-known model of a natural history magazine and broadened the contents. Natural history dominated, two-thirds (57–70\%) in the first series, although declining to half (44–50\%) and then to one-third (32–38\%) in the second series, but from the beginning the physical observational sciences of astronomy and meteorology were regularly represented, showing that the ‘intellectual observation’ of the subtitle was an accurate description. Photography, the experimental physical sciences, archaeology or antiquities, travel, and technical processes had a significant place (see Appendix, Table 1). The trend was to a broader coverage, less natural history, more physical science, more technical topics, and more travel and archaeology, even though the subtitle chosen in 1862, ‘A Review of Natural History, Microscopic Research, and Recreative Science’, emphasized the natural history tradition. The increasing technical content at the 1862 title change is significant as it was a clear departure from the anti-utilitarian attitudes found by Susan Sheets-Pyenson in natural history journals.

The editor of *Recreative Science* was almost certainly Shirley Hibberd. The lead article to Volume 2 was signed by Hibberd, numerous other articles were acknowledged as his, and the lead article to Volume 3 was signed ‘H’. Hibberd was a fellow of the Horticultural Society, editor of the *Gardener’s Magazine* from 1861 until his death in 1890, editor of *Floral World* from 1858 to 1875, and author of numerous books on gardening and aquaria. According to the *Dictionary of National Biography* he was a temperance advocate and a vegetarian.\(^{27}\)


\(^{26}\) The 1865 price rise was announced in ‘Notice to our Readers’, *Intellectual Observer*, 7 (February 1865), 1–3 (2). For other prices see Sheet-Pyenson, ‘Popular Science Periodicals’ (note 2), 567. Advertising can also be used to gauge audiences, but advertising pages usually remain only in unbound volumes of which relatively few can be found in libraries.

Henry Slack, a journalist and enthusiastic amateur microscopist, was editor of the *Intellectual Observer* and *The Student*, although Hibberd remained a major regular contributor and was probably author of the lead article in the first issue of the *Intellectual Observer*.\(^{28}\) Slack was a Unitarian whose religious and political views were characterized as ‘advanced liberalism’ in the *Dictionary of National Biography*, although there is no sign of this within the pages of the *Intellectual Observer* or *The Student*.\(^ {29}\) His signed articles were mostly purely descriptive accounts of microscopical fauna and flora and indicate little of his more general views. There were some changes in content and perspective with the change of editor and first title change but later, equally significant changes of perspective bear no relationship to known changes in personnel.

The majority (over two-thirds) of articles were signed. The unsigned articles included reviews and brief notices of books, summaries, and translations of foreign-language articles, reports of new inventions, the occasional lead article, and some of the regular columns. The named contributors varied widely in scientific status and geographical location. Any systematic study of contributors would be a massive task but it is conspicuous that none mentions Oxbridge affiliations. W. B. Tegetmeier, a medically trained writer on natural history topics, noteworthy for assisting Darwin in his enquiries, produced a monthly ‘Proceedings of Learned Societies’ section and contributed many articles.\(^ {30}\) Other regular contributors included Revd T. W. Webb, FRAS, a popular writer on astronomical topics who served a scattered parish in Herefordshire; S. P. Woodward of the British Museum’s Department of Geology and Mineralogy; George S. Brady, MRCS and secretary to the Tyneside Naturalists’ Field Club; John R. Jackson, curator of the Museum at Kew Gardens; and G. M. Whipple of the Kew Observatory who contributed the quarterly meteorological observations for many years. A woman, the Hon. Mrs Mary Ward, contributed three astronomical pieces to *Recreative Science* early in 1860 and continued to be a regular contributor to the *Intellectual Observer*.\(^{31}\)

Not only the subject-matter but the style of article indicates a shift to broader perspectives in the *Intellectual Observer*. The progress of science was surveyed through a regular section, ‘Proceedings of Learned Societies’, introduced at the title change in February 1862. This was a standard in later journals which aimed to be organs of science but in the *Intellectual Observer* they were far from complete. The

\(^{28}\) Henry James Slack (1818–96) is identified in the *Dictionary of National Biography*, xviii, as editor of both the later titles. From a business family, he had given up business for journalism in 1846. He had published a popular microscopical study of pond life in 1861, and later, in 1878, became president of the Royal Microscopical Society. ‘The Work of the Year’, the lead article in the new title in February 1862, was signed ‘H’ which I take to stand for Hibberd not Henry.

\(^{29}\) For example, Slack supported the higher education of women, was a member of the Jamaica Committee in 1865, and was President of the Sunday League (supporting popular lectures on Sunday evenings) in 1879. See DNB and Bernard Semmel, *Jamaican Blood and Victorian Conscience: The Governor Eyre Controversy* (London, 1962), 64.

\(^{30}\) William Bernhard Tegetmeier (1816–1912) was born in Germany, educated at University College, wrote widely on ornithology, and contributed to and later edited the *Field* newspaper. See *Men of the Time: A Dictionary of Contemporaries…*, edited by Thompson Cooper, 11th edn (London, 1884) and *Chambers Biographical Dictionary*, edited by J. O. Thorne (1897; new edn London, 1961). Unless he had an independent income he lived from writing and journalism.

majority listed were metropolitan scientific societies. Occasional provincial societies were included—for example, the Geological Society of Glasgow and the Bristol Naturalists’ Society; societies concerned with applications were neglected, for example, engineering groups were missing although the Horticultural Society (a sign of Hibberd’s continuing involvement) and some medical groups were included; geography, archaeology, and ethnology were included. In the mid-1860s topics of contemporary political interest began to be included, and advice was offered to government. Scientific investigation of cattle plague was advocated in 1865; in 1866 the unsatisfactorily high level of accidents in coal mines was discussed. 32 Such ‘politicocial’ topics came to be central to organs of opinion but they remained an intermittent and supplementary part of the Intellectual Observer.

In spite of the shifts towards new issues and new forms the dominant tone through all three titles was rational and educational as the titles, ‘recreative’ science and ‘student’, suggest. The introductory level was basic in both physical science and natural history topics. Characteristic titles were ‘A Visit to the Python in the Zoological Gardens’, ‘Reflection from Polished Surfaces’, ‘New Experiments with Soap Bubbles’, and a series on ‘Wayside Weeds and their Teachings’. 33 Instruction was provided in undemanding, amusing form. The Intellectual Observer’s 1868 self-description as being especially adapted ‘to the requirements of young men and women standing on the threshold of Intellectual Culture’ was a grandiose way of describing its educational emphasis, but its additional claim to offer ‘to the educated classes … a record of research and discovery’ is not borne out by its contents. 34 Only occasional efforts to introduce more advanced topics were made, for example, a series of four articles on ‘Recent Progress in Chemistry’ in Volume 1 of The Student; and by the mid-1860s the ‘Proceedings of Learned Societies’ section was often only a few pages long. ‘Organs of science’ were beginning to ‘review’ the progress of science, as will be seen with the Popular Science Review, but the Recreative Science series was far from achieving this.

The shift in contents towards both more astronomy and more travel and archaeology is consistent with the recreational orientation of the series. Astronomy was a subject in which amateurs could participate, it was also easy to find competent contributors and from 1862 on astronomy occupied from one-eighth to one-fifth of the pages. Ethnology made an appearance and a regular column on ‘Archaeologia’ appeared in the Intellectual Observer with the result that ethnology and archaeology together usually contributed more than 10% to the contents.

Amateurs were openly encouraged in the early volumes of Recreative Science. For example, a biography of Alexander von Humboldt presented him as a model of perseverence, showing how it is possible to rise in the world. The award of the gold medal of the Royal Astronomical Society to an amateur astronomer was noted as an ‘encouragement’. 35 This broad participatory notion of science declined but did not disappear in the second series. For example, in January 1866 the editor drew

32 ‘Cattle Plague and Scientific Investigation’, 8 (September 1865), 127–33, was unsigned; ‘Life and Death in our Mines’, 9 (February 1866), 1–16, was by Jabez Hogg.
33 Shirley Hibberd, Intellectual Observer, 2 (March 1862), 123–30; A. Davies, Recreative Science, 1 (January 1860); John Broughton, Intellectual Observer, 8 (December 1865), 358–67 respectively. Spencer Thomson’s regular pieces on wayside weeds appeared in Recreative Science between August 1859 and June 1860. He was identified as ‘M.D.’
34 ‘Notice to Our Readers’, Intellectual Observer, 12 (January 1868), 401–2. Similar claims were made three years previously in ‘Notice to Our Readers’ (note 26).
favourable attention to the achievement of an artisan contributor who described the cheap alternative to the position micrometer which he had devised.36

A curious mixture of attitudes is found in the pages of the series. In her thorough
study Sheets-Pyenson found that natural history journals usually ignored the
applications of science37 but in spite of the natural history emphasis of the Recreative
Science series, and Slack's own recreational interest in microscopy, there was a
continuing interest in 'manufacturing and the useful arts'. Also, in spite of a relatively
positive account of Darwinian theory some natural theology was accepted. Emphases
shift over time as will become clear in the following analysis.

Theological values were conspicuous. Recreative Science opened with an
affirmation of natural theology. Creation shows us a good and skilful creator:

We are of God's workmanship, created in his image, and gifted with powers to
perceive and appreciate the wonders of his skill in the creation which exists
around and above us. It is our privilege that we find delight in the investigation
of causes and the detection of analogies, as well as in observing the distinctive
features of objects in the great system of harmonies which we designate as
Nature.

