

4. THE NEW STREET GASWORKS AND EDINBURGH'S GAS INDUSTRY

4.1 An introduction to the development of the gas industry

Extensive archaeological works associated with the New Waverley development (which is described in 6 'The excavated evidence: New Street Gasworks' below) have recorded remains of the 19th-century New Street Gasworks, which supplied Edinburgh with fuel for gaslight, and later for cooking and heating, from 1817 to its closure around 1906.

4.1.1 Origins of the gas industry

The use of the word 'gas' to refer to flammable vapour is believed to have been coined by Jan Baptista van Helmont (1577–1644), a Flemish scientist who in 1609 discovered that 'a "wild spirit" escaped from heated coal and wood'. This he termed 'gas' from the Greek *chaos* (Peebles 1980: 7). Several people have been recorded as discovering combustible coal gas in the 17th century, including, in Britain, the Rev John Clayton of Wigan, who in 1684 lit gas collected from heated coal and described it as 'Spirit of Coals' (*ibid.*).

As early as the 1780s Archibald Cochrane, the ninth Earl of Dundonald, was using coal gas to light rooms in his house at Culross in Fife (Wood 1982: 1). The Ayrshire-born William Murdoch, while working for Matthew Boulton and James Watt, experimented with coal gas in Cornwall, lighting a room of his house in Redruth in 1792 before installing an experimental lighting system at the company's works in Birmingham in 1798 (Hunt 1907: 42–3, 49; Wood 1982: 2). Murdoch became known as 'the father of the gas industry', as he 'innovated various practical developments in making, purifying and storing gas from coal during his ... employment' (Peebles 1980: 8).

Early use of gas for lighting took the form of private supplies for individual buildings, rather than larger-scale public supply. In Britain, Boulton and Watt saw the potential for supplying cotton mills, installing lighting at the Manchester works of Phillips and Lee between 1806 and 1807 (Hunt 1907: 66; Wood 1982: 2). An article in *The Edinburgh Observer* in 1817 notes that around 1806,

... several attempts were made by private individuals to introduce the gas-lights into their shops in Glasgow and Edinburgh; but the method of separating the different ingredients obtained from coal in the process of distillation, and of purifying the gas to render it fit for burning without offensive smell, was then very imperfectly known, and consequently they were soon abandoned. (*Edinburgh Observer* 1817: 5)

Williams has described how gas lighting caused 'something of a social revolution' as 'by the middle of the nineteenth century ... city streets were brightly lit, making them safer and more conducive to social life at night. Theatres, concert halls, railway stations, and other public spaces too, knew a new brilliance' (Williams 1981: 33–4).

The idea for the use of coal gas for lighting public areas had come from the German, Friedrich Albrecht Winzer, who after changing his name to Frederick Albert Winsor, formed the Chartered Gas Light and Coke Company (also known as the London and Westminster Gas Light and Coke Company) in London in April 1812, the first public (municipal) suppliers of gas (Wood 1982: 2) and the first 'commercial gas enterprise' (Peebles 1980: 2, 10). The Gas Light and Coke Company, based at Great Peter Street in Westminster, began operating in 1813 (Thorsheim 2006: 138) when they built the first gasworks in the world, laid wooden pipes to carry the gas, and 'illuminated Westminster Bridge with gas lamps on New Year's Eve in 1813' (Peebles 1980: 10). Although the success of Winsor's 'splendid illumination' of the streets of Pall Mall was lauded in Edinburgh as a 'first brilliant display of gas-lights in the metropolis' (*Edinburgh Observer* 1817: 5), the success of his company depended on his chief engineer, Samuel Clegg. By 1815 the company had laid 26 miles of gas pipe through London (Wood 1982: 2). Clegg was one of the great early innovators of this industry as he had in 1805 erected 'a gas apparatus in the cotton mill of Henry Lodge, Esq., near Halifax', and had used lime in an attempt to purify gas the next year (Hunt 1907: 70). Clegg was also the designer of 'the horizontal rotary retort in 1817' (Peebles 1980: 10).

