Popular Science Periodicals in Paris and London:
the Emergence of a Low Scientific Culture, 1820–1875

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Summary

Efforts to diffuse useful knowledge on the part of dedicated social reformers, enterprising publishers, and vigorous voluntary associations created new forms of popular literature in the urban centres of Paris and London during the middle decades of the nineteenth century. Popular science periodicals, especially, embodied the aims of the advocates of cheap literature, by providing 'improving' information at prices low enough to reach readers who might otherwise purchase potentially dangerous political tracts. Besides promoting social stability, popular science periodicals served to answer the needs of diverse increasingly literate, leisured, and well paid social groups.

From their inception, through their evolution over half a century, periodicals in London and Paris mirrored these similar commitments and concerns of their creators. Continuous imitation back and forth across the Channel indicated just how closely English and French editors shared common programmes. Yet despite the similar aspirations of their promoters, popular science periodicals in England and France revealed the outlines of two very different low scientific cultures, shaped by the dissimilar characteristics of their audiences, editors, and high scientific communities.

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Whilst scientific quarterlies satisfy to some extent the cravings of the learned and wealthy, such works as the Naturalists' Circular, the Naturalists' Notebook, the World of Science, Science Gossip, the English Mechanic, and etc., published weekly and monthly, bring before the mass of less cultured minds the great truths of science and facts of natural history...

(Naturalists' Circular, January 1868, p. 66.)

1. Introduction

Dedicated social reformers, enterprising publishers, and vigorous voluntary associations encouraged the creation of new forms of popular literature in the urban centres of Paris and London during the middle decades of the nineteenth century. As a result of technological advances in the printing trade, less restrictive legislation and
taxation, along with increased demand from a more literate and leisured public, myriad varieties of reading materials began to appear. These new literary products were distributed to a continuously enlarging readership, through new transportation facilities like railroads and by means of popular educational institutions, such as public libraries. Scientific topics were discussed under a range of formats: in encyclopaedias and dictionaries, serial 'libraries' or 'miscellanies', books and textbooks, juvenile literature, published lectures and courses for the public, articles in general magazines and reviews, and in periodicals dedicated exclusively to popularizing science.

This final category—popular science periodicals—especially embodied the aims of the advocates of inexpensive literature, by providing 'improving' information at prices low enough to reach readers who might otherwise purchase potentially dangerous political tracts. One of them, the *Penny Mechanic*, affirmed that the study of the physical and natural sciences 'by withdrawing the mind from pursuits and amusements that excite the imagination' would tend 'to the improvement of our intellectual and moral habits...and to substitute placid trains of feeling for those which are too apt to be awakened by the contending interests of men in society, or the imperfect government of our own passions'. Knowledge of science for the lower classes, like wealth for the rich, 'gives them a direct interest in the peace and good order of the community, and renders them solicitous to avoid whatever may disturb it'.

Besides promoting social stability, popular science periodicals served to answer the needs of diverse, increasingly literate, leisured, and well paid social groups. At a time when middle-class families found new pastimes in pianos and parlour games (such as 'Virtue Rewarded and Vice Punished'), the *Intellectual Observer* noted 'the striking fact of the great increase in the number of purchasers of microscopes and telescopes, which are becoming necessary portions of the furniture of every well-ordered home'. Better than the simple entertainment afforded by the music-hall, football, or a seaside holiday was the fusing of amusement with instruction, as in a visit to the Great Exhibition or a gallery of science. Reading, a purely intellectual pursuit, was praised for producing 'habits of reflexion' particularly 'favourable to orderly conduct'. Perusing a popular science periodical, generally accessible by its relatively low price and wide distribution, provided the perfect 'rational' recreation.

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1 On these changes see my dissertation, 'Low Scientific Culture in London and Paris, 1820–1875' (University of Pennsylvania, 1976), pp. 25–34. (Xerox University Microfilms no. 77 10, 216.)


3 *Penny Mechanic*, 1 (1836), 305.

4 'Thoughts on Popular Education'. By a member of the Church of England', *Edinburgh Review*, 85 (1825), 245.

5 *Intellectual Observer*, 1 (1862), 471.

6 *Edinburgh Review*, 85 (1825), 244.
Some popular science periodicals discussed general science, undifferentiated by discipline, such as the *Magazine of Science* and the *Ami des sciences*. The *Magazine of Popular Science* and *Science pour tous*, for example, sought to bring science to the 'general reader' and to render it 'à la portée de tous'. Other periodicals, including mechanics' magazines, certain natural history periodicals, and journals devoted to 'useful knowledge' dealt with special kinds of science only, yet they also addressed broadly constituted social groups: the self-improving artisan, the amateur naturalist, and the agricultural labourer.

Popular science periodicals began to appear in the 1820s when mechanized printing processes were just starting to increase the output of the publishing industry. Their production peaked in the 1860s, following the contours of general periodical publication. Though popular science periodicals still proliferated at the end of the nineteenth century, the earlier typologies, the basis of this study, had largely faded away, to be replaced by new ones. During the middle decades of the century, English popular science periodicals fell into three categories: general science, natural history, and mechanics' magazines. In France, popular science appeared in 'useful knowledge' journals, general science weeklies, and general science annuals. Periodicals devoted exclusively to 'useful knowledge' were created in France alone, while popular natural history and mechanics' magazines were founded only in England during this period.

These categories of popular science periodicals were determined according to content, although many periodicals in a particular class followed nearly identical formats. Periodical typologies correspond as well to narrow ranges in journal price and circulation. The remarkably close correlation between format, subject matter, price, and circulation implies that each type of popular science periodical was read by a specific social group. Many editors constantly tailored their periodicals, by adjusting style or content, in order to fit the expectations of a distinct audience.

The term 'low science' may be introduced here as a more comprehensive notion than 'popular science'. Traditionally, 'popular science' has been understood to mean a simplified reflection of 'high' or 'academic' science. But often 'low science' related to 'high science' in a way that was not so directly dependent. 'Popular science' is more properly seen as a subset of 'low science'; specifically, it is that kind of 'low science' that attempts to make 'high' scientific discourse intelligible to the non-scientist. 'Low science' periodicals, more generally, sometimes sought to establish their own canons of scientific investigation, criticism, and explanation. In their descriptions of the scientific significance of a mechanical invention or a natural history observation, for example, these magazines elaborated the ideal of an experiential, inductivist 'low science' that could be understood and created by anyone. On occasion, 'low science' periodicals vigorously opposed the 'high' scientific establishment.