Recreative Science would 'at every step recognize, in hope and faith and love, the
Source of things created, and point the mind of the student to the great Benefactor'.38
Volumes 2 and 3 also opened with theological affirmations (signed respectively by
'Shirley Hibberd' and by 'H') although Hibberd was careful to insist on the limits of
intellectual inquiry: 'we get only shadows of His wondrous attributes, and it is not
in the province of science to attain to His personality'.39 Nevertheless many articles,
especially on natural history topics, opened or closed with allusions to creation,
design, or Providence. Even such a 'despised' creature as the 'common house spider'
was shown to be one of 'God's glorious works'.40

This natural theology shifted with the Intellectual Observer to emphasize that the
Creator worked through law, a position which Adrian Desmond has found to be
characteristic of the Unitarians.41 Unlike each of the three volumes of Recreative
Science, the first issue of the new title in February 1862 did not open with theological
affirmations. In 1864 D. T. Ansted, geologist and mining engineer, introduced readers
to the view, which, he said, was 'gaining ground', that 'the great Creator' worked
through law, the 'perpetual adaptation to incessant change' being one consequence
of those laws.42 Comparing the Intellectual Observer with Recreative Science, a
smaller proportion of articles invoked creation and, although the goodness of
creation and the existence of a creator were not doubted, there was some hesitation

36 Charles Grover (a brush maker and amateur astronomer), 'A Substitute for a Position Micrometer',
8 (January 1866), 447–50. The paper had been sent in by the regular amateur contributor, the Revd T. W.
Webb.
37 'Popular Science Periodicals' (note 2), 555 and 'Low Scientific Culture' (note 2), 101.
38 'The Endeavour', Recreative Science, 1 (August 1859), 1–2 The Recreative Science series did not
consistently capitalize, for example, 'his' here in reference to God.
39 Shirley Hibberd, 'The Heavenly Symbol of Human Knowledge', Recreative Science, 2 (June 1860),
1–3 and 'H', 'The Thirst that is Never Satisfied', Recreative Science, 3 (April 1861), 1–3 (2).
(222).
41 A. Desmond, The Politics of Evolution: Morphology, Medicine, and Reform in Radical London
(Chicago, 1992), 200–22.
42 Professor D. T. Ansted, 'Missing Chapters of Geological Theory', Intellectual Observer, 6 (August
1864), 12–30. Ansted (1814–80) had previously been Professor of Geology of King's College, but he
continued to use the title; see Dictionary of National Biography, 1 and Boase (note 27), 1.
as to the proof of these principles from nature. For example, a review of Darwin's *Variation of Animals and Plants under Domestication* pointed out that the argument from design does not solve the problem of evil which is 'beyond our reach'.43 But, as John Brooke has emphasized, natural theology was flexible and in the same volume an unsigned review of the tenth edition of Lyell's *Principles of Geology* affirmed a variety of natural theology—the gradual evolution of life offers an even 'grander perspective' of the 'power, wisdom, design, and forethought' of the designer—while at the same time commending geology for its contribution to the emancipation of the human intellect from 'superstitious trammels'.44

Inductive views of scientific method were expressed by both Slack and Hibberd in the *Intellectual Observer* in 1862 but by the later 1860s the *Intellectual Observer* and its successor, *The Student*, were espousing a more sophisticated philosophy of science. Theories were essential for the progress of science. The Darwinian theory of evolution by natural selection was an 'admirable' aid to a 'philosophical method of enquiry' and was therefore 'entitled to provisional acceptance until a better appears'. The anonymous reviewer hesitated, however, to accept the 'astounding' theory of pangenesism.45 A discussion of technical education made the same point: science must be taught as theory, for without theories to coordinate facts, science would be nothing but 'heaps of [presumably useless] facts'.46 This theory-focused view of science has been persuasively interpreted by Richard Yeo as making mere observers subject to the 'theoretical guidance of a governing elite', and further, by Sheets-Pyenson, as turning participants in the enterprise into supporters of high science.47 But the correspondence between declining inductivism and declining recognition of amateurs did not move smoothly in the *Intellectual Observer*. 'It is of more importance to acquire a sound method of reasoning, than simply to accumulate a large store of particulars, which must remain in the condition of the dry bones of knowledge until a philosophic informing spirit gives them organic relation and life' readers had been told in 1865, but the amateur astronomer contributor was praised in 1866.48 Although the contributions of amateurs were being downgraded by this account of scientific method, and status boundaries between amateur and professional were emerging, the process was not fully conscious and explicit.

The most conspicuous shift in the series is the changing technical content and changing valuation of utility. From practically no technical topics in Volume 1 of *Recreative Science* coverage expanded to over 5% in volume 3 to over 10% across the first volumes of the *Intellectual Observer* (see Appendix, Table 1). The increasing technical content was associated with an open acceptance of utilitarian values. Hibberd's lead article in the first issue of the new title culminated in the Baconian quotation, 'The true end of science is to enrich human life with useful arts and inventions'.49 The following issue of the journal contained the first of many articles

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43 'Variation of Animals and Plants Under Domestication', *The Student*, 1 (1868), 179–88 (188).
45 'Variation' (note 43), 181. For the inductivism see Hibberd, 'The Progress of Zoology', 1 (May 1862), 245–64 (247), and Slack, 'Life Changes in the Globe', 1 (June 1862), 325–42 (325).
46 'Popular Delusions of Technical Education', *The Student*, 1 (June 1868), 337–42 (339).
48 A critical review of 'Professor Haughton's Geology', *Intellectual Observer*, 8 (1865), 199–205 (199) and, for the amateur contributor, see above at note 36.
49 'Work of the Year', *Intellectual Observer*, 1 (February 1862), 1–10 (10).
on technical topics by J. W. M‘Gauley.50 These were popular, for at the 1865 reorganization a regular ‘Progress of Invention’ feature was introduced, ‘due to Reader requests’.51 Articles on invention and technical subjects fluctuated, but averaged about 10% of the total content of the second title. M‘Gauley’s view, expressed in such articles as ‘Prime Movers’, ‘Chemical Manufactures as illustrated in the Great Exhibition of 1862’, and ‘Aluminium’, was that industry derived great benefit from ‘the quiet, unobtrusive’ labours of scientific men and that ‘experimental work is stimulated by the prospect of profit’.52 He stressed what industry owed to science and did not discuss the converse relationship, the stimulation of science by industry.

The 1868 title change was associated with changes in subject-matter and also with more subtle changes in valuations of science. The decision to include ‘literature and art’ with science was probably designed to attract a broader, popular readership but it also represented a less specific commercial motive. Subscribers liked to own complete sets and the editor therefore expected that new subscribers would begin with the new title.53 The ‘literature’ of the new title was represented by historical articles, most notably by a series of fifteen lengthy articles on ‘Womankind: In all Ages of Western Europe’, and the interest in antiquities was maintained. This left less space for all other topic areas, especially for those which were not running formal series. Astronomy, with contributions from the prolific Richard Proctor, added to the regular pieces from the Revd T. W. Webb, almost maintained its share at about 15% and meteorology expanded, with the addition of popular pieces such as ‘The Thunder Storms of Natal’ to the quarterly meteorological summaries that had been a regular feature since 1859. Technical topics declined, a shift probably linked to the death in 1867 of M‘Gauley, but changes in editorial pronouncements on utility suggest that the decline in technical content and the nod to ‘literature’ represented principle as well as pragmatism.

With The Student came a shift in editorial tone with respect to utility. Although the ‘Progress of Invention’ feature continued, utilitarian motives were condemned in Volume 1 in an unsigned article, ‘Popular Delusions of Technical Education’:

Learn science from a love of truth, and for the pleasure as well as the duty of exercising our faculties upon the phenomena around us. In thus obeying natural laws of mental development, mercantile profit will come in its due place.54

Two years later another unsigned article, on ‘The State of Science in England’, acknowledged an increasing recognition of the importance of the study of science but scorned the attitudes behind it:

50 The Revd James William M‘Gauley was a member of the Council of the Inventors’ Institute, a contributor to their Scientific Review, and one-time professor of natural philosophy to the board of national education in Ireland. See Dictionary of National Biography, xi and S. A. Alibone, A Critical Dictionary of English Literature and British and American Authors… 3 vols (London, 1859–71), ii. M‘Gauley was a regular contributor to the Intellectual Observer from 1862 until his death in 1867 although, according to the DNB, he went to Canada in 1856 and did not arrive in London until 1865.

51 ‘Notice to Our Readers’ (note 26), 2. This category was described as ‘discoveries in applied sciences and practical arts’.


53 ‘Notice to Our Readers’ (note 34). New Series were often started for this reason according to Brock, ‘Commercial Science Journals’ (note 2), 97.

54 The Student (note 46), 342.
Perhaps at no time has there been so general an opinion that our industrial 
prosperity depends upon a knowledge of natural laws, and thus we have arrived 
at a conviction that science may be made to pay. This frame of mind is very 
different from, and very much lower than, a love of science for the sake of truth, 
and as an aid to intellectual development.55

‘Love of truth’ was not only a formula which established a hierarchy between science 
and technology, it also maintained a relationship between science and theology. Thus, 
a review of the fourth edition of The Origin of Species maintained that religious 
questions must be subordinated to ‘love of truth’.56

Although the decline in natural theology corresponds to the Unitarian Slack 
taking over editorship in 1862, the shifting valuation of utility and the declining 
interest in amateur science does not match any known change in editorial personnel. 
However, through changes in editorial personnel and perspectives, the Recreative 
Science series remained a recreational and educational magazine. The survey of the 
‘Proceedings of Learned Societies’ which began in 1862 and the commentary on 
policy issues which began in the mid-1860s showed an awareness that something else 
was possible but, although broadening its content, the Intellectual Observer remained 
close to popular natural history journalism in tone.

3. The Popular Science Review

Founded just two years after Recreative Science, at the time of the title change to 
the Intellectual Observer, the Popular Science Review was similar in many ways. As 
its subtitle, ‘a quarterly miscellany of entertaining and instructive articles on scientific 
subjects’, announced, it intended to be both ‘entertaining’ and ‘instructive’. 
‘Recreative’ and ‘Student’ indicate the same kind of content in the Recreative Science 
series. The subtitle suggests origins in natural history publishing but this was only 
the starting point and the Popular Science Review went much further than the Recreative 
Science series in developing a broader content. Although, like Recreative Science, it 
emphasized the observational sciences of natural history and astronomy (but not 
meteorology), it was initially to a much greater extent an ‘organ of opinion’ and a 
source of news.