4.1.2 Growth and decline of the gas industry: from gaslight to electricity

In the early 19th century, domestic demand for gaslight 'proved far greater in Scotland than in England' (Cotterill 1980: 19), no doubt due to the relatively longer winter nights. Gas was used widely in private dwelling houses earlier than in English cities, with relatively little use of gas in 'the better class of houses' in London and other English towns for this purpose even as late as 1874, perhaps also due in part to 'the far higher purity of Scottish gas' (Cotterill 1976: 1218–19).

The world's first gas cooker was invented by James Sharp as early as 1826 (Peebles 1980: 11). However, while there were early examples of the use of gas for heating and cooking, and the public became more aware of the use of gas for these purposes from 1840 onwards, very few could afford to use gas fuel in this way (Cotterill 1976: 1278). Alexander Graham of Glasgow's Eagle Hotel produced the only popular Scottish gas cooker of the 1850s–60s (*ibid.*). The growth in the use of gas for purposes other than lighting, including cooking and heating, began in earnest in Britain around the late 1870s with the emergence of competition from electricity (Thorsheim 2006: 147). Cotterill notes that 'special gas rates for stoves became a normal procedure for encouraging their use by the end of 1884 in small and medium size companies' but less so at 'the largest undertakings at Glasgow and Edinburgh, which had less fear of rapidly losing their markets to electricity' (Cotterill 1976: 1287).

Peebles notes that gas-powered 'water heaters, room heaters and many other ancillary appliances such as soldering irons and hair-curling tongs appeared on the scene in the mid to late 1850s' while in 1855 Robert Wilhelm von Bunsen invented the atmospheric burner that bears his name, permitting the use of gas 'as a fuel for a whole variety of industrial and other applications' (Peebles 1980: 11). The use of gas in smaller-scale industrial roles is noted by Cotterill, although 'Scottish "town gas" was not widely used for heat in large-scale industrial processes during the nineteenth century' (Cotterill 1976: 1308–9). He notes, however, that 'on a small scale, gas blowpipes, soldering-iron heaters, crucible heaters and annealing furnaces were widely used by 1850' and 'even a town like Edinburgh with

only light industry, in 1911 used gas for branding, linotype bronzing and laundry machines, kilns, coffee-roasters, tailors', upholsterers' and laundry irons, enamelling and drying stoves and gas-heaters' (*ibid.*). Williams states that in the later 19th century 'the gas engine provided industry with a power unit small enough to be used to drive industrial machines, or small groups of machines' (Williams 1981: 38).

The introduction of the electric dynamo in the 1870s presented the first real threat of competition to the gas industry. The main role of gas was in lighting and, prior to the cheap availability of high-quality incandescent gaslight mantles for street lighting around 1895, illumination by gas used burners that were generally quite inefficient, and gave a variable quality of light (Peebles 1980: 11). In 1881 electric lighting was introduced experimentally in Edinburgh and in 1895 the city's first electric power station was established at Dewar Place (Shakhmatova et al 2012: 24). Despite this, the decline of the coal gas industry was a prolonged event with the last gas lamp in Edinburgh being turned off on 21 April 1965 in Ramsay Garden (*ibid.*: 23). Indeed, on the opening of the Granton Gasworks, which would ultimately supersede the New Street works, in 1903, the health of the coal gas industry was noted in the 'face of the evident progress of the Electrical Industry' (Herring 1903: 5). The introduction of incandescent burners was a boon to the gas industry, enabling 'Scottish gas undertakings ... to compete successfully with electricity for lighting, and to foster a rapidly expanding market for domestic cooking and space heating' (Cotterill 1976: 1315).

4.2 The techniques and technology of early gas production

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The last surviving (though no longer operational) town gasworks in Scotland is Biggar Gasworks, and there the various elements of a late-19th-century/20th-century gasworks can be seen, albeit on a significantly smaller scale than the New Street Gasworks. This includes elements such as the coal store, retort house, chimney and gasholders, as well as the extensive apparatus associated with the cleaning of the gas and removal of by-products.

