sum up, in this book there is something for everyone: scientists, engineers, economists, managers, city authorities, investors'.

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Public Science and Public Policy in Victorian England

Roy MacLeod

Aldershot, Hampshire, Variorum, 1996, xiv + 325 pp., £51.50, ISBN 0-86078-535-1

Probably the most significant development in the history of science and technology as a discipline over the past two or three decades has been the emergence and growth of what has been called the 'sociological turn' in the discipline.[1] Roy MacLeod, formerly of the Science Policy Research Unit (SPRU) at Sussex University, foundation editor of *Social Studies of Science*, and currently Professor of History at Sydney University, has been one of the pivotal people in this development; and this collection of papers, originally published between 1965 and 1983 in such respected journals as *Isis, Minerva, Technology and Society* and *Notes and Records of the Royal Society of London*, not only demonstrates the extraordinary range and depth of MacLeod's scholarship, but also provides a telescoped view of the expansion of the sociological perspective over the period. The papers also convincingly demonstrate the continuing relevance of this revolution in historiographic thinking.

Roy MacLeod's specific focus in this collection is on the unprecedented growth of government involvement in science and technology in England from around the mid-nineteenth century, and certain antecedent developments in the earlier part of the century, notably the 'reform' of the Royal Society in the 1830s and 1840s following claims of a 'decline' in science by Charles Babbage and others. MacLeod succinctly summarises his case in the opening sentence of the penultimate paper in the collection, 'The Royal Society and the Government Grant: Notes on the Administration of Scientific Research, 1849–1914', in these words: 'The development of government participation in the support of research is one of the most significant characteristics of nineteenth century science' (VIII: 323—the pagination system will be described below), and the papers leave the reader in little doubt as to the accuracy of this assessment. The first three papers provide detailed and fascinating case studies of government involvement in three diverse areas in the 1860s–1880s—Alkali Acts administration, salmon fisheries and lighthouse illumination—and one of the interesting themes that emerges from these studies is the important role of certain prominent personalities of the period, well-known in conventional histories of nineteenth century science but usually presented as 'great men', somehow standing outside their institutional settings. MacLeod, in these papers, provides a corrective to this view.

Two familiar figures here are 'Darwin's Bulldog', T. H. Huxley, and his friend, the physicist, John Tyndall. Huxley, who had written to his sister in 1852, when despondently looking for a job, that '[s]cience is, I fear, no purer than any other region of human activity' and '[m]erit alone is very little good; it must be backed by ... knowledge of the world' (quoted VIII: 329) had, by 1880, learnt to play the system well enough to have been a long-standing professor in the Royal School of Mines and to have been invited by the Home Secretary, Sir William Harcourt, to accept the position of Inspector of Fisheries at £700 p.a. (in addition to his existing emoluments). Shortly after taking on

the post Huxley wrote to his son that there was 'more occupation than I expected' in it, but 'no serious labour' (II: 140). The post nevertheless soon became a demanding one, not least as a result of the conflicting interests of industrialists (who wanted to keep polluting the streams), land-owners (who wanted to spare the cost of salmon ladders on dams), and both line and net fishermen. 'Science' in such circumstances became largely a matter of negotiation, a delicate task further complicated by rival claims concerning the efficacy of *laissez-faire* versus government-sponsored science.

Around the time of Huxley's appointment, John Tyndall resigned from his post as scientific adviser to Trinity House (a centuries-old authority with semi-official powers over a wide range of maritime affairs) and the Board of Trade over a disagreement about the relative merits of gas versus oil illumination in lighthouses. Again, 'science' in this dispute became more than a matter of simple demonstration. Each method of illumination had its advantages, depending on a lighthouse's particular physical situation (which might mean that one fuel was more easily supplied than another—e.g. oil to an island lighthouse). There were also other complicating factors, such as the brightness or intensity of light required and the necessity for ships' captains to be able to tell one light from another.[2] As Roy MacLeod explains, by the time of Tyndall's resignation, his disagreement with authorities (he favoured gas, they oil) had ceased to be over a question of scientific fact 'susceptible to convincing proof by quantitative method', and had become, rather, 'a question of application involving preferences and requiring choices to be made on grounds of economy, convenience, and expedience' (III: 25). But more than this, the argument had become obscured by personal rivalries and resentment. In this process, Tyndall showed himself as much a strong-willed individual determined to have his way as his 'benighted' opponents, including Trinity House engineer James Douglas and Board of Trade president Joseph Chamberlain, whom Tyndall found guilty of 'grinding despotism' in refusing to give what Tyndall considered a fair test of a new gas burner invented by fellow-Irishman, John Wigham. Further clouding the issue were suggestions of partisan sympathies of Tyndall for Wigham.