Much more than the Recreative Science series, the Popular Science Review 
attempted to keep readers informed on subjects in which they were not involved. This 
was done through a regular feature, the ‘Scientific Summary’ or ‘Quarterly 
Retrospect’, which surveyed the progress of various branches of science, through 
book reviews, and, initially, through a smorgasbord of news and commentary in a 
‘Miscellanea’ column. The subject-matter in the quarterly retrospects was broad: the 
headings used were astronomy, botany, chemistry (both pure and applied), geology 
and palaeontology, mechanical science, microscopy, mineralogy and metallurgy, 
photography, physics, and zoology. A medicine section was added in 1863 and other 
sections were introduced later under Henry Lawson’s editorship. While many articles 
were written for readers who wanted to learn some science (for example, ‘The 
Microscope, with Directions for its Use’57) or were undemandingly recreational

55 The Student, 5 (June 1870), 521–7 (521).
56 ‘Origin of Species by Means of Natural Selection’, Intellectual Observer, 10 (January 1867), 477–8 
(478).
57 By C. Collingwood, Popular Science Review, 1 (1862), 461–73.
('The Natural History of a Beech Twig' and 'The Physical Geography of an Ionian Island'), a serious attempt was made in the quarterly surveys to keep readers informed about the breadth of scientific activity. The activities of scientific societies were covered under the quarterly surveys but, in addition, there was a regular feature entitled 'Science in the Provinces'. This unashamed provincialism contrasts with the metropolitan focus of many journals. Both the provincial and technical interests show the orientation of James Samuelson, the first editor. He was a Liverpool man with manufacturing interests and, like Slack of the *Intellectual Observer*, an advanced liberal.

Under Samuelson the *Popular Science Review* shared both the natural theology and the openness to utilitarian motives of *Recreative Science* and of the early issues of the *Intellectual Observer*. Utilitarian purposes were accepted but religious purposes were even higher. Samuelson opened the journal with a parable of a dying farmer who told his son that treasure was buried on the farm, and then died without revealing the location. The son dug the whole farm in his search but, to conceal his purpose, prepared the soil for sowing at the same time, with the result that he had a prolific crop, became wealthy, and reformed his lazy habits. The moral of the tale was that 'another father' often appeals to 'love of gain' to develop 'the noblest powers' of his children. The scientist was compared to a mountaineer who, if he perseveres to the peak, sees all the provinces and departments below 'grouped in harmony' and catches a glimpse 'however faint, of the Creator-Sovereign' above. This was an interesting variation on natural theology for the glimpse was only 'faint' and it was promised only to those who climb above the clouds. However, the articles often affirmed that the Creator is apparent to anyone who opens his or her eyes and looks.

The dependence of technology on science was a constant theme of the journal under Samuelson's editorship. An article 'On the Relation of Science to Electroplate Manufactures' was an argument for the dependence of technology on science. Electroplating, for example, depended on the discovery of nickel, of the galvanic battery, and of magneto-electricity, but because these are forgotten we are 'unconsciously led to undervalue the importance of abstract scientific investigations'. The curious feature of this article is that it acknowledged all the evidence against the thesis that technology is applied science: 'many processes of manufacture have not been the consequences of abstract scientific discovery' but have been improved by long experience; enamelling and metal-smelting were carried out long before the processes involved were understood; many things promising in theory have failed in practice. The author only partly answered these problems yet he asserted 'there is no manufacture... which does not continually involve scientific knowledge'.

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59 'Science in the Provinces' or, sometimes, 'Provincial Institutions and Societies' was usually a subsection of 'Miscellanea'. Sheets-Pyenson emphasizes the metropolitan context of journalism in 'Popular Science Periodicals' (note 2), 552.
60 James Samuelson (1829–?) was the youngest brother of Sir Bernhard Samuelson of the Devonshire Royal Commission. He founded the Liverpool Science and Art classes and was active in liberal political causes. See Men and Women of the Time: A Dictionary of Contemporaries, edited by Victor G. Plarr, 14th edn revised (London, 1895) and, for his many publications, British Museum, Catalogue of Printed Books. Dates of publications suggest that he was still flourishing after 1910.
62 For a more direct expression of natural theology from Samuelson see 'The Lowest Forms of Life', *Popular Science Review*, 1 (1862), 150–9 (155) and his article on the house spider in *Recreative Science* (note 40). Samuelson probably did intend to include 'her' as will be discussed below.
Science was knowledge of laws, and differed from ‘empiricism...in which we are ignorant of conditions or laws operating’.

The early volumes, while not despising utilitarian motives, nevertheless praised intellectual values. Exercise of intellect makes humans godlike: ‘Man begins to ascend towards heaven, the moment he seriously exerts his mental gifts’. On this subject the views of contributors matched those expressed by the audience. A poem, printed and sold for the Northampton Science Festival, expressed, in mundane style, the highest of non-utilitarian motives;

Do ye ask for our aim?—Towards the Temple of truth [sic]
With steady resolve and high purpose we tend—
Here pilgrims are we! Nor with vanishing Youth
Nor with fugitive years, must our pilgrimage end.

The combination of poetry and high ambition exemplified the desire by artisans to participate on a high cultural level on equal terms, as discussed by Anne Secord.

The provincial news exhibits the breadth of provincial scientific activity and indicates a hoped-for audience. Numerous societies were mentioned: the Wigan Mechanics’ Institute, the Liverpool Chemists’ Association, the Southampton Microscopical Society, the Midlands Scientific Association, and the Liverpool Naturalists’ Field Club which had 500 members although less than one year old. The Popular Science Review lists refer not only to the field clubs and other natural history groups whose popularity David Allen has emphasized, but also to a range of societies interested in the physical sciences.

A major concern of the first editor was science education. The topic was not treated independently in articles but often appeared under ‘Miscellanea’. Here the editor commented on science examinations, and upon the need for improved teaching of science and for training of teachers. He gave advice on how to set up science schools and classes, recommending, for example, that lecturers keep to topics relevant to the life of hearers rather than more entertaining but speculative themes. Samuelson was an advocate of women’s education. He noted that girls had won prizes in some of the Department of Science and Art exams, hoped that women would take the teachers’ exams, and recommended that the Department of Science and Art write ‘she’ as well as ‘he’ in its regulations for teachers. He considered that one of the ‘chief causes’ of the popularity of the Liverpool and Manchester naturalists’ field clubs had been their admission of lady members and praised the Liverpool practice of awarding a prize on each excursion to the lady who collected and arranged the largest number of species. Political commentary was mostly found in passing in the

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64 Gore (note 63), 329–30. Gore (1826–1908) was a chemist in a Birmingham phosphorus factory and was publishing on electrometallurgy in the 1860s. He was widely respected as an electrochemist. See Dictionary of National Biography (1901–1911).
67 Secord (note 21), 297.
68 For the latter see ‘Miscellanea’, Popular Science Review, 1 (1862), 123–8 (123).
71 ‘Science Schools and Classes’ (note 70) and ‘Rewards and Honours for Proficiency in Science’, Popular Science Review, 1 (1862), 126–7.
72 ‘Miscellanea’ (note 68), 123.
‘Miscellanea’ column and under both Samelson and Lawson there were no explicit editorial-type articles.

At the end of 1863 Samelson left the Popular Science Review and joined William Crookes in starting the Quarterly Journal of Science. There were significant changes in the Popular Science Review in 1864 with the change in editorship from Samelson to Henry Lawson. Lawson was a lecturer in histology at St Mary’s Hospital who, as editor of the Monthly Microscopical Journal (1869–77), coeditor of The Practitioner (1868), and editor of Scientific Opinion (1868–70) became increasingly involved in journalistic projects. Structure and content changed under his editorship. Most conspicuously the structure was simplified. The review section and the ‘Scientific Summary’ were retained but the ‘Miscellanea’ section with its politico-social commentary and its provincial section disappeared. Although provincial societies and persons were still recognized the ardent provincialism was dissipated. Natural theology declined and discussion about utilitarian motives practically disappeared. It might seem that not much was left—only a straight scientific journal.

What was left was, first, a journal with a broad coverage of science. The broader content of the Popular Science Review when compared with the Recreative Science series was largely due to the strength of the ‘Scientific Summary’ section, which occupied about a quarter of the space. The signed articles were mostly on natural history and astronomy, as in the Intellectual Observer, although initially practical topics featured regularly. Natural history however, which formed well below half of the contents under Samelson, edged up to near half under Lawson (see Appendix, Table 2). Under Samelson technical topics took one-fifth (21–22%) of the space and although this declined under Lawson the average of about 15% on technical and applied topics was greater than the coverage achieved by the Intellectual Observer. Through 1865 the standard format included a lead article on a technical topic of general interest or relevance to daily life—for example, train signalling, the Atlantic telegraph, or British coal reserves. The Agriculture section (introduced by Lawson in 1864) showed great interest in manures and the Chemistry section reported regularly on new dyes. Even when the technical lead articles disappeared (they declined from 1866) the technical interest continued in the Scientific Summaries. Developments in smelting, improved methods for sealing joints in gas and water pipes, and experiments on corrosion were noted, for example. The societies and journals surveyed in the Scientific Summary included the Builder and the Mining and Smelting Magazine; the closure of the Glasgow School of Mines was noted, showing that engineers were regarded as part of the scientific community. Inventors were noteworthy: a practical mechanic of Birmingham had invented an atmospheric hammer; Mr Hamilton of Liverpool had invented an ingenious self-regulating thermometer.

The medical coverage is noteworthy for, although public health was covered in many popular science journals, medicine, which had its own journals, was usually excluded. Medical and public health topics were prominent in the early years of Lawson’s editorship (over 10% in 1865–6), but this cannot be attributed solely to Lawson’s professional interests for Samelson had introduced ‘Medicine, Surgery

74 Popular Science Review, 4 (1865) for most of these examples; the atmospheric hammer, 118 and the self-regulating thermometer, 232–3.
75 Brock, ‘Medicine’ (note 2), 84–5.
and Therapeutics’ to the Scientific Summary in 1863, had reviewed books under the subject heading of ‘Physiology and the Laws of Health’, and had included articles on medical topics, for example on the newly invented ophthalmoscope.