In the condenser pipes ‘the gas-tar mixture was cooled and most of its tar removed’; the exhauster ‘pumped gas through the scrubber (or filter system) to remove the rest of the tar and ammonia’, while the purifiers used ‘powdered iron oxide ... to remove toxic hydrogen sulphide from the gas’ (Historic Environment Scotland 2017).

In the early 19th century, the coal gas produced for the supply of towns across Britain was referred to as ‘town gas’. It was produced by heating coal in a closed tubular vessel, known as a retort, usually closed at one end and fitted with a door at the other. These were originally made of cast iron and were later manufactured with more heat-resistant fireclay and silica (Wood 1982: 4). The retorts provided an oxygen-free atmosphere and were heated by a furnace, and when several retorts were heated by the

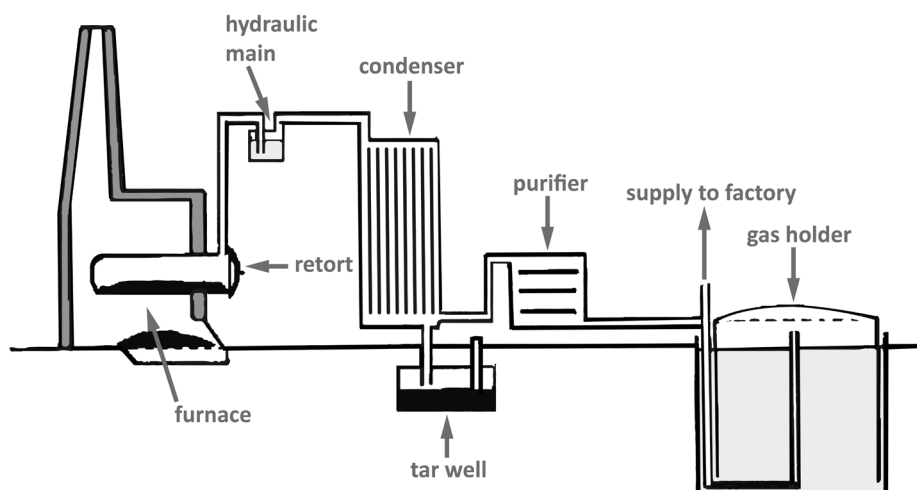
same furnace these retorts became a ‘retort bench’ (Illus 10; Sproat 2006: 33).

The heated coal gave off a complex mixture of gases, mainly hydrogen, methane and carbon monoxide, and various impurities. The residue left behind after the gas was given off was coke, which was used to heat the retorts or sold as fuel. From the outset, it was realised that it was inefficient and impractical to attempt to manufacture gas at the rate at which it was required to be used and so gasholders were used to store gas for use at peak periods. Illus 11 is a schematic representation of a simple gasworks.

The carbonisation of coal at high temperatures produced ‘inflammable air or carburetted hydrogen, which is the primary object of the process, and by the combustion of which the light is supplied’



Illus 10 New Street Gasworks retort bench prior to demolition (© HES)



Illus 11 Schematic diagram of a simple gasworks process

(Edinburgh Observer 1817: 27). ‘Despite becoming red-hot, the coal did not burn, because the retorts were tightly sealed to keep out oxygen. Instead, the extreme temperatures forced virtually all of the volatile constituents from the coal’ (Thorsheim 2006: 137). The useful fuel gases produced included hydrogen, carbon monoxide and methane, while tar, sulphur compounds and ammonia were also produced as by-products (Wood 1982: 4). The ‘gases [were] driven off into a hydraulic main ... then purified, by-products removed and sold on, the gas stored in a holder, metered and distributed’ (Adamson et al 2016: 189). The hydraulic main provided a water-lute, effectively a seal, so that gas was distributed from the retorts under water and ‘could not blow back as an explosive mixture as the retorts were opened for charging with coal’ (Cotterill 1980: 20).

