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Science, Technology and Culture in the Midlands During the Industrial Revolution

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The Industrial Revolution has traditionally been seen as a transformation in the technological basis of production and in the social arrangements surrounding it. On the other hand, the Scientific Revolution of the 16th and 17th centuries was originally conceived as a purely intellectual transition, a shift in mentalities or worldviews. Historians searching for the connection between these two events have often focused on the English provinces in the 18th century, where popularizations of the scientific work of Isaac Newton apparently coincided with the first stirrings of industrial development. The actual linkages between scientific

knowledge and technical innovation have proven elusive, however, as one might expect when two rather different historiographical models are in play on each side. It has been suggested that quite fundamental issues of the relation between ideas and material practice – between the work of the mind and that of the hand – are raised by the search for these connections.

Peter M. Jones believes that the time is right for a new approach. A professor of French history at the University of Birmingham, he has turned his attention to the important role of Birmingham and the West Midlands in the scientific culture of the Enlightenment and the early industrial era. His is the first study systematically to exploit the whole Archives of Soho, the huge deposit of papers from the business partnership of Matthew Boulton and James Watt and from both men's families, which was assembled at the Birmingham City Library in 1994 but has only recently been catalogued. The archive enables Jones to probe the connection between the diffusion of scientific ideas and the rise of technical innovation. Drawing upon this and other evidence, including the reports of foreign visitors to the region, he sets out to map what he calls its 'Industrial Enlightenment' in the late 18th century.

Jones situates his study at the confluence of two currents in recent historical scholarship. On one side, he refers to the historians of science whose work has increasingly been uncovering the roots of scientific ideas in their social and cultural environment. Scholars including Ian Inkster, Margaret Jacob, Jack Morrell, Larry Stewart, and Arnold Thackray have explored the scientific culture of provincial towns in this period. On the other side, some economic historians have recognized the importance of a cultural dimension – the so-called 'knowledge economy' – as one of the preconditions for industrialization. Jones makes frequent reference to Joel Mokyr, whose *The Gifts of Athena: Historical Origins of the Knowledge Economy* (1) placed particular emphasis on scientific institutions and the circulation of technical knowledge in 18th-century Britain.

With a deft blend of quantitative and descriptive evidence, Jones shows why the Birmingham area was favored for economic development in the second half of the century. He describes the extraction of its mineral resources, the building of transportation networks, the demographic growth of its new manufacturing centers, and the continued flourishing of its more established and genteel cathedral cities. He tells how Boulton established his metalworking factory at Soho, just outside Birmingham, in 1762. Boulton's 'Great Toy Shop' produced buttons, coins, shoe-buckles, and other manufactured articles, and its extensive facilities became a tourist attraction for visitors from Britain and overseas. From 1775, he was in partnership with Watt, building and licensing steam-engines to drain mines, power factories, and supply water to towns and estates. Also in the early 1770s, James Keir built a glassworks and chemical factory at nearby Stourbridge. And Josiah Wedgwood visited occasionally from his pottery works at Etruria in Staffordshire. These manufacturers mingled with men of scientific learning, such as the doctors Erasmus Darwin, William Small, and William Withering, and the Dissenting minister Joseph Priestley.

The most famous venue where men of science conversed with men of industry was the Lunar Society, which gathered mostly at Boulton's house over the period from the mid-1770s to the first decade of the 19th century. The society was the subject of a classic study by Robert E. Schofield, published in 1963, and has recently featured in a lively and popular account by Jenny Uglow. Jones is more skeptical than some others about the achievements of this group. He assembles data on the occasions when it is known to have met, showing that there were never more than eight recorded meetings per year and more often only two or three. Some individuals who have been considered members, such as Wedgwood, cannot be shown to have attended at all. The topics known to have been discussed varied with the shifting preoccupations of the scientific world: pneumatic chemistry in the early 1780s, balloons a few years later, the debate over the phlogiston theory and the composition of water toward the end of the decade. The Lunar Society was never a formally constituted institution, but more like a network of Boulton's friends. Jones endorses the conclusion that it is best viewed as a loose coterie of enlightened philosophers, whose interests were not specifically tied to the promotion of manufacturing industry but ranged quite widely across the scientific trends of the time.