By the late 1860s the technical topics were declining and astronomy was receiving a much larger share (nearly one-fifth) of space, a shift probably not unrelated to the regular quarterly contributions of the ever-active Richard Proctor. In spite of this trend toward more amateur interests the physics and chemistry representation remained significant (at over 10%) and the popular topics of antiquities and geographical exploration were not introduced. Under neither Samuelson nor Lawson did the ‘Scientific Summary’ section of the Popular Science Review include ethnology or antiquities—in contrast with the Intellectual Observer. The review section did cover books on anthropology and ethnology and Lawson made occasional caustic remarks on both the Anthropological Society of London and its public controversies with the Ethnological Society. For example, a review of the Anthropological Society’s Memoirs found ‘not a single contribution of value’ which showed that ‘there is not much to say in praise of the Anthropological Movement’ and concluded by hoping that ‘this volume may command a very limited circulation’.76

All this was discussed with almost no reference to the possible inferiority of utilitarian motives. I have found only one weak criticism. In discussing a nutritious ‘extract of meat’ one author characterized the aim of science as ‘to know’ rather than any interest in profit from knowledge. Science was described as ‘unselfish’.77 This was mild when compared with The Student. Throughout the Popular Science Review the useful arts and applied science were simply assumed to be part of the scientific enterprise.

Provincials and amateurs were also included in the enterprise. The societies covered in the ‘Scientific Summary’ ranged from Melbourne to Berlin, from the Academies of Paris and Vienna to the Royal Agricultural Society of Newcastle and the Natural History Society of Armagh. It is difficult to know how many contributors were amateurs, but those without identifying degrees, affiliations to learned societies, or professional positions are those most likely to have been so. Some contributors were provincial men: Francis T. Bond, Principal of the Hartley Institution of Southampton; N. Whitley, Honorary Secretary of the Royal Institution of Cornwall; and Henry E. Fripp, President of the Bristol Naturalists’ Society. Fripp was later identified as lecturer in physiology at the Bristol Medical School, suggesting that his status in the amateur society had been considered in no way inferior to his professional position.78 Two women, Miss Margaret Plues and Mrs Lankester, were among the contributors to the early volumes, demonstrating Samuelson’s practical commitment to women’s participation in the scientific enterprise.79 Many contributors

76 ‘Memoirs of the Anthropological Society’, 4 (1865), 489–91. All reviews were unsigned but I am assuming that those on the life sciences were written by Lawson himself.
78 Bird, Popular Science Review, 4 (1865), 202; Whitley, 8 (1869), 30; Fripp, 5 (1866), 314 and 442. Fripp illustrates the difficulty of identifying contributors. One entry in the Library of Congress National Union Catalogue gives his dates as 1816–80, but I have been unable to find his name in any biographical source. Many contributors who were given no institutional affiliation are impossible to identify.
79 Margaret Plues wrote on natural history topics and on the rosary (see Allibone [note 50], ii and J. F. Kirk, A Supplement to Allibone’s Critical Dictionary of English Literature and British and American Authors, 2 vols [Philadelphia, 1891], ii), Phoe Lankester (c. 1824–1900), the wife of Edwin Lankester who was also a contributor, was ‘a capable botanist’ according to Mary P. English, Victorian Values: The Life and Times of Dr. Edwin Lankester M.D., F.R.S. (Bristol, 1990), 37. She had seven children, the youngest being about two when she first contributed to the Popular Science Review. See also Joe Lester, E. Ray Lankester and the Making of Modern British Biology, edited by Peter Bowler (Faringdon, 1995), 7–9.
had medical school positions, reflecting Lawson's social network. A few were clergymen and there was an occasional engineer. None was identified as having Oxford or Cambridge appointments. The major contributors may be particularly difficult to identify. For example, William Crookes, who contributed one article to the first volume, was also the unacknowledged writer of the Chemistry section of the 'Scientific Summary' and probably also of the Photography and Physics sections.80

Under Lawson natural theology was muted, but not rejected. The Popular Science Review was scathing in its reviews of some works of a theological tendency. For example Philip Gosse was accused of 'reanimating controversy' in an 'offensive' protest against what Gosse had called modern error.81 The Popular Science Review went on to affirm its 'reverence for the Great First Cause'82 but Lawson seems to have maintained a strict boundary between science and theology. In a review of a work of liberal theological tendency he refused to take sides on the theological questions on the grounds that '[t]he pages of a scientific journal are not the place to touch upon questions relating to faith'.83 Perhaps this was partly a pragmatic decision, for Lawson did not enforce this on his authors and Robert Hunt and Richard Proctor, who were frequent contributors, often expressed their theological views strongly.84

In subject-matter covered the Popular Journal of Science changed little from Samuelson to Lawson. Both had a broad coverage of science, including the useful arts of agriculture, medicine, mining, and mechanical science or engineering; and both combined substantial reviews of the progress of science with articles of a recreational style. The major difference was that, under Samuelson, the Popular Science Review had a much stronger and more explicit editorial line. The relationship between science and manufacture, the economic and spiritual benefits of science, the participation of women and amateurs were discussed explicitly by Samuelson whereas there was comparatively little overt discussion of these issues under Lawson. Natural theology was muted, although not given up, and utility was taken for granted. Editorial comment, which had been part of Samuelson's 'Miscellanea' column, was given a more formal place in Samuelson's next journalistic venture.

4. The Quarterly Journal of Science

When Samuelson left the Popular Science Review at the end of 1863 he had invited one of his enthusiastic contributors, the chemist William Crookes, to join him in an ambitious new venture, the Quarterly Journal of Science.85 As David Knight emphasizes, the Quarterly Journal of Science was modelled on the élite reviews.86 The 'quarterly' of its title was undoubtedly an allusion to the Quarterly Review. But the time had come, Samuelson and Crookes believed, for science to have an organ of her

80 Samuelson asked Crookes to be responsible for 'Chemical Science' (which became both 'Pure Chemistry' and 'Applied Chemistry') and Crookes replied in November 1861 offering to add photography and physical science. See D'Albe's Life of Crookes (note 24), 69.
81 'A Year at the Shore', Popular Science Review, 4 (1865), 357–9 (357).
82 'A Year at the Shore' (note 81), 358.
84 If anything, natural theology was more marked in the late 1860s than in the early 1860s because it was characteristic of these few, but very regular contributors. For a sample from Hunt see above at note 65.
85 In 1871, when the relationship soured, Crookes reminded Samuelson that the suggestion came from the latter (D'Albe [note 24], p. 187). Crookes first offered to assist Samuelson in 1861 after reading the prospectus for the Popular Science Review (D'Albe, p. 65).
own, rather than to share space with literature, the arts, and politics. Their new
journal joined the aims which Crookes had already enunciated, but not achieved, in
Chemical News with the format which Samuelson had developed for the Popular
Science Review.

The new journal was to be less popular and more of a review than the Popular
Science Review and directed more clearly and effectively to a general audience than
Chemical News. The Quarterly Journal of Science, its title page announced:

will constitute a Review of the Progress of Science in all parts of the world, and
is intended to serve as a medium of communication between Students in various
branches of Natural and Physical Science, as well as between Scientific
Observers and the Reading Public.

Crookes and Samuelson’s introduction to Volume 1 emphasized communication with
the public:

We have been told by men in every walk of life, that the time is come when
Science may claim for herself a special organ; that not alone scientific readers,
but those of every class, desire to approach the source from which this species
of knowledge is derived,—to learn in which direction the current flows, and how
it is likely to affect their material interests or questions bearing on their eternal
happiness.87

The editors went on to discuss at length the practical benefits of science, identified
spontaneous generation and ‘all questions regarding man’s origin, or his relations to
the lower animals, and concerning the connection or differences between the various
races of mankind’ as leading questions of the day which would be discussed. The
intention of supporting science teachers at all levels, and every labourer, no matter
how humble, in the fields of science was affirmed.88 The implications of science for
material interests and eternal happiness were continuing dual themes of the Quarterly
Journal of Science.

The structure and format of the new journal built on the forms developed by
Samuelson in the Popular Science Review. By the end of 1863 the regular format of
the Popular Science Review was a series of original articles taking about half the total
pages, followed by shorter sections of book reviews and news items, with a final 30-
to 40-page section, about a quarter the total length, being a ‘Scientific Summary’ in
which the progress of science was reviewed under specialist headings. In the Quarterly
Journal of Science the review function became more important. The ‘Chronicles of
Science’ section, which included summaries of the proceedings of scientific societies,
became, at about 40% of the total, the longest section of the journal; the original
articles occupied slightly less than 40% of the whole; reviews of books and pamphlets,
as in the Popular Science Review, were under 15% of the whole; and the
total was made up with a short section of notes and correspondence and reports of
the annual British Association meetings.89 The subject categories of the ‘Scientific

89 More precise figures are: Popular Science Review (1863) articles 52%, ‘Miscellanea’ (news items and
commentary) 11%, reviews 12%, ‘Scientific Summary’ 24%; Quarterly Journal of Science (1865) articles
37%, ‘Chronicles of Science’ 41%, reviews 13%, British Association reports 6%, ‘Notes and
Correspondence’ 4%. The format varied, for example, in 1866 and 1867 the book reviews were grouped
with original articles in the Quarterly Journal of Science (making it look more like a traditional review
journal), before reverting to a separate section in 1868.
Summary' and 'Chronicles of Science' sections were similar. In both journals these surveys, like the book reviews, were anonymous, maintaining the tone of impartial authority characteristic of the leading reviews. But in significant ways the scientific reviews departed from the tradition of high journalism: the majority of articles were signed and it is noteworthy that, as indicated by space taken, the review function of the scientific reviews was carried out less through book reviews than through the quarterly scientific summaries. These summarized important papers from both English and foreign-language periodicals, even translating some articles. The proceedings of societies were reported, and news and commentary were included, for example, on the course of the cattle plague and the discovery of new ore bodies and minerals in 1866. Crookes and Samuelson did not aim, as did some journalistic failures, to include every fact and discovery, but limited themselves to discoveries 'of general interest to those outside the circle of specialised practitioners' and offered assessments of importance, for example, '[a]ll discoveries in electricity which have been made for many years have been surpassed in practical importance by... the new magneto-electric machine'.