Certainly the wishes of readers influenced the 'low science' ideologies articulated in these periodicals. Much of the content of English periodicals derived from articles, letters, as well as notes and queries forwarded by unknown or anonymous readers. Despite claims of impartiality, however, editors screened these contributions and may have, in fact, authored many of them in order to fill up the pages of their periodicals. In any event, by the process of editing they actively tried to shape the attitudes of

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Footnotes:


8 See Appendix below for a complete list of popular science periodicals.
subscribers. The ideologies of science that appeared in popular science periodicals, then, mirrored above all editors’ concerns, aspirations, and prejudices. Examination of their backgrounds and career patterns reveals why they often were not mere popularizers of high scientific activity, but rather the architects of an alternative ‘low scientific culture’.

In short, periodicals in London and Paris, from their inception, reflected the similar commitments and concerns of their creators. Continuous imitation back and forth across the Channel during half a century indicated just how closely English and French editors shared common programmes. Yet despite the closely allied aspirations of their promoters, popular science periodicals in England and France revealed the outlines of two very different low scientific cultures. These were shaped by the dissimilar characteristics of their audiences, editors, and high scientific communities.

Nevertheless, the ‘low scientific culture’, like Robert Darnton’s ‘low literary culture’ or George Rudé’s ‘low political culture’, may be understood best as a peculiar product of the metropolitan environment. Provincial men found it necessary to migrate to London and Paris in order to engage in the enterprise of popularization. In England, as in France, book and periodical wholesaling and distribution came to be centralized in the metropolis by the nineteenth century. As late as 1871, the provincial editor of the Scottish Naturalist remarked: ‘The great tendency of the age is centralization. All information must be sent to, and emanate from, the metropolis’.

2. London periodicals

Almost all the general science, natural history, and mechanics’ magazines published from London were issued in compact and portable octavo format. They were illustrated, either by woodcuts, line engravings, or colour plates, ostensibly in order to increase the intelligibility of their presentation of scientific material. As one reviewer noted, the popular author ‘must teach by illustrations that are a species of representation of what actually occurs, and impress the mind with livelier ideas than the mere abstractions of reason can convey’. Referring to the explanatory power of diagrams, one periodical insisted that ‘one square inch of wood is worth a page of letter press’.

Also to aid their readers’ comprehension, periodicals often tried to eliminate technical language. The London Journal of Arts and Sciences, for example, contended that technical terminology ‘precludes both perspicuity and common sense’. The Penny Mechanic associated the use of ‘hard names’ with a ‘pedantic display of learning’. The English Mechanic, too, felt that pretenders to scientific expertise might hide behind technical terms and symbols: ‘any absurdity, provided it be rendered

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11 Scottish Naturalist, 1 (1871), 1.
12 For example, see Magazine of Popular Science, 1 (1836), 3.
13 Popular Science, Quarterly Review, 84 (1849), 322.
14 Penny Mechanic, 1 (1836), iii–iv.
15 London Journal of Arts and Sciences, 1 (1820), iii.
16 Penny Mechanic, 1 (1836), 7.
elaborate, complex, and mysterious, by the bountiful use of scientific phraseology, will be received with that profound awe and intense admiration which, under ordinary circumstances, every calf may obtain who is brazen enough to assume the lion's skin of science.\textsuperscript{17}

Popular science periodicals usually contained a mixture of information extracted from other periodical publications and books, as well as articles and book reviews written expressly for the periodical itself. Mechanics' magazines, and general science periodicals to a lesser extent, tended to exhibit the signs of 'scissors and paste' work. The result of such a compilation, one writer complained, was simply a 'scientific scrapbook' that could be taken up at any moment and quickly glanced over.\textsuperscript{18} Yet editors defended their rapid passage from one topic to another. According to the editor of the \textit{Mechanic's Oracle}, Alexander Tilloch, the love of novelty provided a powerful stimulus to the mind; therefore, a variety of articles would excite and sustain the reader's curiosity, and create the desire for further information.\textsuperscript{19} Other editors explained that their periodicals' miscellaneous content resulted from the use of diverse materials that were too expensive for their readers to afford. The editor of the \textit{New London Mechanics' Register}, for example, admitted that his periodical was 'avowedly a mere compilation', but pointed out that the facts it recorded were collected from sources generally inaccessible to the great majority of readers.\textsuperscript{20} Natural history periodicals, in contrast, contained a greater proportion of original articles.

The encouragement of amateur scientific activity became a primary goal for English popular science periodicals. All three types of magazine constantly urged their readers to participate in the scientific enterprise. The periodical itself provided a medium where subscribers could communicate scientific observations or technological discoveries to others. Editors insisted that they would suspend critical judgment and admit any contribution to their magazines. In addition, by including copious notes on the proceedings of diverse metropolitan and provincial scientific societies, editors sought to convince any unconverted reader to join the bustling ranks of amateur practitioners.

In order to emphasize the universal accessibility of the scientific endeavour, popular science periodicals maintained that all men possessed the same capacity for scientific understanding:

Every person must have right or wrong thoughts, and there is no reason why a hedger and ditcher, or a scavenger, should not have as correct opinions and knowledge as a prince or a nobleman. Working men and working women have naturally the same minds or souls as lords, ladies, or queens... if any one could have analysed or cut to pieces the soul of Lord Bacon, or Sir Isaac Newton, and that of a chimney-sweeper, it would have been found that both were made of the same divine material.\textsuperscript{21}

\textsuperscript{17} \textit{English Mechanic}, 2 (12 January, 1866), 195.
\textsuperscript{18} \textit{London Polytechnic Magazine, and Journal of Science, Literature, and the Fine Arts}, 1 (1844), 187.
\textsuperscript{19} \textit{Mechanic's Oracle}, 1 (1824), 2-3.
\textsuperscript{20} \textit{New London Mechanics' Register}, 1 (1827), iii.
\textsuperscript{21} \textit{Working Man's Friend and Family Instructor}, 1 (1850), 33.
Readers were told, furthermore, that the raw materials of science could be found in everyday objects that surrounded them at work or during leisure hours. In fact, the working man immersed in his trade had an advantage over other scientific practitioners:

