10. DISCUSSION

The New Waverley development has afforded a unique opportunity to investigate the New Street Gasworks through excavation, historic building survey and recording of the upstanding remains, artefact analysis and documentary research. This marvel of 19th-century innovation was key to the industrial development of Edinburgh and played a significant role in the history of the Canongate and Edinburgh's Old Town. The archaeological fieldwork encompassed the first major excavation of an urban gasworks in Scotland and has revealed significant evidence of its construction and modification which can be associated with critical developments in technological processes in gas production in Scotland and beyond.

These investigations have provided a wealth of information about the construction and use of the Gasworks buildings and demonstrated the role the Gasworks had to play, not only in the development of industry in Edinburgh, but in the advancement of coal gas technology more widely, with far-reaching effects on British society. Research into contemporary documents, newspapers and legislation demonstrates the enormous impact the Gasworks and its processes had on the residents of the Canongate, for better and for worse.

Why was the development of the New Street Gasworks and coal gas lighting technology so important to Edinburgh during the 19th century? An article written by David Laing for the *Proceedings of the Society of Antiquaries of Scotland* and published in their 1857–59 volume gives some insights into the living conditions in the Old Town of Edinburgh prior to the availability of gas lighting. This article, entitled 'Proposals for Cleaning and Lighting the City of Edinburgh (with original signatures of a number of the principal inhabitants), in the year 1735' presents excerpts of an 18th-century manuscript outlining the deplorable state of the City's streets and the efforts put in place to encourage improvement. The main cause of complaint was the lack of sanitation and the common practice of 'throwing over every kind of filth, ashes, and foul water, at shots, windows or doors in the High Street, or in closes, wynds, or passages of the city' (Laing 1859: 174). Comment is also passed on the lack of illumination of the streets and the adverse effects on the local residents. The author quotes from an anonymous poem entitled *The Cloaciniad*, written in 1761, which describes:

> The dangers which the wretched mortal meets,
> Who dares at ten to tred Edina's Streets …
> (Laing 1859: 172)

Laing notes that in 1735, when this proposal was drawn up, the town was 'not then lighted with gas, and the lamps [candle and oil], if I mistake not, were usually extinguished by nine o'clock', and quotes from Fergusson's poem, 'Auld Reekie', that those wishing to traverse the streets after this hour had to carry lanterns 'to guide them through the dangers of the night' (ibid: 176). One of these dangers of the unlit streets was described by Laing as 'that so soon as St Giles' clock struck ten, the windows were simultaneously opened for a general discharge [of waste] … and the streets and closes resounded with one universal cry, Gardyloo!' (ibid: 177). Laing quotes Sir Walter Scott, who states that 'family resided above family, each habitation occupying one story of the tall mansion, or land … accessible by one stair, which, common to all the inhabitants, was rarely cleaned and imperfectly lighted' (ibid: 178). The darkness of the Edinburgh streets was also known to encourage those of an unsavoury character to prowl the city unchecked. In the early 16th century, the Scottish poet Dunbar 'makes mention of the "Stinking Style", a covered passage leading from the north side of St Giles' Church to the opposite side of the High Street, known as the Luckenbooths. It existed and retained its name for at least three centuries, in the very heart of the city, and was a noted place for filth, assaults and robberies' (ibid: 172).

It is in this context that the New Street Gasworks were proposed and, by some, welcomed. The limitations that the hours of darkness placed on the activities of the populace were now relieved, and gas lighting of the streets, houses and establishments of Edinburgh facilitated longer working hours, feeding the City's industrial revolution. The illumination of the streets of Edinburgh went hand-in-hand with the perception of a city 'on the rise' and the New Street Gasworks represents an innovation in chemical engineering that heralded a new era in Edinburgh's development.

