Early Cinema and the Technological Imaginary

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CHAPTER 7:
Popular Science and Journal Publication

Overview

Popular science journals emerged from a long tradition of scientific publication. Although most scholars now regard the "scientific revolution" as a mere convenience of historians rather than a moment of unarguable epistemological rupture, the 16th and 17th centuries did furnish a specific shift in attitude to scientific literature. Of all the social, economic and religious factors that are of importance to this shift, the most significant as far as publishing is concerned is the separation of philosophy and science in the 17th century. Scientists, David Kronick suggests in his study of scientific publishing, are less concerned with internally coherent systems from which to examine particulars, than with paradigms — models of reality — that can be tested and altered in response to new findings. This process of testing and changing favoured the journal rather than the book because new paradigms required the creation of a consensus among peers. In addition, the 17th and 18th century saw a growth in scientific agriculture and mining, both of which stimulated local societies and required an exchange of ideas between the theorist and the practitioner. Moreover, Francis Bacon's advocacy of new ideas about the conduct of scientific enquiry included the rejection of previous scientific texts, such as they were, in favour of accounts of experimental reports. As Kronick argues: "The great defect of the scholastic philosophers in Bacon's view was that they placed too much emphasis on existing texts, neglecting their own powers of observation." The force of this epistemological shift stimulated new practices and modes of inscription. For example, the recording and exchange of data from experimental findings in post-Baconian science initially precipitated the informal personal networks that were subsequently established as academies. These facilitated the transmission of experimental findings to a peer group who could conduct similar experiments to verify the data and create new knowledge. Book publishing proved unsuitable for reporting experimental work since the necessity to accumulate sufficient material to justify publication imposed unacceptable delays. As a consequence, many experiments were written up and published as pamphlets. By the middle of the 17th century, a formalised publication devoted to scientific matters appeared to supplement the academies. From this beginning, a huge publishing industry developed which saw its greatest expansion in parallel to world's fairs and public expositions. Throughout the 18th century, when science was a relatively limited activity, 700 new German, French, English, Dutch and Swiss titles are listed. During the same period, the number of publications increased significantly as national scientific societies were formed in Britain, France and Germany to disseminate new information and ideas to a wide audience and provide a focus for discussion. As the number of journals grew, it becomes apparent that the increasing involvement of ordinary people in science and technology, as well as the subsequent struggle for the regulation of knowledge and the control of the episteme, affected the editorial. One outcome of the struggle that is reflected in the editorial of popular science journals during the second half of the 19th century is a progressive reduction of the difference that existed between national approaches to science — at least as far as non-professional practices were concerned.
The dissemination of science through publication

The experimental scientific method favoured the learned journal as a public forum for information exchange. What is generally recognised as the first scientific journal, the Journal de Scavans, was published in France in 1665 and its format was rapidly copied in England, Holland and Germany, and in the same year the Royal Society published its own journal. Bernard Houghton claims that “[the] journal becomes the accepted medium of scientific communication by the middle of the 18th century and its functions were clearly identifiable.” By the end of the 18th century, the journal form of publication dominated scientific circles, with 401 titles in Germany, 96 in France, 50 in England and 43 in Holland. Their appeal lay chiefly in the publication of scientific news in the vernacular, but they also provided a framework for critical discourse, as well an archive and a college for the “professional”. Between 1800 and 1885, the cumulative number of titles rose dramatically. 1800 there 750 listed; by 1845 (the time Scientific American was first published) there were over a thousand titles available throughout the world, these included general trade journals such as the British The Mechanic's Magazine (1823), and its imitation The American Mechanic's Magazine (1825). Between 1845 and 1885 the number rose to 5,100 and, subsequently, publishing in this area grew even more dramatically as science came to depend on this mode of diffusion. One reason for the expansion of published material is that the methodology of individual experiments which characterised early science required a system of information exchange that was more rapid than the book. Initially, experimental findings were made available to other workers in the field through the informal networks that relied upon word-of-mouth and personal correspondence. However, as scientific societies and newspapers carried scientific information, a more broadcast form of communication between those involved in experiment and observation became necessary. The scientific journal that emerged from this culture still regarded the book as both too expensive as a means of communication and too attenuated in production to be an efficient disseminator for the rapid developments in science. Consequently, as experimental work increased, so the amount of published material also grew.