The experimentalist has to put up forges, or furnish laboratories, at great trouble and expense; but the smelter, the blacksmith, the founder, the glass-blower, and a hundred other mechanics and operatives, have all this apparatus daily before them, and therefore, without any trouble might sound the depths and scan the heights of knowledge. Nothing would be required but a little observation.\footnote{Ibid., 35.}

An experiential and inductivist philosophy of scientific discovery and explanation served to reinforce the fundamental equality of all in the 'Republic of Science'. As the Mechanics' Journal of Science and Art explained, 'Our knowledge of external objects is founded upon experience, which furnishes facts; the comparison of these facts establishes relations, from which, the belief that like causes will produce like effects, leads to general laws'.\footnote{Mechanics' Journal of Science and Art, 1 (12 December, 1838), 4. S. Shapin and A. Thackray mention the 'Republic of Science' ideology in 'Prosopography as a Research Tool in History of Science: the British Scientific Community, 1700–1900', History of Science, 12 (1974), 5.} In contrast, all theory—which editors called 'a heap of speculative rubbish' and 'visionary hypotheses'—was viewed with disdain.\footnote{English Mechanic, 2 (12 January 1866), 187; Penny Mechanic, 1 (1836), 16.} The Naturalist stated simply: 'Facts—not opinions or hypotheses, however novel or specious—are the only contributions which I crave, or covet'.\footnote{Naturalist, (1837), 'The Swiftfoot'; Magazine of Natural History, 1 (1828), 7.} The Magazine of Natural History equated the 'taste for facts' with the 'love of truth, the foundation of justice and honesty'.\footnote{Quarterly Review, 84 (1849), 338.}

Scientific progress depended upon the steady accretion of factual building blocks collected by many observers. The 'slow and gradual accumulation' of modest discoveries could ultimately rival the 'proudest moments of genius'.\footnote{Geological and Natural History Repertory, 1 (1865), 8.} No extraordinary mental prowess was required to order and derive generalizations from these facts. As the Penny Mechanic stated: 'It is not necessary, in order that a person may understand the principles of Natural Philosophy, that he should be a mathematician. The mathematics of common sense will enable him to comprehend all the great laws of nature'.\footnote{Penny Mechanic, 1 (1836), 2.} Participation in the egalitarian 'Republic of Science' therefore required no skillful manipulation of experimental data, nor the ability to construct theoretical, abstract chains of reasoning. The amateur scientific practitioner needed neither particular education nor expertise, but simply an eagerness to participate and communicate his gleanings to others.

Viewed in its totality, the audience for popular science periodicals in England resembled a pyramid. At the highest level were the hundreds of upper and middle class subscribers to natural history periodicals who could afford to pay a shilling per
monthly issue. Often provincial naturalists, they found their scientific interests and even their social prejudices reflected in these moderately expensive, high quality publications devoid of technological and practical matters. At a level beneath them were thousands of middle class readers of general science periodicals. The moderate price (four pence) and emphasis on the applications of science in these periodicals, though not to the exclusion of pure scientific topics, made them particularly appropriate for the leisure hours and even the home libraries of educated and scientifically-inclined subscribers. Finally, at the lowest level, inexpensive (at several pence an issue) and technologically-oriented mechanics' magazine provided tens of thousands of urban workers (whether prosperous master craftsmen or unskilled day labourers) with advice on how to advance their social position through scientific pursuits.30

Cutting across these low science ideologies was a new vision of scientific activity promulgated by the high scientific community in the 1860s. Mechanics' magazines became increasingly interested in the achievements of engineers and scientists. General science periodicals started to desert their readers concerned with amateur societies and applied science, in order to lobby more effectively for professional science. Natural history periodicals began to suggest that the field should be mastered in specialized bits and pieces. Accomplices of the high scientific community, popular science periodicals were replacing the 'entrepreneurial ideal' of the self-made science worker with the 'professional ideal' of the scientific expert.31

In other words, low science was gradually being fashioned into popular science. As the editor of Nature, Norman Lockyer, suggested, popularization of high scientific achievements would ensure continuing public sympathy for the activities of professional scientists: 'when the number of science-teachers and science-students is daily increasing, and the necessity for combined action and representation among scientific men themselves is being more and more felt, the popularisation of science becomes more important than ever'.32 Readers were no longer so strongly encouraged to participate in an alternative low scientific culture, but were told that they should be well acquainted with high scientific attainments.

Nevertheless, the bustling world of amateur science could not be easily vanquished. Mechanics' magazines and natural history periodicals were particularly reluctant to forsake the ideology of amateur participation and cooperation. Popular science periodicals continued to project the image of a democratic Republic of Science, where scientific activity depended upon common-sense induction from everyday experiences, fifty years after this ideology was first introduced.

3. Paris periodicals

Three different types of popular science periodicals were published in France from the 1820s through the 1870s: 'useful knowledge' journals, general science weeklies, and general science annuals. The first category, remarkably inexpensive journals dedicated to the diffusion of 'useful knowledge' (which answered the immediate 'needs of the workshop and of domestic economy'), was the most important type of popular science

30 On the circulation and readership of these periodicals, see my dissertation (footnote 1), pp. 74-7, 83-5, 92-4, 103–106.
periodical in July Monarchy France. These journals stressed topics in agriculture, hygiene, rural economy, and horticulture. Visibly differentiated from more expensive publications by their muddy type and cheap paper, useful knowledge journals sometimes cost as little as four francs a year. The enormously successful advertising campaign of one editor, Emile de Girardin, brought an extraordinary 132,000 subscribers to his Journal des connaissances utiles.

Only with the proclamation in 1852 of the Second Empire under Napoleon III did new forms of popular science periodicals begin to replace useful knowledge journals. These general science weeklies and annuals of the 1850s and 1860s, which treated pure science as well as its applications, explained to their thousands of readers the new concept of vulgarisation. According to these journals, vulgarisation described their efforts to make high scientific discourse intelligible to the layman. Popularizers had to be accomplished in the art of lucid translation, said one periodical, because scientific formulae seemed like the words of a foreign language to the public. As Science contre le préjugé pointed out, because of its technical language and neologisms, 'the water that stands in the pathway of scientists appears turbid to us—it is loaded with academic salts, making absorption impossible'. Periodical editors interpreted academic science by removing elements unique to specialized and theoretical research. The result would not be an 'elementary science', distinct from high science, but a 'popularized' version of 'advanced science', made accessible 'to all who are eager for progress and capable of a slight effort'.

