



Socio-technological disasters and engineering expertise in Victorian Britain: the Holmfirth and Sheffield floods of 1852 and 1864



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Abstract

Urban and environmental historians are becoming increasingly interested in the social construction of expertise in the management and control of natural resources. Experts are often depicted as disinterested, neutral and objective professionals, sufficiently qualified to gauge an independent perspective on a given problem. Yet what happens when an expert's judgment is called into question by other professional experts? The micro-analysis of socio-technological disasters offers one way to interrogate the construction and challenge of professional expertise at both the empirical and conceptual levels. Taking a comparative approach towards the study of two major reservoir failures involving considerable death and destruction in the United Kingdom – Holmfirth in 1852 and Sheffield in 1864 – this paper draws on the under-utilised research of the sociologist Barry Turner and others on the social aetiology of disasters as a route into revealing and accounting for the contested nature of expertise within the Victorian engineering professions. It is based on extensive archival research, including the written records of local and central government, private waterworks' proprietors, the printed press and the records of public inquiry. The cases reveal remarkable continuities in administrative and professional knowledge regarding the explanation of socio-technological disasters, as well as the widespread use of outside experts to interrogate the supposed failings of interested parties.

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In the path-breaking book published in 1978, *Man-made Disasters*, the sociologist Barry Turner questioned the limits to an engineer's expertise when faced with explaining the causes of socio-technological failure. Whilst engineers benefited from having technical skills with which they could account for engineering failure, they were more likely to find fault with external environmental and organisational factors that were outside their control, rather than identify deficiencies with their own specialised knowledge-base and skills-set.¹ Two decades later, after Turner's death, the book was re-issued with an additional chapter by Nicholas Pidgeon. Turner and Pidgeon established the consensus that, rather than being 'bolts from the blue', socio-technological disasters (as 'man-made' disasters will be referred to in this article) are complex events, the product of long incubation periods, during which 'failures of foresight' develop based on erroneous assumptions, misinformation or misunderstandings within large organisations. Disasters, they argued, are the outcome of a lack of knowledge, mistakes made by engineers and other interested

parties, and the failure to act upon early signals of failure. They are the product of social, organisational and technical practices; they also reveal longstanding technological and administrative deficiencies within large organisations' safety cultures. Moreover, such events are subsequently subjected to intensive scrutiny by administrative, technical and political actors, from both local and central government.²

Given the long-standing influence of Turner's work within the field of disaster studies, it is surprising that comparatively few historians have explained the causes of socio-technological disasters through recourse to his classic study. The overwhelming majority of research has been published in specialised journals devoted to the study of disasters, crises and emergencies: history only really exists here as a backdrop to reveal 'a prior, more fortunate time, when foresight, prudence, good behavior or divine grace might have unscrolled history toward a happier conclusion.'³ One or two exceptions exist: for example, E.L. Quarantelli, Patrick Lagadec and Arjen Boin have shown how historical studies reveal

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¹ B.A. Turner, *Man-made Disasters*, London, 1978, 31.

² B.A. Turner and N. Pidgeon, *Man-made Disasters*, Oxford, 1997. See also S. Gherardi, Man-made disasters twenty years later: critical commentary, *Health, Risk & Society* 1 (1999) 233–239.

³ S. Jasanoff, Introduction: learning from disaster, in: S. Jasanoff (Ed), *Learning from Disaster: Risk Management After Bhopal*, Philadelphia, 1994, 1.

changing social interpretations of disaster, as well as cultural differences in coping with everyday disaster, but they remain concerned with explaining the emergence of systematic disaster research as a recent phenomenon.⁴

This historiographical blindness to Turner is largely reflected by the historical field's focus on post-disaster reconstruction and re-planning.⁵ It is also the product of an eclectic and varied global interest in disasters from multiple sub-fields: urban and environmental history, the history of technology, science, technology and society studies, planning history, and, more recently, cultural history.⁶ Whilst one can celebrate the multi-disciplinarity of the field, the history of disasters lacks a disciplinary centre, which has inevitably generated a fragmented approach towards historical analysis.

In nineteenth-century Britain, civil engineering was an evolving field of technical knowledge and professional practice contingent on the diffusion of shared cultural beliefs through an associational network. Engineering knowledge evolved through practice, which included learning from mistakes made on the ground. The only really effective way that such knowledge could be shared more widely was through national associations of professionals, such as the Institute of Civil Engineers (ICE), founded in 1818, and the Institution of Mechanical Engineers (IME), established in 1847, which organised lectures and published proceedings for wider dissemination. With increasing specialisation, new fields emerged, each with their own knowledge, approaches and institutions, which inevitably meant that the profession lacked a single coherent voice.⁷

Nowhere was the quest for professional expertise more evident than in the field of nineteenth-century British waterworks design. In their pursuit of ever larger supplies of potable water, private companies and municipal authorities extended their urban footprints ever further into the surrounding countryside. Public health crises, marked by outbreaks of cholera and other water-borne diseases, were an inevitable consequence of the unprecedented growth of industrial towns during the first-half of the nineteenth century. Waterworks were consequently built to provide a regular supply of clean water for commercial, industrial and residential consumers. Moreover, since the provision and management of waterworks was integral to the successful functioning of the urban economy, the supply of water had to be regulated and serviced by large organisations. These included joint-stock companies, quasi-elected property-owning oligarchies, and a small but growing number of elected municipal water departments, all of which drew upon an increasingly specialised external labour pool to design the plans and engineer the works.⁸