This broader review function may have owed something to less élite traditions than the great quarterlies. When in 1862 both the Intellectual Observer and the Popular Science Review introduced their 'Proceedings of Learned Societies' and 'Scientific Summary' sections they may have been learning from an earlier form of popular science journalism. The long-running Year-Book of Facts in Science and Art: exhibiting the most important discoveries and improvements of the past year... had, since the 1830s, been publishing annual surveys under the headings of mechanical and useful arts, natural philosophy, electrical science, chemical science, natural history, geology, and astronomical and meteorological phenomena. These surveys included summaries of articles in foreign journals and reports of papers read to foreign and local scientific societies. Technical advances, such as new industrial processes, new ships, and new scientific instruments, were described, and events of interest, for example, accidents, volcanic eruptions, and the sealing of Trafalgar Square, noted. The variety was enormous and the coverage not trivial for although most items were less than an octavo page in length some were two to three pages long. The Intellectual Observer limited its surveys to reports of meetings, but Samuelson's surveys approached the breadth of the Year-Book.

The book reviews of the Quarterly Journal of Science clearly followed the traditions of the élite reviews. Reviews of major publications or thematic groupings of lesser publications were an opportunity for extended discussion of the major issues of the day. David Knight identifies the major similarities between the new scientific quarterly and the quarterly review tradition as anonymity, spaciousness, and sympathetic exposition, with the purpose of getting across understanding rather than

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90 The Quarterly Journal of Science, like the Popular Science Review, listed astronomy, botany, chemistry, geology and palaeontology, physics, and zoology. It introduced agriculture, but so did the Popular Science Review, in 1864. The differences show no systematic pattern. The QJS extended 'mineralogy and metallurgy' to explicitly cover mining; but did not introduce 'engineering', corresponding to the 'mechanical science' of the PSR, until 1867. The QJS initially followed the PSR in having microscopy and photography sections, but although these disappeared within two years the equally popular topics of entomology and geography, not represented in the PSR, were added. A medicine section was not introduced in the QJS although public health had a column in 1867–8.

91 'Chemistry', 1 (1864), 115–19 (115) and 'Physics', 3 (1866), 432–8 (438). One failure, The Scientific Record: A Weekly Journal of Scientific Progress, was 'devoted exclusively to the publication of facts' (p. 4). It appeared twice in April 1864.

92 This list comes from the 1860 volume.
Anonymity marked both the book reviews and quarterly surveys. There were occasional exceptions, such as A. R. Wallace’s ‘Creation by Law’, a long (17-page) reply to the Duke of Argyll’s *Reign of Law*, with an opportune response to the recent substantial critique of Darwin’s evolution by natural selection in the *North British Review*. Long reviews were often included in the article rather than the review section of the *Quarterly Journal of Science*. The 19-page, anonymous ‘Darwin and Pangenesis’, reviewing *Plants and Animals under Domestication*, was the lead article in July 1868. Although Darwinian debate took much space many other issues were covered in extensive reviews. A review of the proceedings of six different field clubs was an opportunity to discuss the activities and roles of these groups. ‘Synthetical Chemistry’, a review of four books on organic chemistry, provided an opportunity to discuss the possibility of creating life in the laboratory, and ‘Sewage and Sewerage’, reviewing eleven reports, pamphlets and books, discussed and assessed the various methods proposed for sewage removal. The review as a vehicle for discussion, which characterized the tradition of quarterly reviewing, was used to good effect in the *Quarterly Journal of Science*.

The *Quarterly Journal of Science* developed the editorial mode of politico-social commentary, pursuing this more systematically than did the *Popular Science Review* under either Samuelson or Lawson. It took up the promise in the introduction to promote scientific education and the wealth of ‘instructors of all ranks’. South Kensington was condemned for cutting payments to science teachers while increasing payments to the South Kensington officials. The *Quarterly Journal of Science* suggested that a teachers’ association be formed and was gratified when this occurred. Concern was expressed about the price of textbooks. A review of W. B. Carpenter’s *Principles of Physiology* was an opportunity for comment on both government funding of science and the public benefit of science. Carpenter had given up the professional pursuit of physiology to become Registrar of the University of London in 1856. It ‘does not redound to the credit of England’ that there were no rewards to physiologists, pronounced the *Quarterly Journal of Science*, and yet the principles of this science ‘are truly one of the keys to human happiness’. Issues of public health and public safety were taken up in signed articles, in unsigned editorial pieces, and in the quarterly surveys. Colliery owners should be responsible for the orphans and widows of those killed in accidents. Railway trains would be safer if there were means of internal communication and movement. The public was dissatisfied with the provisions of the Alkali Act.

The balance of subject areas in articles, in book reviews, and in the quarterly ‘Chronicles of Science’ exhibits the success of Crookes and Samuelson in achieving

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93 Knight (note 86).
94 ‘Creation by Law’, 4 (October 1867), 471–87. Fleeming Jenkin’s anonymous ‘The Origin of Species’, which appeared in June 1867, was a major challenge to Darwin and Wallace’s response was rapid. See Adrian Desmond and James Moore, *Darwin* (London, 1991), 547.
95 ‘Our Field Clubs: Their Aims, Objects, and Work’, 4 (1867), 508–13. Given the interest in field clubs shown by the *Popular Science Review* under his editorship, Samuelson is the likely author of this review.
99 ‘Mining, Mineralogy and Metallurgy’, 1 (1864), 137–54 (141); Captain Tyler (identified as: Royal Engineers, Railway Department, Board of Trade), ‘On Circulation and Communication in Railway Trains’, 2 (1865), 571–91; ‘Air-Pollution by Chemical Works’, 6 (1869), 330–41.
a broad review function. Natural history was down to one-third of the contents over the first three years of publication, lower than in both the Intellectual Observer and the Popular Science Review (see Appendix, Table 3), and while exotic interest gave popular appeal to some articles, for example, ‘The Mammals of Madagascar’, many articles were of broader practical or theoretical significance, for example, ‘The Late Earthquake, and Earthquakes generally’ and ‘The Conservation of Force applied to Physiology’. Astronomy was contained at under 10% and the other physical sciences, which had less amateur appeal but more relevance to industry, occupied (at 13%) more space than astronomy. Topics of practical significance—agriculture, mining, engineering, public health, medicine—took more than one-fifth of the space, maintaining the emphases which Samuelson had established in the Popular Science Review. The weighting of topics is suggested by the book reviews in the first issue: the longest review (nine pages) was of Henry Bates’s books on the natural history of the Amazon region, but the second longest (six pages) was of William Fairbairn’s Mills and Millwork. Under my category of ‘travel, archaeology, ethnology’ the Quarterly Journal of Science had relatively little travel and antiquities but regular, substantial discussion about human origins and human interrelationships, issues at the centre of ethnology and the new science of anthropology. Overall, the spread of subject-matter was similar to that of the Popular Science Review under Samuelson but it was maintained more successfully. Astronomy and natural history were kept in check, with natural history even decreasing to less than a quarter of the contents in the volumes of 1869 and 1870. But the most significant shift from the Popular Science Review was the development of politico-social commentary.

Materials interests were respected, as shown by the space given to technical topics, the acceptance of utilitarian motives, and the inclusion of practical men in the scientific enterprise. The major part of the 23-page introductory manifesto was an account of the practical benefits of science—including the importance for agriculture of understanding drainage and fertilizers, the significance of geology in finding coal and oil, the contributions of physical science in making machinery more efficient. Seeking to increase ‘social comforts and enjoyments’ was a legitimate motive for the pursuit of science.100 The growing recognition, evidenced by the Liverpool Town Council re-establishing its scientific lectures, that science has monetary value to a manufacturing country was commended.101 No distinction between theory and its application was developed. Engineers and anyone using science were part of the scientific community. For example, the death of Nicholas Wood, colliery owner, ‘who ha[d] ever been the promoter of scientific applications to the necessities of colliery operations’, was reported. Mechanical inventions were contributions to the enterprise: Mr R. Angus, Locomotive Superintendent of the North Staffordshire Railway, had designed machines for refitting the cylinders of locomotives without taking them out of the engine.102

Although they were never scornful of material interests Samuelson and Crookes occasionally made it clear that they considered the spiritual benefits of science to be higher. The most important benefit of science, they said, was not its contributions to comfort and material prosperity, nor its ‘elevation of the intellect’, but the ‘purer and

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100 ‘Synthetical Chemistry’ (note 96), 40. Crookes was probably the author.
101 ‘Annual Retrospect for 1865’, 3 (1866), 133–47 (141). The local Liverpool knowledge suggests that Samuelson was the author.
102 ‘Annual Retrospect for 1865’, (note 101), 139 and ‘Engineering, Civil and Mechanical’, 4 (1867), 104–9 (105).
more elevated conception of the Creator' it imparted.\textsuperscript{103} Occasionally the search for Truth was advocated, although without the emotive strength of the frequent references to Providence and the Creator. With a subtle twist, Crookes advocated 'discovery of Truth' as a better goal to those who valued scientific knowledge by 'money worth' or 'sensational value'.\textsuperscript{104} As the context was a review of physics books, including two by John Tyndall, renowned for his spectacular lecture experiments, Crookes was undoubtedly criticizing this ardent advocate of higher values.