A closely-knit, self-conscious community of professional vulgarisateurs emerged during the Second Empire, to act as mediators between the world of high science and the layman. For a few of them, however, discussion of science became a pretext to mask their opposition to the political order. By criticizing the high scientific establishment, editors could express their distaste for the regime that supported it. When several periodicals, such as the Echo du monde savant and Cosmos, could no longer endure the constraints on the petite presse to eschew all discussion of political and social matters, they became licensed political papers.

All French popular science periodicals stressed the utilitarian benefits of science. Useful knowledge journals emphasized household hints and recipes. Second Empire general science periodicals also supplied this kind of information to their readers, but it was usually overshadowed by descriptions of new technological achievements, particularly railroads, submarine telegraphy, and steel-making. No group of French periodicals discussed pure science exclusively, in the manner of English natural history periodicals. According to most Paris periodicals, the discussion of pure scientific topics

33 'Considérations sur les sociétés pour la propagation des connaissances usuelles', Revue encyclopédique, 38 (1828), 17.
34 Prices given are Paris rates. Annual subscriptions usually cost one to two francs more in the provinces, in order to cover postage charges. On the readership of useful knowledge journals, see my dissertation (footnote 1), pp. 128-9.
36 On the readership of science weeklies and annuals, see my dissertation (footnote 1), pp. 152-3.
37 Lumiére, 1 (1851), 1.
38 Science contre le préjugé, 1 (1856), 2.
39 Cosmos, 1 (1852), 2.
40 The tendency of literary and religious periodicals to covertly attack the government has been recognized. Bellanger (footnote 2), p. 285, discusses the case for literary periodicals. Archives Nationales, Paris: F 18 294, 'Etat du tirage des journaux politiques et non politiques', 1er semestre, 1866 on 'Journaux non politiques' mentions hostility expressed in religious periodicals.
was restricted to the high scientific community. The process of popularizing high
scientific discourse involved extracting elements that were useful or might be applied in
daily life. The public could grasp the applications of science, whereas theoretical
concerns were best left to a scientific elite.

To the vulgarisateurs, infrequent exciting discoveries in science lent themselves to
popularization much better than normal science. As one editor remarked, 'public
attention is attracted more by bold empirical attempts, than by regular work that
supports its precise conclusions with numerous observations'. He further explained:

The public loves theatrical effects; in order to be enthusiastic, they must see
progress accomplished immediately before their eyes. If the long work that slowly
and infallibly leads to knowledge leaves them cold and inattentive, the
announcement of a discovery accomplished suddenly, tomorrow allowing them
to travel in the clouds or to predict storms with certainty, will awaken them with a
start.

Popularizers continuously singled out several spectacular or controversial events
calculated to catch the fancy of their readers. Throughout the 1860s, for example, they
constantly returned to debates that had occupied the scientific community during the
early years of the decade, particularly questions of the origin of species and
spontaneous generation.41

French periodicals lacked the specialization apparent in English journals. There
were neither popular natural history periodicals nor mechanics' magazines where only
one aspect of scientific knowledge would be considered. Instead, French periodicals
adopted an encyclopaedic approach by discussing all varieties of science and
technology in a single publication. Encyclopaedic knowledge, like the practical
applications of science, could be comprehended and even utilized by a number of social
groups. Indeed, this characteristic differentiated popularizations from the concerns of a
narrow circle of savants. As one reviewer explained, unlike specialized treatises, the aim
of popular works was to be useful to 'toutes les professions, à toutes les positions
sociales, à tout le monde'.42

Indeed, a short statement about their commitment to an encyclopaedic orientation
was often the only hint of a periodical's philosophical position. On occasion, popular
science periodicals vaguely invoked the 'positive sciences' as their domain of interest.
Sometimes, too, periodicals mentioned their opposition to 'philosophical dissertations'
and 'rash theories'. Science pour tous, for example, intended to avoid 'all transcendent
theory that, instead of being a guide, is always a maze where the uninitiated goes
astray'.43 The scantiness of these remarks indicates that the endorsement of a particular
philosophy of scientific discovery and explanation did not critically concern French
periodicals. Their indifference to philosophical formulations contrasts with English
periodicals' constant appeal to experience and inductivism, so crucial for the amateur
ideology of scientific activity.

41 Annuaire scientifique, 3 (1863), v-vi.
42 Revue encyclopédique, 38 (1828), 737.
43 Causeries scientifiques, 1 (1861), v. Moniteur des connaissances utiles et pratiques, 1 (1854), 4; 2 (1855),
'Avis à nos lecteurs'. Science pour tous, 1 (1855), 2.
Although French periodicals occasionally asked readers to submit contributions, such communications never fattened their columns. Nor did periodical editors encourage in any other way the scientific inclinations of their readers. The *Journal des connaissances usuelles*, for example, explicitly repudiated the task of 'making' scientists and even of communicating new information to those who already possessed much. Furthermore, French periodicals did not point to a series of scientific societies in which the amateur practitioner might participate. In fact, the most uniform feature of all French popular science periodicals was a report on the proceedings of the Académie des sciences. French periodicals, then, did not try to stimulate amateur scientific pursuits, but instead eagerly followed the affairs and achievements of the world of professionalized and specialized high science.

From the creation of the *Journal des connaissances utiles* in 1831 to the founding of *La Nature* in 1873, editors sought to popularize science in France by imitating forms and even copying titles of periodicals that were successful on the other side of the Channel. They also shared with their English confrères the same concern for social stability that might be realized through widespread diffusion of useful and scientific knowledge. Editors of popular science weeklies were particularly concerned about counteracting the effect of certain 'demagogic newspapers' widely diffused among the urban working classes. *Science pittoresque*, in addition, was determined actively to oppose 'all that feverish, aphrodisiac, and indecent literature that is a disgrace to humanity and the scourge of homes where it is allowed to enter'.

Despite imitative forms and similar preoccupations, French popularizers fashioned a product strikingly different from that of their English colleagues. Dissimilarities can be explained, in part, because French editors were writing for an audience with a different demographic composition, experiencing an earlier stage of industrialization. Because most Frenchmen lived in the provinces and were employed in agriculture during the July Monarchy, useful knowledge journals emphasized rural and domestic economy. With quickened industrialization and urbanization under the Second Empire, periodicals began to describe high scientific and technological progress of greater interest to readers who more commonly resided in cities. Like useful knowledge journals aimed at the middle classes in particular, general science weeklies and annuals looked to urban dwellers enjoying increased leisure and higher incomes.