In 'Science and the Civil List, 1824–1914' and 'The Support of Victorian Science: The Endowment of Research Movement in Great Britain, 1868–1900' Roy MacLeod closely investigates some central premises of social studies of science, namely that the 'direction of research in natural science is partly dependent on the influence of external social, political and economic considerations', and specifically, that 'economic factors may impel particular fields of research or innovation in certain directions' (V: 1)—considerations of which narrower, internalist accounts of the history of science and technology (see, e.g. D. R. Oldroyd's *The Arch of Knowledge*[3]) seem blissfully unaware. MacLeod finds that the situation, in his case studies anyway, is far from simple. With the Civil List pensions for scientists, instigated by Sir Robert Peel in the 1830s, the amount of money involved was often so trifling (perhaps £50 or £100 per annum), besides being frequently only awarded long after a scientist's active research life (or posthumously), that they were unlikely to have any marked effect on the kind of science done. By the late nineteenth century, however, government expenditure on science generally had increased enormously compared with the earlier part of the century (and this trend of course continued: MacLeod provides figures which show that the government grant to the Royal Society alone grew from £1000 in 1855 to £4000 in 1882, £5000 in 1919, £21,000 in 1946, and stood at £169,000 in 1967), and this was bound to have some influence.

Again, we see some of the same names turning up. Prominent on the Royal Society's Government Grant Committee (GGC) were (from 1881) T. H. Huxley, and another close friend and X-Club member (and founder of *Nature*), the astrophysicist Norman

Lockyer. A biology subcommittee of the GGC under Huxley had 26 members, which was more than in any other sub-committee ('mathematics and physics' was second largest with 21). Chemistry, by comparison, had 11 members. Such arrangements tended to perpetuate 'certain fundamental discriminations in [the GGC's] distribution of funds' (VII: 351); indeed, as MacLeod notes, the number of grants awarded by the society in physiology (Huxley's own special field of biology) quadrupled between 1889 and 1914, whereas chemistry less than doubled. 'Biology is very well looked after', was the way a columnist in *The Times* put it in 1893 (quoted VIII: 353).

But the kind of money disbursed by the Royal Society was as nothing compared with that absorbed by the Science and Art Department. This government instrumentality, established following concerns expressed at the 1851 Great Exhibition that Britain was losing its lead in the industrial 'race' with Continental Europe, quickly became connected with the 'endowment of science' movement led by Huxley and others. Huxley lost no time in championing biology's importance in science education as '*the* experimental science, *par excellence*',[4] and by 1859 he had secured for himself the position of examiner in zoology and animal physiology in the Department's annual science examinations. (Tyndall was appointed as examiner in physics the same year.) The cost of this Department burgeoned. MacLeod provides figures which show that, whereas total government expenditure on 'Education, Science and Art' averaged £296,000 per annum in the decade 1841–50, by 1886 this had blown out to £4,480,000 per annum, much of which was taken up by the Science and Art Department. Attempts to curb these costs by the introduction of a 'payments (to teachers) by results' system of examinations had little effect, and voices were soon raised in protest at this kind of money being diverted from other uses. The *English Mechanic*, for instance, in 1880 objected that Norman Lockyer and others 'wanted the money *themselves*'. The 'Endowment of Research', the *English Mechanic* went on to say, has 'come in these later days to signify the subsidising of such things as Committees on Solar Physics and not in the very slightest degree the helping of the real student' (IX: 224).