From the beginning of the 18th century, changes in the methods of printing and publishing, together with more sophisticated distribution networks, facilitated the expansion of material available. Increased literacy, changes in taxation, better domestic lighting and larger amounts of leisure time stimulated an appetite for material in sections of the populations of that had hitherto been unused to reading, which led to a publishing boom around 1860. In Britain and France, the imperatives of social stability that lay behind the institution of the public lecture also shaped the pattern of scientific publication. The dissemination of useful knowledge and the proliferation of improving literature during the 19th century was motivated by social reformers who saw the dangers of a literate public satisfying their appetites on seditious or pornographic material. As a consequence of these factors, the existing titles were augmented in the early 19th century by improving scientific journals, published at relatively cheap prices. In this way, the attempted regulation of the public enthusiasm for reading coincided with other tactics of social control to reinforce a continuity between the journal as an outcome of professional scientific experiment and the interests of the amateur at a time when most other fields were becoming more exclusive. Nationally, however, the editorial style of journals differed significantly so as to reflect the distinct
social relationships that each constituency had with science. As we have seen with the institutions of display, in the United States, a republican commitment to science as a national project differed from the British struggle for sectional control on a class basis, while the French were either indifferent or openly antagonistic to professionals and academics. Editors were well aware of each others’ products, and frequently pirated material for inclusion in their own journals, after carefully tailoring them to suit their readership. Nonetheless, by the close of the 19th century, a much more international style of popular scientific publishing emerged, as new relationships between culture and science became universal as the gulf between the professional and amateur was widened – although the route to this homogeneity was not a simple progression.

National difference in styles: America

The pattern of readership in the late 18th century in America and Britain was relatively similar but subsequently became differentiated before converging. Middle-class reading favoured general natural history, botanical and geological periodicals. With their emphasis on observation, field-work and mechanical invention, these journals served to progressively bridge the gap between increasing industrialisation and traditional agricultural economies in both countries. In America, however, vocational education became increasingly more important for publishing in general. As Sally Gregory Kohlstedt observes, “By 1850 textbooks accounted for over a third of the book trade.” Children’s books became more didactic, replacing imaginary fantasies with gently instructive stories. Scientific periodicals, which frequently had a “children’s corner”, also changed and became more didactic, supporting a raft of other educational initiatives to encourage adults to improve themselves. While in a fairly direct way the working class reader of improving literature saw economic gain for himself and his children, Kohlstedt claims that there were different issues for the middle class. Periodicals, texts books and school curricula were used to redefine legitimate future occupations for their children. The journals point to a social use of science in America in pursuit of personal advancement.

Three of the leading American journals in this later period, between 1860 and 1900, were Scientific American, The American Journal of Science and Science. Scientific American was a weekly periodical first published in 1846, which was taken over in 1867 by Munn and Company, New York, at a subscription rate of $3 per year, which put it within the reach of most working people. It was an illustrated broad-sheet with a prose style and technical demands on the reader were slightly less than the average newspaper and, as a journal of practical information, it embraced art, science, mechanics, chemistry and manufacture. Considerable editorial space was given to major civil engineering works, with regular reports and updates on railway tunnel and bridge projects, architectural achievements, military technology, and major engineering works. It listed the latest patent claims and was particularly attractive to rural communities who were, to some extent, remote from the latest thinking yet economically shaped by agricultural technology. To satisfy this readership, the emphasis lay on improved cultivating machines, rakes and planters which appeared regularly in the issues, alongside trivial gadgetry and domestic inventions to improve hygiene and comfort. Some of the featured inventions were advertised alongside the copy so
that readers could then either buy new implements to improve productivity or even devise their own from the technical descriptions in the copy. There were correspondence columns where readers exchanged ideas and experiences, and requests for inventions to solve particular industrial and agricultural problems. Despite its broad-sheet appeal, however, *Scientific American* shared with the world’s fairs and amusement parks the mix of the serious and the trivial, and, as a consequence, assiduously reported the proceedings of the American Association for the Advancement of Science (AAAS) which were both technical and demanding.