More important, perhaps, French editors were inspired by a radically different conception of popularization. They defined their work, their writings, and even their audience with the image of the professional savant always in mind. Even those popularizers who became hostile to high science, still were preoccupied with the injustices and the prejudices of the scientific community. In France, no alternative amateur low scientific cultures emerged, like those represented by mechanics' magazines and natural history periodicals in England. A few disaffected journals urged the neglected amateur to come forward, but when he did not, they turned to broader political programmes. Even this avenue became, finally, not a constructive approach for effecting scientific or social reform, but just another arena for negative, sniping attacks on the world of high science.

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44 *Journal des connaissances usuelles*, 1 (1825), prospectus, second page.
45 *Science pittoresque*, 1 (1861), 214.
4. Editors

French popular science periodical editors were part of a tightly knit, self-conscious community of professional vulgarisateurs who launched their careers by serving as science columnists for Parisian newspapers. English editors, by comparison, were striking in their heterogeneous occupations and concerns. They were united only by their activity as amateur scientists and amateur science writers. Unlike their French counterparts, English editors were little aware of each other’s efforts to popularize science.

French popularizers also shared similar backgrounds and educational experiences. An overwhelming majority were provincial men who migrated early in life to France’s intellectual and scientific centre, Paris. They usually obtained formal educational degrees, and sometimes even advanced scientific ones. Attestingly to their expertise in specialized fields, French periodical editors frequently wrote at least one scientific monograph. But, typically, once they began to popularize science, their careers as research scientists came to an end. As one popularizer pointed out, ‘research and popularization are two different things’. French popularizers had little time left for any other pursuit, whether practising science or another vocation.

Perhaps the best representative of these tendencies would be Louis Figuier, who became the most prolific and perhaps the best-remembered science popularizer in Second Empire France. Like the majority of his colleagues, Figuier was born in the provinces, in his case at Montpellier. At the age of twenty-three, in 1842, he left for Paris to study chemistry. Figuier’s father was a pharmacist, his uncle held the chair of chemistry at the school of pharmacy in Montpellier, and Figuier himself had just obtained his medical degree at Montpellier in 1841. At Paris Figuier worked in the laboratory of the Sorbonne, but failed to pass the agregation in medicine in 1844. He returned to Montpellier in 1846 and remained there until 1851 as professeur agrégé at the school of pharmacy. In 1850 he received his doctorate in physical sciences from Toulouse. Figuier returned to Paris in 1852; there, in 1853, after passing the agregation in pharmacy, he was appointed professeur agrégé at the school of pharmacy.

From 1844 to 1855, during his professorial years, Figuier wrote a number of works on general chemistry applied to physiology and medicine. Yet his scientific research and publishing terminated after his dispute in 1857 with Claude Bernard over the glycogenic function of the liver. Shortly thereafter, Figuier’s candidacy for the Académie de Médecine was turned down. He gave up his Paris professorship, ostensibly in order to devote all his time to popularizing science.

Although Figuier had already published two volumes of an Exposition et histoire des principales découvertes scientifiques modernes in 1851, his career as science vulgarisateur really began in 1855, when he replaced Victor Meunier as scientific editor of La Presse. A year later, Figuier founded the Année scientifique which he edited until his death in 1894. Figuier used his columns from La Presse not only to constitute the Année, but also as the basis for some of his books.

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47 Science et les savants en 1866, 4 (1867), 25.
Figuier’s success as a popularizer was extraordinary. His works often went through four, five, or even six editions. He estimated that 80,000 copies of his *Exposition... des principales découvertes scientifiques* had circulated in France alone. Figuier’s method of popularizing science was grounded in the history of science and moral pronouncements. Once science was presented in a simple way, said Figuier, through its history, children could be raised according to the precepts of elementary natural history books, rather than on fables, fairy tales, legends, or mythologies. Those reared according to Figuier’s programme would become honest, upright citizens, he contended, unlike those whose upbringings predisposed them towards ‘an ignorant fanaticism or a menacing socialism’. Figuier also tried to popularize science through the theatre, by means of staging dramatic episodes from the lives of scientists and inventors. To Figuier, science at the theatre could exert a moralizing influence on the lower classes and help them to ‘understand their duties, love their country, and respect its laws’.

One of Figuier’s biographers remarked that despite his remarkable productivity as a popularizer, this ceaseless work won him neither positions nor honours. Figuier had left the scientific establishment’s network of sinecures and rewards following his controversy with Claude Bernard, for a new profession whose alternative system of positions and honours were not so widely recognized. As first president of the *Cercle de la presse scientifique*, and as perhaps the most successful *vulgarisateur* in Second Empire France, Figuier became content to watch and describe the world of Parisian high science from the sidelines.

In contrast to the French case, prerequisites were few for English science popularizers, at least if contemporary accounts are to be believed. Their books supplied the evidence:

> In nineteen cases out of twenty they are the work of persons who, having themselves learnt Natural Philosophy in six lessons, profess to teach it in half-a-dozen—who fill their small phials from another’s bottle and adulterate what they steal—who render science easy by suppressing difficulties instead of explaining them, and who keep to its shallows less from the fear of advancing beyond the pupil’s depth than of being detected in wading out of their own.

The caricature exaggerates—self-taught expositors of science were out-numbered by those who had received some kind of formal schooling. Yet the scientific credentials of English periodical editors were not impressive. Only rarely did they possess a university degree.

The typical English popularizer proceeded about his work, little concerned with the activity of fellow science-disseminators. Seldom was popularization more than an avocation to its English practitioners; it occupied hours that were not spent in business pursuits or in leisurely scientific investigations. The occasional attempt to make a living by full-time popularizing ended in failure. Despite their amateur status, English

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54 ‘Notice’, *L’Année scientifique*, 38 (1894), vii et seq. (p. x).

55 See footnote 13.
Popularizers tended to specialize in a particular sort of popular science like entomology or the 'arts'. In the few instances where one editor directed several popular science periodicals, they were always of the same type. The kind of science that editors popularized reflected their own amateur scientific interests and sometimes their occupational concerns.