The conviction that Providence was behind it all was combined in the \textit{Quarterly Journal of Science} with advocacy of scientific modes of reasoning and openness to the potential future discoveries of science. In the opening manifesto they assured readers, especially 'ministers of religion', whom they hoped would support the journal, that there was no need for anxiety or apprehension about scientific developments. Sound science will drive out superstition but 'it will never lower man's religious nature'. If future discoveries extend human history greatly backwards in time, the \textit{Quarterly Journal of Science} perceived no threat to spiritual truth. Perhaps in the future man would learn how to 'fabricate organized matter', but if he thus became 'a creator himself' Crookes assured readers that this would be 'under the divine government'.\textsuperscript{105} The discovery of ether was interpreted as providential and Samuelson providentialized Spencer's optimistic interpretation of the struggle for survival: 'What we in our ignorance are apt to regard as an evil [his example was the shortage of meat brought about by the cattle plague] is often designed by Providence as the incentive to exertion and progress'.\textsuperscript{106} The modes of reasoning characteristic of science could be extended to other areas of life: 'habits of observation enable them [scientific men] to reason with more accuracy than other men'.\textsuperscript{107} In the style of the advocates of scientific naturalism, science was associated with freedom of thought and moral rectitude. Darwin was an example of the courage required 'for the exertion of unfettered thought'. The Declaration of the Students of the Natural Sciences was condemned because it would have introduced 'coercion' and interfered with the 'freedom of thought'.\textsuperscript{108} Nevertheless contributors were warned that freedom of thought should not surpass the bounds of good taste and, two years later, members of the Anthropological Society of London were reproved for the 'relish' they exhibited in describing the 'filthy customs' and 'foul practices' of various African and Pacific peoples.\textsuperscript{109}

\textsuperscript{103} 'Introduction' (note 87), 23.
\textsuperscript{104} 'The Modern Aspects of Physical Science', 5 (1865), 329–37 (331). The review was unsigned but as Crookes covered the physical sciences I assume him to be the author.
\textsuperscript{105} 'Introduction' (note 87), 22; 'The Origin and Antiquity of Man', a review of four books, 3 (1860), 54–60 (60); 'Synthetical Chemistry' (note 96), 40.
\textsuperscript{107} 'Science, Politics, and Religion', 2 (1865), 187–98 (189).
\textsuperscript{108} In two lead articles, 'Darwin and His Teachings' 3 (1866), 151–77 (151) and 'Science, Politics, and Religion' (note 107), 187–8. The Declaration, which men of science were asked to sign, asserted that science and scripture, properly understood, were not in conflict. See W. H. Brock and R. M. MacLeod, 'The Scientists' Declaration: Reflections on Science and Belief in the Wake of Essays and Reviews, 1864–65', \textit{British Journal for the History of Science}, 9 (1976), 39–66.
\textsuperscript{109} 'Introduction' (note 87), 22 and 'Anthropology' 3 (1866), 43–7 (46).
In their association of science with freedom of thought, their insistence on the broad applicability of scientific methods of reasoning, and in the high moral tone which they associated with science Samuelson and his collaborators had much in common with the advocates of scientific naturalism. But in their providentialism they finally split with the naturalism advocated by Huxley and his associates. Crookes became an advocate of spiritualism in the 1870s, and the Quarterly Journal of Science became his platform, but in the 1860s the journal’s interpretations were in the broad tradition of English natural theology. The interpretations of Darwin belong to what Peter Bowler has called the ‘non-Darwinian’ revolution. Lamarck has been underestimated by disciples of Darwin; Darwin endows natural selection ‘with Omnipotence and Omniscience’ and nature with ‘the capacity for designing and planning’.

The Quarterly Journal of Science concluded that Darwin was ‘right about the effect, but only partially right as to the causes’. He should use ‘intelligent Deity’ instead of ‘Nature’. His facts were really ‘one long argument’ in favour of ‘a constant, ever-watchful, ever-designing, and ever-active Providence’. These themes were repeated. Darwin, like Galileo, was a bold pioneer of truth and, like Galileo, he must be followed by Newton to explain why the earth moves or nature selects. All natural laws imply a law-giver; the laws discovered by human mind are ‘the material manifestations of the energies of one Almighty mind’. There was a consistency of editorial viewpoint in the Quarterly Journal of Science, suggesting that Samuelson had a more cohesive group of contributors than either Hibberd, Slack or Lawson had been able to gather. Crookes, who had been associated with Samuelson from the beginning of the Popular Science Review, wrote occasional signed articles, and probably contributed both the chemical science and physical science surveys, and book reviews in these fields.

In 1869 the editorial leadership changed. Three men were added, and Crookes was demoted to join them in some ill-defined associate role while Samuelson alone had the title of editor. The three new associates, William Fairbairn, Robert Hunt, and Henry Woodward, had all been named as contributors at the first appearance of the journal in 1862 but as only Fairbairn contributed a signed article it can be assumed that Hunt and Woodward were contributing to either the book reviews or the quarterly surveys. Fairbairn, an eminent engineer, was knighted in 1869, drawing no doubt welcome attention to Samuelson’s journal. He contributed articles on ships, submarine telegraphy, and metallurgy and was possibly writing the ‘Mechanical Science’ section for the Quarterly Retrospect. Robert Hunt, Keeper of the Mining Records, contributed articles on mining and mineral resources, was also a regular contributor to the Popular Science Review under both Samuelson and Lawson, and is the likely author of the quarterly review of ‘Mining’. He shared Samuelson’s natural theology.

Henry Woodward, FGS, assistant keeper in the Department of

110 'Darwin and His Teachings', 3 (1866) 151–77 (157, 153).
111 'Darwin and His Teachings' (note 110), 166 and 176.
113 See note 80.
114 The title page read ‘conducted by William Fairbairn, William Crookes, Robert Hunt, Henry Woodward and James Samuelson (ed)’. Crookes complained to Samuelson that the resolution that Samuelson have sole control was ‘a deliberate insult offered to myself’ by ‘you and your friends’. See D’Albe (note 24), p. 187. For biographical information see: Dictionary of National Biography, vi, for Fairbairn (1789–1879); DNB, x, for Hunt (1807–87); Allibone (note 30) for Woodward (1832–1921) and Men and Women of the Time (note 60) for Woodward and Samuelson.
115 See examples at notes 65 and 112.
Geology at the British Museum, contributed few signed articles and must therefore have been writing quarterly surveys, most likely the 'Geology' column, and book reviews. Samuelson, who had studied zoology at Konigsberg, was probably the 'Zoology' columnist, the author of the editorials on educational topics, and the reviewer of Darwin. He contributed signed articles on a wide variety of topics, from spontaneous generation, to the nature of light, to a social commentary on beer drinking.

An important contribution of editors was their ability to persuade friends to write articles, so well-connected assistant editors were therefore an advantage. Crookes, when protesting his demotion in 1869, stressed not only his own contributions but the number of contributors whom he had attracted.\(^{116}\) Samuelson's brothers, Martin and Bernhard, contributed. Edward Hull of the Geological Survey contributed an article each year from 1864 to 1868. The majority of named contributors were professional men of science. Engineers were well represented but there were relatively few medical men (unlike the *Popular Science Review*), or clergymen (unlike the *Intellectual Observer*). One of the few medical contributors was Dr Edwin Lankester who contributed articles and a regular public health column after the failure of his *Journal of Social Science* in 1866, although the advertisements for medical texts, prescription forms, and *Photographs of Eminent Medical Men* in the *Quarterly Journal of Science* indicate that medical readers were expected.\(^{117}\) Oxbridge was represented in 1866 and 1867 by Charles Daubeney, Professor of Chemistry and Botany at Oxford. Men from Scotland, Ireland, India, France, South Africa, and Australia contributed. Provincialism and amateurism declined. The old 'Science in the Provinces' section became the medium for the 'all parts of the world' promised in Volume 1 and the provinces competed with Asia, Brazil, and other regions for coverage. Amateur achievement was still acknowledged. For example, the achievements of Herman Goldschmidt, a German amateur astronomer noted for improving the accuracy and completeness of star charts and for the discovery of thirteen asteroids— with only a modest five-foot achromatic telescope, were reported in 1867 for 'the encouragement of amateurs'.\(^{118}\) Samuelson's interest in field clubs was still expressed occasionally but with the dilution of amateurism and recreational natural history, women disappeared from the contributor lists.\(^{119}\)

In both the 'Chronicles of Science' and the articles and book reviews Samuelson and Crookes succeeded in giving an overview of the progress of science with commentary on its broader implications. They avoided topics of interest only to specialists. Also, in contrast with the *Popular Science Review* there was no overt educational and recreational function. Exotic topics and tinted and coloured plates were little used to attract readers. They succeeded in their aim of writing about science for 'the Reading Public' and in providing working scientists and manufacturers with surveys of sciences outside their specialties. In the *Quarterly Journal of Science* science was interpreted broadly and the scientific community included engineers, manufacturers, and science teachers at all levels, but amateur contributors and recreational pursuits were edged to the periphery. Science was presented as important to the larger public not as rational, moral or healthy recreation but for its practical and philosophical or spiritual implications. Samuelson and Crookes discussed the issues


\(^{117}\) English (note 79), p. 142 on Lankester; January and April 1867 for advertisements.

\(^{118}\) 'Astronomy', 4 (1867), 85–92 (85).

\(^{119}\) 'Our Field Clubs' (note 95), 508–12.
which they had identified in their introductory manifesto—the consequences of science for material interests and eternal happiness—with the assurance that science was useful and that Providence sustained the laws of nature and their discovery by the human mind.

5. Scientific Opinion

*Scientific Opinion* was a remarkable journal, matched only by the *Quarterly Journal of Science* and *Nature* in the breadth and quality of its comment on the politico-social aspects of science. The quality of its comment has led Roy MacLeod to the judgement that it 'could only have come from the leading London reformers'.

Henry Lawson, who in 1869 was advocating spontaneous generation against the authority of such leading reformers as Huxley and Tyndall, did not advertise his editorship. In starting a weekly journal when he already had a quarterly, Henry Lawson was following a similar path to William Crookes who started the *Quarterly Journal of Science* when he already had the weekly, *Chemical News*. There was no gradual development of the *Popular Science Review* towards *Scientific Opinion*. Rather, *Scientific Opinion* took up some of the forms which had characterized the early *Popular Science Review* under Samuelson. Commentary on the social affairs of science returned and the structural form became much more varied: a lead article, articles reprinted from other journals, reviews, proceedings of scientific societies, correspondence, and a miscellaneous section of news and commentary called 'Notes, Queries and Memoranda'. Notices of forthcoming meetings of scientific societies and answers to correspondents completed each issue. Much of this was extracted or summarized from other publications and put together in a scissors and paste procedure under pressure of a weekly deadline. Comparatively few of the 'authors' had written specifically for *Scientific Opinion*.