Alongside Glasgow, the first major coal gas production centre to be opened in an urban setting in Scotland, the New Street Gasworks led the way; soon gasworks were being established in the surrounding areas of the rapidly expanding city and across Scotland. As well as Edinburgh and Glasgow, Cotterill lists 31 further gas companies formed in Scotland up to 1833, including several in settlements on the outskirts of Edinburgh and Glasgow, for example in Leith, Penicuik, Port Glasgow and Paisley, as well as numerous companies in locations across Scotland as diverse as Alloa, Arbroath and Ayr, Campbeltown and Cupar, and Aberdeen, Dundee and Inverness (Cotterill 1976: 120–1). The continual modification and expansion of the Gasworks complex, as demonstrated by the numerous intercutting, overlapping and overlain structural elements revealed during the excavation, are indicative of the increasing demand for gas lighting across the city, which was sustained until the end of the 19th century, when electric lighting began to overtake what was, by that time, seen as an outmoded technology. The development and sprawl of the Gasworks complex at New Street is well documented by cartographic evidence but, as already noted, analysis of the contemporary documentary records reveals that the cartographic survey process could not, at times, keep up with the pace of the construction and additions to the Gasworks infrastructure, resulting in discrepancies between the map evidence, the documentary records and the surviving structural features exposed in the ground. As a result of the excavation, six broad phases of development of the Gasworks could be traced through the surviving structural features, but inevitably some areas and building remains could not be reconciled with the contemporary cartographic and documentary records.

Among the mass of red brick, stone and metal, exposed beneath the concrete of the New Street Bus Depot, it has proved difficult to isolate the work of the many individual hands that contributed to the development of the Gasworks and led to its success over its decades of operation. Many of the individuals associated with the operations of the New Street Gasworks, such as John Grafton, were pioneers in their field and were responsible for innovative developments in gas-production technology. This included the continual process of refining techniques and engineering new systems to produce higher-quality products while also reducing the negative impacts of the noxious by-products. Of all the engineers involved in the New Street Gasworks, it is probably Grafton's innovations that are the most apparent among the excavated features, in the form of the surviving refractory clay retorts and their associated benches and furnaces.

Nineteenth-century complaints over inconsistency in the quality of the gas, the smell of the product and the pollution resulting from the gas-production process all drove improvements in the technology employed by the New Street Gasworks. Even the by-products from the production process were exploited to their fullest. Coke, coal tar and sulphur are but a few of the materials produced during the gas-production processes which were sold on for other uses. This was often lauded as the Gasworks fulfilling its responsibilities to keep pollution to a minimum, but it appears to have been encouraged by the high prices that could be charged for these waste products; a sideline industry that could be more profitable than the gas production itself.

To the residents of the expanding city whose water was poisoned and whose air was polluted by the noxious fumes and sulphurous odours, the New Street Gasworks was also a source of misery. The wealthier residents of the Canongate, with the financial means to move, sold their properties and took up residence in more salubrious and genteel areas of the city after the establishment of the Gasworks. By the mid-19th century, the demographics of the Canongate had entirely changed; the area was populated by the poorer classes and maintenance of the properties had decreased. Archaeological evidence of the Gasworks' attempts to reduce the pollutants entering the city's groundwater, and the adjacent stream that fed the Calton Hill Brewery, was identified during the excavations in the form of several wells that were intended to provide the Gasworks with a sustainable and independent water supply. However, it is known from 19th-century legal complaints that these efforts were not entirely successful.

The voices that are less easy to hear in the story of the New Street Gasworks are those of the workers themselves. Recollections of working conditions at other contemporary and later gasworks have to be used as a proxy in this instance, but we

know that the day-to-day toil would have been physically demanding, set within the context of the extreme heat of the furnaces and the noxious fumes of the retort houses. It did not go without notice that those corrosive gases produced within the Gasworks building during its operations were so severe that they caused the iron and steel fittings to degrade; a fact witnessed in the poor condition of the surviving iron objects, tools and fixtures from the site. In later phases of the site's development we see the employment of galvanised steel fittings, perhaps an attempt to thwart the worst effects of these destructive fumes. However, less concern appears to have been expressed over the welfare of the employees of the Gasworks, and one is left to imagine the effects that such fumes had on those who inhaled them every day, leading to both respiratory diseases and skin conditions. Burns, crush injuries and chemical poisonings must have been typical effects on a gasworker's life. The foundation of a National Union of Gasworkers and General Labourers in March 1889 arose from these poor working conditions.