To choose only one example to illustrate these fairly diverse patterns, Edward Newman, editor of three popular natural history periodicals, was born in 1801 in Middlesex, the son of a Quaker manufacturer of morocco leather. He was educated at a Quaker boarding school in Gloucestershire, and afterwards joined his father who by that time had retired and become a woolstapler in Surrey. In 1826 he moved to London and bought his own rope business at Deptford, though he found a more congenial pursuit when he entered into partnership in 1840 with George Luxford, a London printer. Apparently Newman had met Luxford, printer of the *Magazine of Natural History*, at a time when he temporarily edited that periodical. He bought out Luxford the following year, and retained the business until his retirement in 1870.

Newman had early demonstrated his interest in natural history by helping to found the Entomological Club of London in 1826. He encouraged the formation of the Entomological Society in 1833, an organization that grew out of the Club. In the same year he joined the Linnean Society. He also became a member of the Zoological Society and of the Royal Microscopical Society. During the 1830s, Newman edited the Entomological Club's journal, contributed regularly to the *Magazine of Natural History*, and published a monograph on entomology, but his independent publications on natural history diversified and expanded once he began his career as a printer.

Newman created the *Entomologist* in 1840, and several years later became editor of the *Phytologist*. He founded the *Zoologist* in 1843. Besides contributing articles to all three periodicals, Newman wrote numerous popular books on entomology, ornithology, and botany. His *History of British Ferns* went through four editions from 1840 to 1865. In the late fifties he also became natural history editor for the *Field* and the *Friend*. Because he printed his own works, Newman could carry on ventures like the *Phytologist* that were not commercially successful.

Despite his business and editing obligations, Newman found time to continue research in natural history. The *Royal Society Catalogue* lists 131 of his works, mostly on entomology. Newman was better known as a zoologist than a botanist, but he was one of those 'all-round' naturalists who worked in 'every branch of every subject of natural history'.

Newman's life typifies the career of the English popular science periodical editor. In the societies they joined and the specialized papers they wrote, these editors belonged to England's broadly-based scientific community. But rather than promoting its professionalization, they sought to extend the domain of scientific practice to an ever-widening group of amateur scientists like themselves.

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5. Conclusion

As I have stressed, an ideology of amateur participation in the scientific enterprise permeated English periodicals. The image of the Republic of Science constantly invoked required that its members possess neither special education nor natural endowments, but simply an eagerness to collect facts from everyday experience that might contribute to scientific progress. The popular science periodical itself acted as a medium where improvements in industrial processes or descriptions of newly discovered organisms might be presented for the edification and encouragement of other amateur practitioners. Periodical editors, scientific amateurs themselves, announced that they would suspend all criticism and simply marshal these facts.

A proliferation of amateur scientific societies provided graphic illustration of the democratic composition of the Republic of Science.\textsuperscript{57} Dispersed throughout the country, they could be as broad in membership and scope as the mechanics' institutes and societies of arts, or as specialized as natural history societies and clubs. Editors urged their readers to participate in their meetings where 'the active interchange of ideas and discussion on topics of common interest ... awakens and directs the spirit of inquiry, supplying a constant stimulus and fresh energies to the mind'.\textsuperscript{58} The \textit{Popular Science Review} expressed the symbiotic relationship between amateur science and scientific societies: 'The principle of combination, whilst it has lightened the labours of the student, has aided materially to enrich our stores of knowledge, and the greater the harvest becomes, the more numerous will be the husbandmen'.\textsuperscript{59} By joining societies or by contributing to popular periodicals, the English amateur cooperated in the scientific endeavour, at the same time helping to shape a vital low scientific culture.

French popular science periodicals, in contrast, portrayed science as the domain of a gifted, specially trained, professional élite. Popularizers worked to translate and simplify the discourse of the world of the \textit{savant} so it could be comprehended by non-scientist readers. The image of high science conveyed was often marred by slight imperfections, introduced by an emphasis on dramatic discoveries and controversies of the recent past, rather than current normal science. Sometimes, high science was considerably distorted through the polemics of a \textit{vulgarisateur}.

The lay audience of periodical readers in France played a passive role as onlookers, just as the popularizer, too, stood at the sidelines of high scientific activities. Readers were not seen as potential scientific practitioners who could contribute important discoveries or observations. Scientific pursuits, in turn, were not portrayed as a means to advance one's intellectual or social position. Nor did periodicals point to a range of amateur associations where readers might participate. Instead, endless reports on the proceedings of the Académie des sciences reinforced the layman's belief that scientific


\textsuperscript{58} 'Scientific Institutions', \textit{Quarterly Review}, 24 (1826), 172.

\textsuperscript{59} \textit{Popular Science Review}, 1 (1862), 5.
societies belonged to those with privilege and position. As Louis Figuier remarked, 'academies represent the intellectual aristocracy'. The French layman could learn about high science and its institutions only through the popularized interpretations of the vulgarisateurs.

What might be the implications of these two traditions? The ideology of low science expressed in natural history, general science, and mechanics' magazines mirrored the amateur condition of the scientific community in England at mid-century. Republic of Science imagery was not empty rhetoric. There were still contemporary examples of scientists and inventors who had achieved prominence not through special gifts and advanced educations, but because of their own persevering efforts.

By the 1860s, though, appeals to the scientific capabilities of social groups like improving artisans became increasingly infrequent. Within the scientific community, the shining examples of self-made men—Brunel, Stephenson, and Faraday—had passed away. A younger generation of scientists began to try to mould the Republic of Science's amateur practitioners into sympathetic supporters of professional high science. Undoubtedly there was resistance to this programme on the part of avid amateur naturalists and inventors. Yet the thousands of middle-class readers of general science periodicals might have been more easily convinced to put aside their amateur pursuits in order to further the worthy cause of scientific men. Energetic amateur scientists could be transmuted into an equally active group of 'science boosters'.

In France, popularization developed as a means of relating the proceedings of the professional scientific community to the layman. The professional popularizer acted as mediator between the scientific élite and the public and by his skill made high science captivating and enticing to the non-scientist. Throughout this process, the audience remained passive bystanders.

On occasion, popularizers reacted against their traditional role, that of supplying a recitation of academic proceedings and striking scientific discoveries, and used popular science as a vehicle to criticize the scientific establishment. The physicist J-B. Biot complained that some science journalists denigrated academic science, that they practiced their trade as if it were 'an army on the offensive, attacking the Academy with the utmost violence, distorting its intentions, its acts, its works, even the words that are spoken there'. Without a broadly-based amateur low scientific culture to object, popular science could be fashioned into a weapon to attack high science.