Although, as Jones notes, it is not the aim of his book to explain the origins of the Industrial Revolution, he does engage with Mokyr's arguments and makes some well-aimed criticisms. While Mokyr claims that propositional knowledge (including that codified as science) informs prescriptive knowledge (the practical

know-how that gets things done), Jones points out that a good deal of the knowledge pertinent to industrial processes was never codified at all – and certainly not in scientific texts – but was preserved in the tacit skills of artisans. Incidents in which Boulton's Soho factory was subject to espionage and skilled workers lured away show that knowledge was not communicated as propositional information, but was often embodied in the persons of those who possessed it. Indeed, the critical point could have been pressed further. While it is understandable that an economist would want to quantify the scientific factor in industrial development, historians are likely to insist that even the categories of 'science' and 'technology' are cultural constructs that take on different forms at different times. How the notions were understood and the relationships between them formulated are topics for historical inquiry; they cannot be assumed in advance. Jones himself sometimes fails to historicize these categories sufficiently. Thus, he points to the lack of a 'properly scientific understanding' (p. 130) of metallurgical chemistry before the end of the 18th century, as if all that counts was whether chemists then believed what they do now. Or, he describes Aimé Argand's innovative oil-lamp design as 'the product of scientific thinking rather than improvisation, or tinkering' (p. 136), as if scientific thinking was always something quite distinct from improvisation or tinkering.

In these respects, Jones has not altogether kept up with the historians of science in their more rigorous historicization of knowledge and practice. He assumes Mokyr's terminology of 'savants' and 'fabricants,' searching for the interactions between them and for individuals who combined the two roles. But he also notes, with reference to the work of David Philip Miller, that the issue of whether (for example) Watt was a 'philosopher,' a 'scientist,' or merely a 'mechanic' was a hotly contested one. Watt's credentials were called into question as late as the 1830s, in a dispute over who deserved credit for discovering the composition of water. In this connection, one can see how ideas about intellectual and practical knowledge were heavily tinged with assumptions about social status, assumptions that in turn were fought over in the course of the political upheavals of the era. This makes it particularly difficult to decide what was properly 'scientific' knowledge in the period, or consequently to measure its role in industrial development.

When it comes to the political turmoil of the 1790s and its effect on the scientific culture of the West Midlands, Jones tells an interesting and convincing story. Birmingham was the site of the notorious 'Priestley riots' in 1791, when a loyalist mob attacked Priestley's own house and those of other prominent Dissenters. The riots led to what Jones calls a 'retreat from Enlightenment' (p. 188), sending Priestley himself into exile in America and disrupting the previously cordial relations between Anglican and Dissenter elites in local government and cultural life. The subsequent two decades of war with France created problems for scientific communication and for trade. Boulton's business suffered as international commerce was seriously hindered, and the hostilities also interrupted the exchange of scientific information, notwithstanding assertions that the sciences were never at war. The era of Jones's 'Industrial Enlightenment' was ending, and, though the sciences continued to flourish, they did so in an institutional setting that was substantially reconfigured. The Birmingham Philosophical Institution, formally initiated in 1803, followed the model of the Royal Institution in London. It presented public lectures on the utility of science to a middle-class audience. The broader social aims of Enlightenment philosophy were lost sight of, and the participatory milieu of such groups as the Lunar Society largely abandoned.

A rather similar picture emerges from Paul A. Elliott's study of the scientific culture of the town of Derby. Elliott covers a longer period than Jones – a century and a half – and his book is less focused on analyzing the relations between science and industry. Instead, he uses his survey to illuminate a range of questions that historians have been concerned with, often concluding by confirming the patterns they have found elsewhere. Thus, he shows how the scientific culture of Derby in the 18th century emerged as part of the widespread commercial development of provincial towns. He describes the activities of itinerant scientific lecturers, some quite well known (such as Adam Walker, John Arden, and John Ferguson), others much less so (including Benjamin Parker, a stocking maker who turned to writing and lecturing on astronomy and natural philosophy in the 1730s). Elliott shows that an informal scientific club existed in Derby by the 1770s, including among its members Peter Perez Burdett, a cartographer and land surveyor, and John Whitehurst, a clockmaker best known for his geological interests.