*The American Journal of Science* was established a little earlier in 1818, but in 1885 it changed its editor and, in the following ten years, it altered its style. It was originally a heavyweight publication priced at $6 per year. Its main concern was geology and mineralogy which not only had practical relevance, but also a resonance far beyond the mining industry in the widespread religious discussions concerning the origin of man. It was a crucial mix of the practical and philosophical for its readers since, as Underwood and Faulkner claim, the two major influences shaping modern America were the industrial revolution and Darwin’s hypothesis, popularised by John Fiske and E L Youmans, founder of *Popular Science Monthly*. Although *The American Journal of Science* did not engage with the fierce and often hostile philosophical debates concerning the origin of the earth and man, nonetheless, the passionate conflicts surrounding the Darwinian hypothesis attracted a readership for this journal beyond the academic and mining professionals. As these disputes lost some of their significance towards the end of the century, the section of the periodical it called “scientific intelligence” expanded and the journal as a whole became less specialised, and generally it began to turn its attention away from geology towards reporting on the emerging technologies of electricity and lighting.

The shift to a less philosophical tone in *The American Journal of Science* was not matched in Edison’s ill-founded periodical, *Science*. From its outset in June 1880, *Science* was a portentous journal and failed to capture a wide readership. The title was bought by Alexander Graham Bell in December 1881, who let it lapse only to reissue it as a much lighter periodical in February 1883, with a content that resembled the mix of world fair’s and expositions. It was priced at $3.50 and found a niche in the market as a respected publication. In 1900 it became the official organ of the AAAS and was regarded as a popular magazine that emphasised the variety of scientific and technological activity. In addition to regular correspondence and answer columns, it favoured publication of extracts or reworkinged scientific papers illustrated with engravings and photographs. It mixed reports of the proceedings of the National Academy of Science with practical advice for the amateur. It also carried accounts of explorations and travel, ethnographic research, and political and geological geography, and was notable for its campaigning stance over preventive medicine and public health, the quality of food, environmental conservation and the treatment of children. But perhaps *Science’s* most distinctive feature was the willingness of its reports to discuss the philosophical issues and the human dimensions of technology.

During the second part of the 19th century, American popular science periodicals changed.
They pursued a distinctive national agenda of the integration of technologies — developed to transform the hostile frontier — with the social attitudes of early 19th-century America. According to Frederick Jackson Turner, these attitudes, based on the pioneering spirit and a muscular individualism, were largely shaped by that same environmental hostility that machines were increasingly being used to overcome. In many ways, technological innovation challenged the way American people thought about themselves. While ostensibly publicising the latest inventions as they emerged, these discussions of new technology in the American journals helped provided a platform for a re-conceptualisation of the intangible qualities of being human. Discussions of science and technology were used to address social issues, such as the place of individual effort and the family in the project of national progress, as well as philosophical questions concerning the creation. Achievements in invention became un-coupled from science, and by the late 19th century, technology was becoming a more differentiated term implying control of the environment as it also became linked with the national effort of post-Civil War reconstruction and economic growth. Presenting technology as continuous with the environment encouraged the reconciliation of some of these oppositions. In this enculturating task, popular scientific journals played their part by marshalling arguments, encouraging formal education and optimistically presenting the mass of latest patents, together with practical, although sometimes frivolous, applications. It was a project in which inventors were expected to devise machines that would help re-define nature as something within human control.