This is a timely and highly readable collection of papers which reminds us that claims of a 'crisis' in science funding are not new. Yet the surprising thing about this is that most of the papers were written in the 1960s and early 1970s, at a time when, as Roy MacLeod explains in a helpful Introduction, a 'Fabian consensus' ruled in Britain, in which a generally positive view was taken of State acceptance of responsibilities in science and technology. I can find little to criticise in the book; my only query would be why the publishers have chosen to retain the original page numbers, differentiating them for index purposes with capitalised Roman numerals over-printed on each page (hence the numbering used above). Surely it would have been just as easy to white out the originals and have a new, consecutive pagination? Be this as it may, this handsomely bound volume is a valuable resource for science historians and anybody else interested in broader questions of science and technology policy.

Notes and References

1. See J. R. Brown (ed.), *Scientific Rationality: The Sociological Turn*, D. Reidel Publishing Co., Dordrecht and Boston, 1984.
2. This particularly interested me. When I was 13 I spent some time on King Island, Bass Strait, collecting relics from some of the numerous ships whose captains had mistaken the lighthouse at Cape Wickham at the northern tip of the island for that at Cape Otway on the southern coast of Victoria. See Anon., *'Echoes of the Past': The Story of Shipping Disasters on King Island*, Currie, King Island, News Office, ca. 1959.

3. D. R. Oldroyd, *The Arch of Knowledge: An Introduction to the History of the Philosophy and Methodology of Science*, University of New South Wales Press, Kensington, N.S.W., 1986.
4. T. H. Huxley, 'On the educational value of the natural history sciences', in T. H. Huxley (ed.), *Lay Sermons, Addresses and Reviews*, MacMillan, London, 1871, p. 139.

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The Political Economy of Telecommunications Reform in Developing Countries: Privatization and Liberalization in Comparative Perspective

Ben Petrazzini

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Petrazzini's book explores how and why there have been differences across less developed countries (LDCs) in the adoption of telecommunications (telecoms) liberalization and the achievement of privatization. Reasons for these reforms are socio-economic in nature and range from structural adjustments to improvements of each country's telecoms networks through economic liberalization, new local and foreign investments, repatriation of capital, decreased inflation, rapid growth of markets, rollouts to under-serviced areas and so on.

LDCs may share, according to Petrazzini, similar telecoms reform goals and patterns of development, but achieve different outcomes in restructuring attempts. Different socio-economic effects of liberalization and privatization, comparatively speaking, are yielded by these outcomes. Petrazzini has analyzed the telecoms reforms of Chile, Jamaica, South Africa, Argentina, Mexico, Malaysia, Thailand, Venezuela, Uruguay, Colombia and Greece. He draws the following conclusions on why, in some of these countries, telecoms reforms failed while in others the reforms succeeded.

First, at the moment of privatization, current and predicted attractiveness of the domestic economy, and in particular of the telecoms market, is a key element in determining a country's ability to enforce partial market liberalization while simultaneously selling its state-owned telecoms enterprise (SOTE). Evidence in the book from his comparative analysis of the LDCs shows that while the introduction of competition calls for an attractive domestic market that would give local governments enough leverage to bargain with potential investors, the opening of the economy to private ownership calls for a closing of the polity to widespread participation. In countries were this has happened, telecoms reforms have succeeded (for instance in Malaysia and Mexico), while in countries where this situation did not exist reforms have failed as in Argentina (1981–1989) and South Africa (1991). Both Argentina (1990) and South Africa (1995–1996) have since had successful reforms when their political and economic situations improved.

Successful reforms were achieved in Chile, Jamaica and Malaysia (1987–1990), Argentina and Mexico (1990) and Venezuela (1991), while failed reforms were those attempted in Argentina and Thailand (1981–89), Colombia and South Africa (1991), Uruguay (1992) and Greece (1993). Thailand's open political system and a progressive decentralization of power weakened the Thai government in its ability to enforce economic reforms including privatization. Colombia's political turmoil was characterized by opposition to reform by workers, unions, political groups, and citizens opposed to