*Scientific Opinion* was justly proud, as it opened its third volume in 1870, that it had discussed all those topics of the day 'which relate to Science in its politico-social aspects'. Editorials were wide ranging, covering differences of opinion within the Sunday Lecture Society, asking for a Royal Commission on government aid to science, assessing the University of London's science examination papers, and advocating a standardized procedure for amateur meteorological observations. The state of various scientific bodies was assessed: a clique had excessive power in the British Association and 'puerile' discussions were being permitted in the Biology Section; the Royal Botanic Society did not deserve the title Royal as it was only interested in making money at plant shows; the Society of Arts had 'been asleep for many years'. Many editorials were concerned with public health and industrial safety issues, for example, the new Mines Inspection Bill. Accidents were not due to

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120 'Macmillan and the Young Guard' (note 4), 435.

121 Lawson's role in the spontaneous generation debate is analysed by James Strick in his dissertation (note 6) and I am grateful to him for pre-publication copies of his work. Lawson's editorship in not well known; for example, he is not identified by Sheets-Pyenson. My source is a note in the *English Mechanics* when it took over *Scientific Opinion* in 1870 (see note 73).

122 The multitude of small items make content analysis, of the type undertaken for the previous titles, difficult.

123 'Our Past and Our Future' (note 15).

124 'Scientific Sunday Evenings', 1 (30 December 1868), 153; 'Government Aid for Physical Science', 2 (18 August 1869), 221; 'Science at the University of London', 2 (4 August 1869), 181; 'Amateur Meteorologists', 2 (28 July 1869), 161; 'The President Elect of the British Association', 2 (25 August 1869), 241; 'The Management of the British Association', 2 (1 September 1869), 269; 'The Scientific Labours of the Royal Botanical Society', 2 (9 June 1869), 21; 'The Society of Arts', 2 (15 September 1869), 325.
the ignorance or carelessness of miners but were caused by faulty construction and by poor drainage and ventilation. If the men smoked then safe smoking areas should be provided.125

The provincial interest of the *Popular Science Review* was maintained, even strengthened. The journals extracted ranged from the élite French journal, *Comptes Rendus* to the Proceedings of the Aeronautical Society and the Quarterly Magazine of the High Wycombe Natural History Society. Although one lead article was critical of the achievements of the majority of provincial societies it considered they had the potential to be ‘a powerful machinery’ for the advance of knowledge and made recommendations as to how they might be organized more effectively in order to produce original work.126 Thus, in *Scientific Opinion*’s view, amateurs could be part of the scientific enterprise. T. P. Barkas, one of the few named regular contributors to *Scientific Opinion*, was a provincial amateur, described by *Scientific Opinion* as ‘one of our most accomplished provincial savans’.127 Barkas was a successful bookseller of Newcastle, a Unitarian, a temperance advocate (like Hibberd), and an enthusiast for scientific culture. Over his life he gave five thousand gratuitous lectures. He set up competitions through popular science journals offering prizes to juveniles for natural history collections.128 He was himself a fellow of the Geological Society and had a large fossil collection.

There was little discussion of the motives for pursuing science and the value of science in *Scientific Opinion*, but events sometimes provoked editorial comment. An attenuated natural theology was expressed in response to the Dean of Carlisle’s criticisms of science: ‘patient, earnest, ever-working men of science... toil on in the pursuit of truth, and [are] thus certainly the better fitted to “look from Nature up to Nature’s God”’.129 A lead article on ‘Commercial Practical Chemists’ accused many analysts of fraud, for example in testing for food adulteration, and expressed doubts about the effect of commercial motives: ‘When any branch of science is capable of application to commercial purposes *chalatenerie* immediately steps in’.130 But this remained a passing comment on human nature and was not developed into any affirmation of the higher value of love of truth or condemnation of utilitarian motives.

In July 1870 *Scientific Opinion* was taken over by the *English Mechanic*. On internal evidence it seems that Lawson conducted *Scientific Opinion* almost alone and as a review of science it could not compete with the support, through both contributions and subscriptions, given to the well-connected *Nature*. As a journal of opinion it had been outspoken, which must have lost it some friends.

127 This description of the anonymous Newcastle author of ‘The latest news from the Stars’, can refer only to Barkas ([4 November 1868], 7–8). Thomas Pallister Barkas (1819–91) was he son of a builder and was himself a builder for 10 years. He wrote *Outlines of Ten Years Investigations into the Phenomenon of Modern Spiritualism* (1862) and *A Manual of Coal Measure Palaeontology* (1873). In 1870 he opened an Art Gallery and newsroom in Newcastle. (See Boase [note 27], IV.) The only other regular named contributor was F. B. Falkner about whom I have found nothing.
128 One such competition was advertised in *Hardwicke’s Science Gossip*, 3 (1867), 106. Another, advertised through the *Circuit Magazine*, was referred to in *Scientific Opinion*, 1 (11 November 1868), 27–8.
130 ‘Commercial Practical Chemists’, 2 (21 July 1869), 141.
6. Conclusions and hypotheses

Science periodicals were taking new forms in response to the cultural and economic circumstances of the 1860s. With science becoming more entangled in daily life, in policy debate, in industrial enterprise, and in religious controversy, and with technical and political changes making journalism of all kinds cheaper, popular science periodicals flourished. The review functions of the élite quarterlies, the overviews of scientific progress characteristic of older popular science journalism, the recreational and educational style of popular natural history journals, and the editorial commentary of newspapers were all drawn on in developing new forms of science journalism.

Professional identity emerges here as a complex issue in locating editors and in defining the scientific community. The editors identified represent a variety of professional and geographical locations. Only William Crookes can be described as a ‘leader of Science in London’ and as a representative of professional science. He was a chemist without independent means, living by consultancy. He had become FRS in 1863 and was achieving recognition in the centres of London science until, from 1870, he became an advocate of spiritualism. Henry Lawson, although professionally identified with medicine, achieved some scientific reputation, but he was outside the circle of ‘leaders of Science in London’ because he was in direct confrontation with Huxley and Tyndall in the spontaneous generation debates of the late 1860s and early 1870s. By no adjustment of our definitions can James Samuelson, manufacturer from Liverpool, and Shirley Hibberd, summed up by the Dictionary of National Biography as ‘journalist and writer on horticultural topics’, be described as representing élite London science or professional science. The amateur–professional distinction has been fruitful in describing shifts in the Victorian scientific community and Bernard Lightman has distinguished the interpretations of professional men of science and professional journalists in analysing differences in popular science journalism, but we need to know more about where the Victorians drew boundaries. Did medical men (Lawson) and scientifically educated manufacturers (Samuelson) count as men of science? Both Samuelson and Lawson included engineers and inventors in their scientific communities and Samuelson also included science teachers. From the evidence of popular periodicals it seems that the intellectual and social boundaries between science and engineering, science and religion, researchers and teachers, and amateurs and professionals were drawn in varied ways in the 1860s and that consensus was still being negotiated.

In their acceptance of theological motivations for science and theological interpretations of nature all four identified editors stand apart, in varying degrees, from Huxley, Tyndall and the movement for scientific naturalism. The survival of natural theology in many of these journals shows how flexible it could be. Darwin did not destroy natural theology, not only because many adapted Darwin, but because natural theology was sufficiently protean to take new forms. Attempts to identify trends over time in natural theology and to relate variations of emphasis to professional status founder on problems of anonymity, of uncertain authorship for major editorial contributions, and of the obscurity of many named contributors. However, the most outspokenly persistent natural theology seems to come from Samuelson, the manufacturer, in association with Crookes and Robert Hunt, both professional scientists; and the mildest version from Lawson, the medical man.

There are many indicators in these journals of the existence of an amateur provincial public. The significance of regional differences in English life has been
emphasized by social and political historians and some differences, for example between London, Oxbridge and provincial universities, have been emphasized by historians of science.\textsuperscript{131} The \textit{Popular Science Review} under Samuelson and \textit{Scientific Opinion} point to a flourishing provincial science broader than the red-brick universities and the needs of local industry. Philip Lowe has discussed the provincial amateur public in the context of the British Association, showing that in the 1870s and 1880s local societies were strong enough to form regional associations which rivalled the British Association.\textsuperscript{132} Although encouragement of amateurs diminished through the 1860s it did not disappear and only in \textit{The Student} was there an ideology which excluded amateur contributions. I suggest that amateurism was as much edged out by the space taken by new issues as it was pushed out by deliberate and conscious advocacy of professional identities and ideologies. On this interpretation the shift from the \textit{Popular Science Review} under Samuelson to the \textit{Quarterly Journal of Science} is not due to Samuelson rejecting the amateurism which was so conspicuous in 1862–83 but to his and Crookes’ plan to emphasize the review and editorial functions of the new journal.

There are clear trends from \textit{Recreative Science} to the \textit{Popular Science Review} to the \textit{Quarterly Journal of Science} to \textit{Scientific Opinion}. As recreational and educational articles declined, more space was given to discussions of technical developments which impinged on daily life, to overviews of the ‘progress’ of science, and to editorial commentary on policy issues. In the words of \textit{Scientific Opinion}, science was entering ‘more and more into the commonest operations of daily life’.\textsuperscript{133} With the successful laying of the Atlantic cable in 1866, every journal carried an article on submarine telegraphy. Railway construction and accidents, attacks of cattle plague and typhus, and reports of the coal supply being exhausted were also topics where scientific and technical information became part of general knowledge. Engineers and physicists explained the principles of telegraphy; medical men and chemists debated contagion and cure; geologists assessed the extent of coal resources.

Specialization, professionalization and the growth of publication in all areas of science made reviews of scientific progress increasingly useful. The \textit{Intellectual Observer}, in a small way, and the \textit{Popular Science Review}, more thoroughly, introduced such reviews in 1862. In 1864 the \textit{Quarterly Journal of Science} closely followed the format of the \textit{Popular Science Review}. Manufacturers, engineers, and scientists in other specialties thereby gained broad summaries enabling them to identify developments which might be useful in their own work.

Editorial commentary was the third new form to appear. \textit{Recreative Science} and the \textit{Intellectual Observer} had much to say about the theological associations of science but comments on issues of public policy were rare. In the \textit{Popular Science Review} Samuelson had introduced editorial commentary under the section of miscellaneous news, but in the \textit{Quarterly Journal of Science} Samuelson and Crookes took up the editorial mode of newspapers and began regular and more systematic commentary on policy issues related to science and manufacturing. Issues of education and public


\textsuperscript{132} The peak for formation of local natural history and field clubs was in the 1870s. By 1888 there were 55 corresponding societies of the British Association with 19,000 members (and by 1900 500 societies with approximately 100,000 members). See Philip Lowe, ‘The British Association and the Provincial Public’, in \textit{The Parliament of Science}, edited by Roy MacLeod and Peter Collins (London, 1981), 118–44 (132–3).