This paper is the first to integrate the historical scholarship on Victorian urban water supplies with the sociology of disasters, in

order to scrutinise the ways that socio-technological disasters challenge existing professional expertise and culture. It continues a well-established trend in the history of technology literature to assess the value of technological change through detailed empirical analysis.⁹ Two major reservoir failures in mid nineteenth-century urban-industrial Britain – the Bilberry Reservoir above Holmfirth, near Huddersfield, in West Yorkshire (1852), and the Dale Dyke Reservoir at Low Bradfield, up-river from Sheffield in South Yorkshire (1864) – involving high human casualties, brought the engineering profession into dispute in explaining systemic failures in waterworks technology. Engineers debated whether such events were the product of poor engineering, defective management or natural causes. Evolving knowledge formed the bedrock for such contestations, which took place in various professional and public arenas. By focusing on the relationships between different experts during these two cases, this paper argues that the creation and dissemination of expertise occurred on contested terrain. It draws upon extensive archival research into the records of the waterworks' proprietors, local and central government, as well as the media. In so doing, it contributes to growing scholarly interest in the history of professional experts as members of an elite group responsible for the control and management of the environment and its resources.

A tale of two floods

The Holmfirth and Sheffield floods occurred twelve years and roughly twenty miles apart, but they shared important similarities in the design, construction and operation of the reservoirs, as well as the public's reaction to their failure. Both involved the collapse of commercially-designed and legally-sanctioned earthfill embankment reservoirs, which remained a popular style of reservoir construction into the second half of the nineteenth century despite growing safety concerns. Although they were subject to cracking and subsidence, they remained popular on grounds of cost and because they constituted an agreed type of 'working knowledge' following years of practice. As John Pickstone has shown, technological and scientific decision-making was invariably based on available knowledge, which was derived from a combination of observational and interventional methods: since the latter was, in the mid nineteenth century, an expensive and risky option for contracted engineers, they preferred to follow existing methods rather than experiment with alternative building materials like concrete and stone.¹⁰

As Christopher Hamlin and Anthony Wohl have shown in relation to Victorian public health improvements, local elites invariably based their decisions about infrastructural investment on a combination of incomplete and evolving technical knowledge, weighed

⁴ E.L. Quarantelli, P. Lagadec and A. Boin, A heuristic approach to future disasters and crises: new, old and in-between types, in: H. Rodríguez, E.L. Quarantelli, R.R. Dynes (Eds), *Handbook of Disaster Research*, London, 2007, 16–41.

⁵ For example, L.J. Vale and T.J. Campanella (Eds), *The Resilient City: How Modern Cities Recover from Disaster*, Oxford, 2005; G. Parrinello, The city-territory: large-scale planning and development policies in the aftermath of the Belice Valley Earthquake (Sicily, 1968), *Planning Perspectives* 28 (2013) 571–593.

⁶ On the relationship between these sub-fields, see J.K. Stine and J.A. Tarr, At the intersection of histories: technology and the environment, *Technology and Culture* 39 (1998) 601–640. For a flavour of the recent literature, see C. Mauch and C. Pfister (Eds), *Natural Disasters, Cultural Responses: Case Studies toward a Global Environmental History*, Lanham, 2009; G. Bankoff, U. Lübken and J. Sand (Eds), *Flammable Cities: Urban Conflagration and the Making of the Modern World*, Madison, 2012; J.H. Jackson, *Paris Under Water: How the City of Light Survived the Great Flood of 1910*, New York, 2010; S.G. Knowles, *The Disaster Experts: Mastering Risk in Modern America*, Philadelphia, 2011.

⁷ R.A. Buchanan, Institutional proliferation in the British engineering profession, 1847–1914, *Economic History Review* 38 (1985) 42–60.

⁸ J. Hassan, The growth and impact of the British water industry in the nineteenth century, *Economic History Review* 38 (1985) 531–547; R. Millward, *Private and Public Enterprise in Europe: Energy, Telecommunications and Transport, 1830–1990*, Cambridge, 2005, 33–58; H.L. Platt, *Shock Cities: The Environmental Transformation and Reform of Manchester and Chicago*, Chicago, 2005; H. Ritvo, *The Dawn of Green: Manchester, Thirlmere and Modern Environmentalism*, Chicago, 2009; J. Broich, Engineering the empire: British water supply systems and colonial societies, 1850–1900, *Journal of British Studies* 46 (2007) 346–365; J. Thornton and P. Pearson, Bristol Water Works Company: a study of nineteenth-century resistance to local authority purchase attempts, *Water History* 5 (2013) 307–330.

⁹ D. Edgerton, Innovation, technology, or history: what is the historiography of technology about? *Technology and Culture* 51 (2010) 680–697.

¹⁰ N. Smith, *A History of Dams*, London, 1971, 171–181, 212–225; J.V. Pickstone, Working knowledges before and after circa 1800: practices and disciplines in the history of science, technology and medicine, *Isis* 98 (2007) 489–516; J.V. Pickstone, A brief introduction to ways of knowing and ways of working, *History of Science* 49 (2011) 235–245.

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