A rich photographic archive of the Gasworks buildings during the later years of its operation and prior to its demolition survives in the collections of Historic Environment Scotland's National Historic Environments Records. These have proved a valuable source of information in the identification of the various underground structures exposed during excavation. They provide an insight into the former appearance of some of the features, such as the retort benches and chimneys, for which only the foundations survived at the time of excavation. Individual artefacts, such as the scroll-shaped decorative plaster console brackets (see 9.2 'The architectural plasterwork') and architectural ironwork (see 9.8.3 'Architectural ironwork' above), provide glimpses of some of the other areas of the Gasworks, perhaps the office suites or public areas.

The removal of above-surface structures and machinery in the early 20th century made identification of the function of many features exposed during excavation problematic, such as the various large platforms for engines and machinery. It is clear that as many of the metal tools, fittings and fixtures as possible were stripped out and salvaged from the Gasworks for scrap or reuse, meaning that the surviving evidence is incomplete. Survivals include tools used to feed and clear the furnaces and retorts and fittings that relate directly to the gasworking process, including an intact Glenboig fireclay retort, an iron retort inspection box and spoked hand wheels that would have been used to adjust the valves to pipes that transported water and gas in the exhauster house.

As well as the 19th-century Gasworks, the archaeological investigations at the New Waverley project also uncovered significant evidence of earlier activity on the Canongate, stretching back to the late 12th century. This expands on evidence for the occupation of the Canongate backlands identified during previous archaeological works, confirming the presence of medieval and post-medieval backland occupation identified by Gooder during the original evaluation works (Gooder 2000). Evidence for medieval occupation has also been identified to the east of the present site at 22 Calton Road (Jones & Holden 2003) and at Canongate Poorhouse (Engl forthcoming), confirming the wide extent of these medieval backlands north of the Canongate.

The excavation across the Gasworks and at the other sites in this part of the Canongate, including the PA1(A) and PA1(B) sites (Appendix 1), have therefore revealed pockets of survival of early backland deposits, of medieval and post-medieval date, demonstrating that even on a site as heavily disturbed by industry as the Gasworks, evidence for previous land use can survive.

The nearby Poorhouse excavations of 2013 and 2014, associated with the PA1(C) area of the New Waverley development, revealed an area which, like the present site, appears to have been on the periphery of the medieval Canongate Burgh. It was in open cultivation from the 12th/13th century until the development of more formal burgage plots between the 14th and 17th centuries. In this area, the presence of imported ceramics shows that the Canongate remained the preserve of Edinburgh's wealthy mercantile elite until the economic decline of the mid to late 17th century (Engl forthcoming). Unfortunately, at the present site, ceramics were rare in the later medieval period but late-16th- and 17th-century imports were present, reinforcing the evidence for elite occupation of the Canongate area at that time. While the greater part of the pottery assemblage at the present site comprised industrial-produced wares of 19th-century date, a Ch'ien Lung

(*c* 1760–70) Chinese Export teapot perhaps suggests that the decline in the standing of the area was a prolonged process.

Occasional sections of wall, including two areas where walls contained window bays, evidenced occupation of the present site in the period prior to the Gasworks by significant buildings, likely domestic structures of 18th-century date. The artefacts from these surviving islands of post-medieval backland soils demonstrate a diverse post-medieval community, and as well as a broad array of household ceramics, including imports from China, Italy, Holland and Germany, the assemblage of clay tobacco pipes, produced both locally and further afield (although having a residual character), forms an important group that illustrates the development of the local pipe production industry and includes the earliest pipe so far identified in Scotland.

The New Street Gasworks and the technology it introduced to the City of Edinburgh changed the face of the Canongate and had far-reaching effects on the living conditions of the local community. The New Waverley development has provided a unique insight into this Gasworks which was at the forefront of Edinburgh's burgeoning industrialisation and heralded the City's progression into the modern era.