An explanation for the alleged decline of French science during the nineteenth century is undoubtedly complex. It involves factors such as the resistance to change of scientific and technical institutions, political divisiveness, and government parsimony. But the absence of an amateur low scientific culture, and instead the presence of passive 'science watchers' will have to be taken into account. Unfortunately, the French tradition of vulgarisation had not created numerous science workers, and science watchers could not be counted as faithful allies and supporters of the scientific enterprise.

60 Discours prononcé le 12 juillet 1858, au banquet pour l'installation du Cercle de la presse scientifique (Paris, 1858), p. 4.
62 J. Ben-David sums up the declinist argument in 'The Rise and Decline of French Science', Minerva, 8 (1970), 160–79. For the most recent contribution to this discussion, see Mary Jo Nye, 'Scientific Decline: Is Quantitative Evaluation Enough?', Isis, 75 (1984), 697–708.

Figure 2. Louis Figuier (1819–1894). Frontispiece to L'Année scientifique et industrielle, 38 (1894).
Appendix

Popular Science Periodicals, 1820–1875

Periodical titles and editors, including changes resulting from the publication of new series, are derived from H. C. Bolton, *Catalogue of Scientific and Technical Periodicals* (Washington, D.C., 1897). *Mitchell's Newspaper Press Directory* (from 1846) also provided information on periodicity and price. Often periodicals themselves indicated their price and frequency of issue, and sometimes their editors' names. The following list is arranged according to the decade when the periodical was founded. Editors' names, periodicity, and price are indicated when these are known. For English periodicals, prices given are per issue.

**London Periodicals**

*Mechanics' Magazines*

1820s


*New London Mechanics' Register and Magazine of Science and the Useful Arts. Embracing exclusive and authentic reports of the lectures delivered at the London Mechanics' Institute, etc.*, 1827–28.

3d.

*Mechanics' Magazine*, 1823–58.


*Iron; the journal of science, metals, and manufactures, with which is incorporated the mechanics' magazine*, 1873–93.


Monthly; later a weekly with monthly parts. 3d.

*Mechanic's Oracle and Artisan's Laboratory and Workshop*, 1824.

Alexander Tilloch.


Weekly. 3d.

1830s


Weekly. 2d.

*Penny Mechanic, a magazine of the arts and sciences*, 1836–29 July 1837.


Weekly. 1d.
1840s

Monthly. 1s.

Mechanic's Organ, or Journal for Young Men and Women, 1847–50.
Monthly. 1d.

1860s

British and Foreign Mechanic and Scientific Instructor. Devoted to the spread of technical instruction in all arts and industries, 1869–70. Merged into English Mechanic and World of Science.
Edward H. Todé.
Weekly. 2d.

The English Mechanic: A record of mechanical invention, scientific and industrial progress, applied chemistry, arts, manufactures, engineering, building, & etc., 1865–66.

English Mechanic and Mirror of Science and Art, 1866–72.

English Mechanic and World of Science, 1873–95.
Weekly. 1d. 1866, 2d.


Scientific and Literary Review and Journal of the Inventors' Institute, 1873–79.

Monthly. 6d.

General Science Periodicals

1820s

Arcana of Science and Art; or one thousand popular inventions and improvements, abridged from the transactions of public societies and from the scientific journals, 1828–30.

Arcana of Science and Annual Register of the Useful Arts, 1831–38.

Yearbook of Facts in Science and Arts; exhibiting the most important discoveries and improvements of the past year in mechanics and useful arts, natural philosophy, electricity, chemistry, zoology and botany, geology, etc., 1839–79. John Timbs, 1828–73; C. W. Vincent, 1874–75; J. Mason, 1876–79.
Annual. 4s 6d, 1828; 5s, 1829.

London Journal of Arts and Sciences. Containing reports of all new patents, with a description of their respective principles and properties; also original communications on subjects connected with science and philosophy, particularly such as embrace the most recent inventions and discoveries in practical mechanics, 1820. Second series, 1828–31, by W. Newton and C. F. Partington.


Monthly. 1s.
Register of the Arts and Sciences, containing a correct account of several hundred of the most important and interesting inventions, discoveries, and processes, 1823–27.

Weekly, 3d. July 1827, 4d.

Weekly. 8d.

1830s

Society for the illustration and encouragement of practical science at the Lowther Arcade, London.
Annual.

1840s

The Magazine of Science, and School of Arts; Intended to Illustrate the Most Useful, Novel and Interesting Parts of Natural History and Experimental Philosophy, Artistical Processes, Ornamental Manufactures, and the Arts of Life, 1840–50.

The Magazine of Science, and Artist's, Architect's, and Builder's Journal, 1851.

Magazine of Science, School of Arts, and Architect's and Miner's Journal, 1852.
G. Francis, from 1841. Weekly. 1½d.

Scientific Miscellany. An occasional publication of treatises relating to chemistry and the other experimental sciences, 1840.
J. J. Griffin. Monthly. 1½d.

1860s

Nature; a weekly illustrated journal of science, 1869–95 +
Norman Lockyer. Weekly. 4d.

Popular Science Review. A Quarterly Miscellany of Entertaining and Instructive Articles on Scientific Subjects, 1862–76. n.s., 1877–95 +
James Samuelson; later, with H. Lawson; n.s., W. S. Dallas
Quarterly, 2s 6d.

Quarterly Journal of Science, 1864–70.
Quarterly Journal of Science, 1879.

Journal of Science and Annals of Astronomy, Biology, Geology, Industrial Arts, Manufactures, and Technology, 1880–85 +
James Samuelson and William Crookes.
Quarterly; monthly, 1880. 5s.

Recreative Science. A Record (and Remembrancer) of Intellectual Observation (in the various branches of physical science), 1860–62.
8d.

The Intellectual Observer; a review of natural history, microscopic research, and recreative science, 1862–68.
1s; 1866, 1s 6d.

Scientific Opinion; a weekly record of scientific opinion (progress, from v. II) at home and abroad, 1868–70. United with English Mechanic and World of Science. Weekly. 4d.

Scientific Record. A weekly journal of scientific progress, 1864. Weekly. 3d.

1870s

Scientific Summary. A monthly record of science, arts, and manufactures, 1870. Monthly. 3d.

Popular Natural History Periodicals

1820s


1830s

Field Naturalist; a review of animals, plants, and minerals, the structure of the earth and appearance of the sky, 1833–34. James Rennie.