National difference in styles: Britain

Although scientific periodicals existed in Britain well before the 1800s, it was only in the 19th century that improving journals began to be published at relatively cheap prices. The variety and volume of scientific journals published during the 19th century reflects the intellectually open structure of “scientific” discourse of the period, as well as the broad range of popular engagement with its projects. There was a wide range of topics directed at a broad constituency of readers. Susan Sheets-Pyenson’s comparative study of publications between 1820 and 1875 shows that general science periodicals were complemented with mechanics’ magazines directed at artisans were as cheap as a penny a week, and flourished until late in the century. Natural history periodicals were initially few and expensive, but they too became more common and considerably cheaper up to the boom in publishing after which they fell from favour. They were primarily designed as a social regulator to structure the leisure time of the working-class reader with productive entertainment and to contribute to the socialising project through the “trickle down” of middle class habits. Consequently, most publications that were on offer were serious journals and built upon the entertainment customs and practices of the privileged upper class. To this end, they advocated the universality of science, claiming that specialist knowledge was unnecessary since new understandings of the world would eventually develop through observation and the careful collection of specimens.

Nonetheless, in spite of the universalising claims, the journals were socially stratified. As Bernard Houghton points out, they were intended to provide not simply a record of progress but to “represent effectively the industrial activity in which we live, to keep pace with the
progress of improvements and developments in all departments of the arts and manufactures which contribute to our material comfort.”

However, some were extended accounts of proceedings of societies, and others were designed to appeal to tradesmen while others. Between 1820 and 1875, cheap magazines such as The Mechanics’ Magazine, (founded in 1823), The Engineer (1856) and Engineering (1866) were directed at artisans. In addition, from the 1830s onwards, cheap general science periodicals became prolific. In keeping with the inductivist tradition in science, these journals generally prioritised “low” scientific method which favoured the true amateur. Many journals avoided technical language and were extensively illustrated. One of the most enduring journals, Nature (first published in 1869), tried to combine the two distinct genres and claimed to be both populist and an arena for professional scientific discourse. Practical participation in science was encouraged by each type by advocating field-work and the steady accumulation of data as the preferred scientific method. Editorials were frequently openly antagonistic to the mystifications of the professional scientist, and they vigorously rejected theoretical and speculative “high” science in favour of the engagement of their readers in practical “low” science. Question and correspondence columns were extensive and they constantly urged their readers to take part in projects and join local groups, and reported on their proceedings with enthusiasm.

To some extent, this progressive accretion of material which characterised “low” science was mirrored in the way that the publications were produced. The cheaper journals, in particular, generated little original copy but, instead, relied on previously published articles, which they either sub-edited, condensed or openly collaged. This editorial practice was thought to be particularly democratic since it made expensive material available cheaply while at the same time providing the stimulus of variety and novelty. Generality was considered a virtue, and only later, after 1860, did increasing professional specialisation and distinctive branches of science, with regulated discourse and claims to expertise, lead to the demotion of the inductive, and, experiential and a reduction in titles.

The new objective of popular scientific publication was to interpret the results of professional scientists and make them available to a general public rather than enlist the efforts of the layman in scientific research. The task was no longer to encourage practical participation in science but to help readers to keep abreast of science through the spectatorial pleasures of catalogues of the kinds of technology which could be enjoyed in public exhibitions and displays. These movements in the editorial policy of British science periodicals during the 19th century support the assertion that changes in the professional practice of scientists which sought to marginalise the practical scientist — the itinerant lecturers of Wright’s painting and the likes of William Sturgeon — also precipitated a different kind of popular engagement with science and technology. It became something to be passively witnessed as cultural progress, rather than a personal enlightenment to be experienced. Science, in particular, progressively distanced itself through social, mainly academic, institutions and methodological barriers while, at the same time, acquiring key pieces of intellectual property from the popular discourse. The evidence of public displays of science as technology, and the content of popular science journals, reflect these changes as a sequence of ruptures and attenuated struggles that ended in the collapse of popular participation in scientific projects.
National difference in styles: France