\textsuperscript{133} ‘Our Address’, 1 (11 November 1868), 1.
health and safety predominated in their commentary. The frequency of Scientific Opinion offered the opportunity for more immediate intervention in public debate. Lawson encouraged readers to contribute their opinions, through letters, especially on the ‘important question’ of science teaching in schools.\(^\text{134}\) His own editorials ranged widely across education, public health and safety, and the internal politics and organization of the scientific community.

Huxley, Tyndall, and Lockyer were not acknowledged contributors to any of the journals discussed here. Nevertheless their voices were heard. W. B. Carpenter who was close to Huxley and the X Club circle contributed to the early issues of the Quarterly Journal of Science but, much more significantly, their lectures were reported and their books reviewed at length.\(^\text{135}\) In October 1863 the Popular Science Review took ten pages to review Huxley’s Man’s Place in Nature when most reviews were between one and three pages in length. The Quarterly Journal of Science devoted twenty pages to a lead article reviewing Darwin’s Variation of Animals and Plants under Domestication, a length matched only by one other, recreational-style article in the 1868 volume.\(^\text{136}\) Those who gave many lectures were frequently reported. The Quarterly Journal of Science, for example, reported J. D. Hooker’s presidential address to the British Association and Tyndall’s presidential lecture on ‘Scientific Materialism’ to Section A in 1868 and Scientific Opinion, which filled its columns by summarizing others, reported Huxley’s lecture ‘On a Lump of Coal’.\(^\text{137}\) The reviewers frequently made their disagreements clear. The Student was sceptical about pangenesis. According to the Quarterly Journal of Science, Darwin should say ‘intelligent Deity’ rather than ‘Nature’. The Popular Science Review acknowledged that Darwin had ‘initiated a revolution in thought’ but doubted whether ‘all his conclusions will be accepted’.\(^\text{138}\) Issues associated with Darwin’s theories were at the centre of debate as Crookes and Samuelson had made clear in opening the Quarterly Journal of Science,\(^\text{139}\) and Darwin’s associates could therefore not be ignored.

All the editors discussed had to negotiate a balance between the practical and the intellectual aspects of science, between material and spiritual values. Attitudes to utility varied within these journals. To Lawson, a medical man, the distinction between theory and its application was of no concern. Samuelson, a devout manufacturer, ranked religious motives for the pursuit of science higher than utilitarian purposes although he did not denigrate utility. Samuelson and Lawson had broad views of the scientific community, including engineers and inventors and those who were concerned with the ‘useful’ arts. Hibberd, although not decrying utility in the early years of Recreatic Science, had a more polite and recreational image of science. The rejection of utility and the ‘love of truth’ advocated by Slack in The Student and Intellectual Observer represented a growing emphasis among some sections of the scientific community. T. W. Heyck has explained the rejection of utility by professional scientists as arising from their desire to be perceived by

\(^{134}\) Ibid.

\(^{135}\) Carpenter’s close friendship with Huxley is clear in Adrian Desmond, Huxley: The Devil’s Disciple (London, 1994).

\(^{136}\) ‘Darwin and Pangenesis’ (note 112) was the same length as G. Zaddach’s ‘Amber: Its Origin and History, as Illustrated by the Geology of Samland’, 5 (1868), 167–86.


\(^{138}\) On pangenesis see note 43; for the advice to Darwin see note 111; M. C. Cooke, ‘Darwin on Fertilisation in Plants’, 4 (1865), 424–36 (424).

\(^{139}\) See note 88.
Oxbridge as contributing to a liberal education. I would link it also to their desire to defend themselves from the accusations of sordid materialist values and mechanistic attitudes from Thomas Carlyle, Matthew Arnold, and other cultural critics. Gieryn’s argument is that the distinction between science and its applications justified the claims of scientists for public support. I suggest that ‘love of truth’ served both to distance science from engineering and money making and to unify a scientific community divided by scientific specialty, by religion and, increasingly, by irreligion. Natural theology could no longer unify the scientific community, but ‘love of truth’ was a unifying slogan from which no research scientist could dissent. My hypothesis is that ‘love of truth’ increased as natural theology declined, but, as is clear here, natural theology was slow to decline and both theological and utilitarian values were acceptable to many of those on the margins of the scientific community.

Appendix: content analysis of journals

The percentages given here are the percentage of pages covering that subject area in a complete volume. The range indicates the variability in content across two or three volumes for each title under the editor and in the period indicated. If the percentages are calculated per issue they fluctuate much more. Pages rather than numbers of articles are counted because not only do articles vary greatly in length, but news items and reports of meetings of societies cannot be compared with standard articles except by counting pages.

The percentages in all tables should be treated as approximate because (1) they are based on a sample of volumes and (2) many items are difficult to classify unambiguously. The percentages do not add to 100% because some articles, for example, biographies, theological affirmations and philosophical reflections, and discussions of education policy, do not fall within the categories used. The difficulties can be illustrated by articles on photography, which was a regular topic in most titles. Photography articles could be about chemical processes, applications in astronomy, applications in printing, or photography as an art form, and often covered more than one of these areas. I have classified photography articles as astronomy, chemistry (other physical science), or technical only when this aspect was dominant so most photography articles are not represented in the tabulated percentages.

Natural history is a broad category, including not only the traditional collecting and observing sciences but the new biological sciences. Most discussions of Darwin are classified here, although some which are predominantly philosophical and theological are omitted. Astronomy was an unambiguous category except for a few items on photography. The ‘technical, useful’ category includes engineering, metallurgy, and agriculture and those chemistry articles which were predominantly applied rather than theoretical in character. Public health and water supply topics have been classified with ‘health and medicine’ rather than ‘useful’. Also in this section are classed discussions of human physiology, new medical tools, and food and drugs. ‘Other physical’ includes branches of physics, chemistry, and some meteorology (usually classified here rather than as natural history). There was almost no mathematics in any of these journals. Finally travel, archaeology, ethnology

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140 The Transformation of Intellectual Life in Victorian England (London, 1982), 114ff. Richard Yeo (note 47, 273–81) has argued that in discussions of scientific method the unity of science was often used in arguing that science trained the mind and hence contributed to a liberal education.
includes geography, antiquities, and discussions of relationships between human groups. Some discussions of evolution border on anthropology and natural history. Accounts of the geology or fauna and flora of some exotic region of the world have generally been classified as natural history, although in some instances they could also have been classified as travel. All this emphasizes that large arguments cannot be based on small percentage differences.

Table 1. Content analysis of the *Recreative Science* series.

<table>
<thead>
<tr>
<th>Contents by subject area</th>
<th>Recreative Science 1860–1 (%)</th>
<th>Intellectual Observer 1862–3 (%)</th>
<th>Intellectual Observer 1865–6 (%)</th>
<th>The Student and Intellectual Observer 1868–9 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural history</td>
<td>57–70</td>
<td>44–50</td>
<td>32–38</td>
<td>25–39</td>
</tr>
<tr>
<td>Astronomy</td>
<td>4–11</td>
<td>12–19</td>
<td>19–20</td>
<td>13–18</td>
</tr>
<tr>
<td>Meteorology</td>
<td>2–3</td>
<td>2–4</td>
<td>3–10</td>
<td>4–9</td>
</tr>
<tr>
<td>Technical, the useful arts</td>
<td>2–7</td>
<td>10–12</td>
<td>6–14</td>
<td>6–8</td>
</tr>
<tr>
<td>Other physical science</td>
<td>5–13</td>
<td>4–7</td>
<td>6–8</td>
<td>3–10</td>
</tr>
<tr>
<td>Travel, archaeology, ethnology</td>
<td>0–6</td>
<td>3–13</td>
<td>8–19</td>
<td>5–7</td>
</tr>
</tbody>
</table>

*Note:* There were almost no medical or public health articles in the *Recreative Science* series.

Table 2. Content analysis of the *Popular Science Review*.

<table>
<thead>
<tr>
<th>Contents by subject area</th>
<th>Samuelson 1862–3 (%)</th>
<th>Lawson 1865–6 (%)</th>
<th>Lawson 1869–70 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural history</td>
<td>42–44</td>
<td>45–50</td>
<td>44–52</td>
</tr>
<tr>
<td>Astronomy</td>
<td>6–10</td>
<td>5–8</td>
<td>16–19</td>
</tr>
<tr>
<td>Technical, the useful arts</td>
<td>21–22</td>
<td>12–17</td>
<td>7–11</td>
</tr>
<tr>
<td>Health and medicine</td>
<td>6</td>
<td>8–20</td>
<td>5–7</td>
</tr>
<tr>
<td>Other physical science</td>
<td>6–7</td>
<td>7–13</td>
<td>10–16</td>
</tr>
<tr>
<td>Travel, ethnology</td>
<td>4–6</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

*Note:* The *Popular Science Review* did not include archaeology and the entire last category almost disappeared under Lawson's editorship.

Table 3. Content analysis of the *Quarterly Journal of Science*.

<table>
<thead>
<tr>
<th>Contents by subject area</th>
<th>Samuelson and Crookes 1864–6 (%)</th>
<th>Samuelson 1869–70 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural history</td>
<td>30–33</td>
<td>22–24</td>
</tr>
<tr>
<td>Astronomy</td>
<td>8–9</td>
<td>10–12</td>
</tr>
<tr>
<td>Technical, the useful arts</td>
<td>18–24</td>
<td>18–28</td>
</tr>
<tr>
<td>Health and medicine</td>
<td>2–10</td>
<td>0–7</td>
</tr>
<tr>
<td>Other physical science</td>
<td>13</td>
<td>18–22</td>
</tr>
<tr>
<td>Travel, archaeology, ethnology</td>
<td>7–14</td>
<td>7–9</td>
</tr>
</tbody>
</table>
Acknowledgement

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