If one were to ask what was unique about science in Derby in this period, part of the answer would be that it

was documented in the extraordinary paintings of Joseph Wright. Wright made portraits of Burdett and Whitehurst, and one of his famous scenes of people attending a scientific lecture may feature a likeness of Ferguson. On at least two occasions, he painted Erasmus Darwin, who made his own significant contribution to science in Derby after he moved there from Lichfield in 1781. Darwin was the moving force behind the creation of the Derby Philosophical Society in 1783. The group pursued similar interests to the Lunar Society, including electricity, pneumatic chemistry, and meteorology. The Derby philosophers launched a balloon toward their colleagues in Birmingham in December 1783, though it never arrived at its intended destination. Medical interests were prominent in the Derby group, as one would expect from the number of physicians associated with it. And the attention to industrial issues reflected the involvement of William and Joseph Strutt, owners of a cotton-spinning factory. In general, Elliott gives a similar account to Jones's of the Lunar Society: the Derby Philosophical Society was another informal coterie of enlightened intellectuals, whose wide scientific interests often went along with a commitment to political and social reform.

Elliott also confirms Jones's account of the transformation of this scientific culture in the wake of the French Revolution, tracing the rise of more formalized and utilitarian institutions in the early 19th century. The Derby Literary and Philosophical Society, founded in 1808, lasted only eight years but it established an agenda for public scientific education. Taking a leaf from the playbook of Humphry Davy at the Royal Institution in London, Charles Sylvester lectured at the Derby 'Lit. & Phil.' on the latest chemical discoveries and demonstrated them with a powerful galvanic battery. Subsequent institutional innovations included the Derbyshire General Infirmary, established in 1810, and the Mechanics' Institute, founded in 1825 to spread the benefits of scientific education to the artisan class. Elliott also traces a distinctive line of Derby-based scientific thought in the evolutionary ideas nurtured by Darwin, and then by William George Spencer, a schoolteacher and local intellectual, and his son Herbert Spencer, the most prominent philosopher of social evolution in the Victorian era. The lineage is an intriguing one, but it remains unclear to what extent it was actually given public expression in the scientific institutions of the town.

Taken together, these two books go a long way toward reconstructing the scientific culture of English provincial towns in the 18th and early 19th centuries. The science of the English Enlightenment emerges as more than just a dim precursor of the more formalized institutions that succeeded it. It was a distinctive form of cultural expression, rooted in the economic growth of particular urban centers and sharing in more widespread patterns of socialization and the circulation of knowledge. Though it intersected with manufacturing enterprises in the places where they occurred, it was not entirely tethered to industrial development. The science of Derby and the West Midlands comprised much more than popular versions of Newtonian mechanics. Chemistry was at least as crucial as mechanics, and other preoccupations – such as electricity and astronomy – had their uses but bore little relation to manufacturing industry. Whatever claims were made for the dependence of the practical arts upon the sciences, historians are discovering that the actual relations between scientific knowledge and technical innovation were subtle and ambivalent. They also turn out to have depended to a significant degree on broader social and political forces. In both Birmingham and Derby, enlightened scientific culture proved vulnerable in the political crisis of the last decade of the eighteenth century and during the ensuing wars. Science did, of course, survive into the new century, but it came to be rooted in new civic institutions that tended to overshadow the more informal gatherings of the previous decades. Jones and Elliott have both made significant contributions toward the historical recovery of that lost world of enlightened science in the English provinces.

Notes

1. Joel Mokyr, *The Gifts of Athena: Historical Origins of the Knowledge Economy* (Princeton, NJ, 2002). Back to (1)

Other reviews:
[3]

Links
[1] http://www.history.ac.uk/reviews/item/4808
[2] http://www.history.ac.uk/reviews/item/4809
[3] http://www.history.ac.uk/reviews