French periodicals were significantly different from those produced in Britain and America since they too needed to satisfy a national agenda for the conduct of scientific enquiry. Sheets-Pyenson’s research shows that, until 1852, French journals were mainly collections of useful knowledge dealing with agricultural and rural topics. They were cheap, with large circulations and were, generally, badly produced. Throughout the 1820s, 1830s and 1840s there were around a half dozen “useful knowledge” titles selling for between 25 centimes and 1 franc a month. In 1850, however, there was a substantial increase in titles as new kinds of science publications appeared. This boom coincided with the stabilisation of the French economy, and the beginnings of a structural revolution in French industry that was more or less completed by 1880. After this restructuring, French journals became more metropolitan, reflecting the consolidation of industry in major centres, and gradually became closer to their American and British equivalents which also had undergone change.

In France general scientific periodicals simply catalogued technological achievements in civil engineering, communications and industry. Some other science weeklies saw their function firmly in the domain of popular science and acted as mediators between the professional and layman. They positioned themselves as critics of an elite professoriate in order to build a legitimate platform to indirectly challenge a range of government policies, both domestic and foreign, without breaking censorship laws. Unlike the British periodicals, they did not encourage lay participation in scientific activity which was not part of the French tradition, and was in any case widely thought to be both the task and duty of professional scientists. For this reason, there were few correspondence columns and readers’ questions, nor the philosophical speculations of their British and American counterparts. Instead, they emphasised how scientific work was benefiting the layman, but they could be pessimistic and dystopian in their vision of the future. They provided serious articles on recent technological achievements and could be savage in the critique of their scientific professoriate and the use of science as a political weapon. Many features show diverting amusements that were largely frivolous applications of new discoveries, some of which subtly undermined the assertions of the professionals.

This changed somewhat when a new journal was launched in Paris, edited by George Tissander, which was intended to reflect international trends. It was entitled *La Nature* and ran from 1873 in continuous publication until 1905. It was not only a popular weekly but was also highly respected by professionals. It was a copiously illustrated journal and showed especial interest in photography, stereoscopy and moving images. George Tissander was an active populariser. In June 1894, he wrote an account of Edison’s Kinetoscope in the same issue that featured Marey’s work. In the following years, Janssen, Edison, Marey, Londe, Demeny, Muybridge and the Lumière brothers were discussed with varying regularity. However, unlike American and British journals, it retained the trace of its origins as a French popular science journals, and placed serious items and important scientific papers on physiognomy and the cathode ray tube, for example, alongside more obvious entertainments, such as conjuring, home experiments and trick photography.

*La Nature*, like most French journals, did not take to the moral high ground of education or
national progress, but saw itself much more as providing a particular kind of entertainment. The journalists approached their task with the flair of theatrical impresarios and singled out those achievements that might capture the public imagination. Quite contrary to their British counterparts, the spectacular discoveries and creative flashes of unpredictable genius were celebrated at the expense of the plodding repetitious method of the professional scientist. Since such discoveries were scarce and irregular, this editorial policy discouraged specialist copy and, instead, they took the form of the encyclopaedia, drawing material from the international community to provide an impression of giving information on all branches of knowledge. The variety and novelty made it a popular format that maximised circulation by addressing a wide range of professional and social groups, and a broad band of interests, in one journal. The legacy of criticism remained, however, many of the articles that appeared in popular science journals during the second half of the century were conjuring tricks and games to be played with scientific instruments that either replicated or amplified human perception. These demonstrations and tricks frequently incorporated infantile versions of the serious copy that they carried. In January 1882, for example, under the title, *Recréations Photographiques: photographies amusantes sur fond noir*, La Nature ran a piece in which a series of photographs were technically explained in a way that, with sufficient motivation, the process could be copied. They included a man sitting at a table eating his own enlarged head, a man cleaning a sword after decapitating himself and a man carrying his own head in a wheelbarrow — the images were almost identical to some Méliès and Mutoscope films that show the direction of the body in a humorous frame, and indeed the creative mix of technology and fun which is characteristic of 19th century attitudes in France towards science shared much with early cinema. For the French reader, the experience of science and technology was always one of pure spectacle, to be enjoyed as a passive layman. This was due to a number of forces, not least a rationalist approach to science by the professoriate, and the relative lateness of France’s economic development and the lack of a background of popular scientific societies and amateur engagement, *La Nature*, like the other publications, exhibitions, lectures and world’s fairs, began quite early to delimit science by taking its laboratory apparatus — instruments used to support claims about reality — and presenting them as almost incomprehensible marvels to be explained or amusing spectacles to be chuckled at.