Zoological Magazine; or journal of natural history, being a series of miscellaneous articles, original and translated, on interesting subjects in zoology, 1833. Monthly.

1840s


Zoologist; a popular miscellany (monthly journal) of natural history for recording facts, etc., 1843–95+. Edward Newman; J. E. Harting from 1877. Monthly. 1s.

1850s

The Geologist: A Popular Illustrated Monthly Magazine of Geology, 1858–63. 1s: 1863, 1s 6d.
The Geological Magazine, or Monthly Journal of Geology; with which is incorporated the 'Geologist'. 1864–95+
S. J. Mackie. 1858; T. Rupert Jones, assisted by Henry Woodward. 1864–74; H. Woodward. 1874–95+
Monthly. 1s; 1866. 1s 6d.

Kidd's Own Journal for intercommunications on natural history, popular science, and things in general, 1852–54.
William Kidd.
Weekly. 1½d.

Naturalist; a popular monthly magazine; illustrative of the animal, vegetable, and mineral kingdoms, 1851–58.
Magazine of Natural History and Naturalist, 1860.
Beverley R. Morris, etc. From 1856, F. O. Morris.
Monthly. 6d.

1860s
Monthly. 6d.

Eyes and No Eyes; a magazine of local and general meteorology and natural history, 1867–68.
W. Tuckwell.
Monthly. 3d.

Geological and Natural History Repertory, 1865–67.
S. J. Mackie.
Weekly. 2d.

Hardwicke's Science Gossip; an illustrated medium of interchange and gossip for students and lovers of nature, 1865–90+
Monthly. 4d.

Naturalists' Circular, 1868.
Monthly. 2d.

Naturalist's Notebook, 1867–69.
Monthly. 6d.

1870s
Paris

Useful Knowledge Periodicals

1820s

*Journal des connaissances usuelles et pratiques, ou recueil des notions immédiatement utiles aux besoins et aux jouissances de toutes les classes de la société et mises à la portée de toutes les intelligences*, 1825–43.

C. de Lasteyrie. From 1830, Gillet de Grandmont. Monthly. 12 fr./yr.

1830s


E. de Girardin. Monthly. 4 fr./yr.; 1848, 6 fr.

1850s


L. Favre. Monthly. 4 fr./yr.; 1862, 5 fr.

General Science Weeklies

1830s

*L’Écho du monde savant; journal analytique des nouvelles et des cours scientifiques (cours scientifiques inédits des professeurs de Paris)*, 1834–39.

12 fr./yr.


Nerée Boubée; 1839, Auguste Desprez and Félix Dujardin; 1840, A. de Lavalette. 1842, also V. Meunier; 1843, also C. B. Fraysee.

6 fr./yr.

1850s


V. Meunier, 1855–59; Piton-Bressant, 1860–62. 6 fr./yr. or 15 c. nos; 1858–60, 10 fr./yr., 25 c. nos; 1862, 13 fr./yr., 25 c. nos.

*Cosmos; revue encyclopédique hebdomadaire des progrès des sciences et de leurs applications aux arts et à l’industrie*, 1852–81.

l’Abbé Moigno; 1867–70, S. and V. Meunier. 20 fr./yr.


La Science: journal du progrès des sciences纯es et appliquées, des découvertes et inventions, 1855–57. Auguste Blum; later A. de Gondrecourt; then T. du Moncel. 40 fr./yr., daily edition; 24 fr. semi-weekly; 15 fr. weekly; also in nos.

La Science contre le préjugé; journal paraissant tous les samedis, 1856–57. L. Minot; from 1857, Félix Maynard.

8 fr./yr.

La Science pour tous; journal illustré paraissant tous les jeudis, 1855–95. Collaborators include Le Noir, C-H. Lecouturier, J. Rambosson, M. Durand. 5 fr./yr.; 1879, 7 fr.; also in nos.

1860s


V. Meunier.

Cours de science vulgarisée; résumé oral du progrès scientifique et industriel, 1864–65. Moigno.

Les Mondes; revue hebdomadaire des sciences et de leurs applications aux arts et à l’industrie, 1836–73. Moigno.


Cosmos, les mondes, 1882–84. (Absorbed Cosmos.)

Cosmos: revue des sciences et de leurs applications, n.s., 1885–95.

Revue des cours scientifiques de la France et de l’étranger; physique, chimie, zoologie, botanique, anatomie, physiologie, géologie, paléontologie, et médecine, 1863–70.

Revue scientifique de la France et de l’étranger, 1871–84.

Revue scientifique (Revue rose), 1884–95. Founded by Odysse Barot; 1863–70, Emile Alglave; 1871–80, with Eugene Yung. 1881–84, Charles Richet.


1870s

La Nature; revue des sciences et de leurs applications aux arts et à l’industrie, journal hebdomadaire illustré, 1873–95. Gaston Tissandier.

20 fr./yr. or 50 c./no.

La Science illustrée; journal hebdomadaire, 1875.
General Science Annuals

1860s

L'Année scientifique et industrielle, ou exposé annuel des travaux scientifiques, des inventions et des principales applications de la science à l'industrie et aux arts, qui ont attiré attention publique en France et à l'étranger, 1856-93+
Louis Figuier.

Annuaire scientifique. Les Progrès des sciences en 1861 (69), 1862 70.
P. P. Déhérain.
3 fr. 50 c./vol.

Causeries scientifiques, découvertes et inventions; progrès de la science et de l'industrie, 1861–95.
H. de Parville.
3 fr. 50 c./vol.


Moigno; 1870, M. Seguin.

Mouvement scientifique pendant l'année, 1864–66.
E. Menault and A. Boillot.

Petites Chroniques de la science, 1861–72.
S-H. Berthoud.

Prévision du temps; almanach et calendrier météorologique à l'usage de l'homme des mers et de l'homme des champs, 1865–77.
F.V. Raspail.

Revue des sciences et de l'industrie pour la France et l'étranger, 1862–63.
L. Grandeau and Aug. Laugel.

Science et les savants, 1864–68.
V. Meunier.

Science populaire, ou revue du progrès des connaissances et de leurs applications aux arts et à l'industrie, 1863–66.
J. Rambosson.

Semaines scientifiques, ou exposé critique annuel des progrès de la science et de leurs applications à l'économie sociale, agricole, industrielle et domestique, 1866.
André Sanson.