**Conclusion**

The intimate relationship between the practices of experimental science and the single experiment as the unit of reporting means that scientific journals provide a reliable index of the relative states of its social organisation. As the new professional discourse of science that emerged in the later part of the 19th century eliminated its earlier concern with what might be called natural philosophy and the question of anti-science or conscience, it used positivist philosophies instead to cast suspicion on the perceiving human observer as a reliable witness. Scientists increasingly insisted on instruments that could “objectively” record the physical world. Experimental methods were developed and standards of objectivity set, requiring instruments that were generally unavailable to the practical scientist and the amateur observer. Unlike the air pump that interrogated the physical world and stimulated a spectrum of speculative responses, these methods and instruments made absolute claims and
formed the epistemic and technological basis of professional science. The world-view they asserted was returned to the public domain in the form of irrefutable facts or entertainments that often demonstrated the unreliability of human perception. This essentially meant that both technologists and ordinary people were progressively eliminated from the very scientific project that had begun by enlisting them so vigorously.

This transformation in the social organisation of science is reflected in the editorial content of popular science journals as they were developed during the latter half of the 19th century. In the United States, the apparent contradictions that technology presented, as nature was progressively tamed, were resolved in philosophical discussions informed by new scientific knowledge. The many idiosyncratic inventions made by ordinary people were also featured as evidence of a general technological greatness that was as vital to American growth as the frontiersman had been. Inventions that increased comfort and productivity were highlighted in the framework of technological inevitability. By the end of the century, the journals reflected the re-definition of science in terms of respectable careers and those bent on self-improvement. They became much more entertaining in the way they presented material, and euphoric in the presentation of major civil engineering projects financed by large corporations. In Britain, the differences between early and late popular science journals were much more marked. The seriousness of popular participation required by an inductivist scientific method, gave way first to a rear-guard action to retain the importance of the local societies, and then to a conversion into the more widespread model of a self-improving entertainment. In France, journals were not especially important forms of transmitting new knowledge until after mid-century. When the economy stabilised, and expansion was possible, they matched American journals with entertaining and informative articles. In as much as they performed a social function beyond mere distraction, it was in their re-tracing of the old resentments that lay between the scientific elite and the ordinary man by directly attacking the failures of scientists in critical articles and by playfully subverting new inventions in order to indirectly undermine the rationalist claims of high science.

By the turn of the 19th century, the popular scientific journal had become something of a universal publication whose subtext contained various oppositional feelings towards the professional hierarchy, revealed only by the way some items were treated. At the same time, new kinds of pleasures and entertainments were developed, using new technologies that matched the editorial content of popular journals in all three countries. Although there were vestiges of earlier perceptions of technology as a socialising force, and nationally-specific differences were still maintained, the ways in which technology was presented became much more universal as the modes of exposition became more elaborate. The heuristic function of displays and discussions of technology in helping the majority of people to represent vague, and possibly unformed, ideas became universalised, not simply through more sophisticated trade and transport networks, but also through a radical re-interpretation of what science and technology were.