The elements of an early gasworks included the furnace, which heated from below the airtight horizontal retorts (Illus 10 & 12) filled with coal; gravity-fed inclined retorts were invented in 1885 (Peebles 1980: 15) and later vertical retorts were used. Heat then distilled gas from the coal, leaving residual coke, which was removed before the retort was refilled with fresh coal. Raw gas, including impurities, would rise through an ascension pipe to pass to various treatment vessels (Russell 1973; Hide 2010: 7).

First, condensers cooled the gas in order to remove volatiles, which could otherwise have caused

pipe blockages when they condensed into viscous liquids. John Perks invented a ‘multiple inverted U-tube air-cooled design’ of condenser in 1817, which permitted tar and ammoniacal liquor to be siphoned off (Cotterill 1980: 32–3). Then the gas went through a series of structures to purify it and remove by-products.

The exhauster was invented by S Broadmeadow at Abergavenny in 1825 (Cotterill 1980: 34). These machines were especially suitable for the clay retorts of Scotland. They were ‘normally placed after the condensers, and pushed the gas forwards through the purifiers and on to the gasholders. By taking the full weight of “back-pressure” caused by the friction of gas passing through that apparatus, the exhauster reduced the pressure of gas in the retorts, thereby reducing damage to the retorts and drawing out larger volumes of gas from the coal’ (Cotterill 1976: 310). An efficient exhauster was invented in 1841 by John Grafton at Cambridge, following his time at New Street (Cotterill 1980: 34).

The washer was a simple gas-tight box where gas passed through perforated wooden boards running with water (Cotterill 1980: 35), the gas bubbling through water to absorb ammonia, carbonic acid gas and hydrogen sulphide (Russell 1973; Hide 2010: 7). The gas then passed through the scrubber, which was ‘very similar, but in the form of a tower with elaborate sleeves and a water-spray at the summit’ (Cotterill 1980: 35) where sulphuretted



Illus 12 Horizontal retort benches and double furnace in process of demolition (© HES)

hydrogen was removed. It was the rise in ammonia prices in the late 1860s that led to the technological development of washers and scrubbers ‘to remove saleable ammonia and residual tar from gas’ (ibid).

The gas would then go through a purifier, initially using lime though later iron oxide was utilised. Dry lime had been used for purification as early as 1806, while Samuel Clegg introduced wet liming, purifying gas by means of a bucketful of lime suspended in water. In 1817, Reuben Phillips of Exeter patented gas purification using slaked, or damp, lime, although this was not widely adopted until the 1860s. Instead, dry liming was at first popular in provincial Britain, as the residue could be used as a fertiliser. The residue from wet liming, known as ‘blue billy’, was noxious and difficult to dispose of. From around 1850, iron oxide came to be used for purifying. Sulphur compounds such as sulphuretted hydrogen could combine with the iron oxide to form iron sulphide (Williams 1981: 15).

The gas product would be sent to a gasholder for storage before distribution through a pipe system, while wells were used to store liquid and

tar (Russell 1973; Hide 2010: 7). The quantities of gas produced and stored would need to be gauged, and Samuel Clegg took the first patent for a ‘wet gas meter’ in 1815, with dry meters being introduced around 1850 (Peebles 1980: 15). The meter house monitored the storage and capacity of the gasholder to indicate the volume of production, supply and demand (Sproat 2006: 34). Another vital element of the gasworks was the coal store, which had to be kept well ventilated as coal oxidises when in large heaps, raising its temperature and leading to a ‘danger of spontaneous combustion’ (ibid: 33, 37).

4.2.1 By-products

A large part of the area of a gasworks was taken up in removing impurities from the gas, including plant for the recovery of those by-products, such as ammonia and coal tar, that could be profitably used elsewhere (Wood 1982: 4).

Albert Winsor produced two pamphlets in favour of the gas production process in 1804, which are referenced by Hunt (1907: 94–5). He indicates

that five ‘costly products’ can be gained from the smoke from the combustion of fuel, ‘viz. oil, pitch, acid, coke and gaz’ (ibid: 96). Among the many benefits enumerated by Winsor is ‘the value of oil and pitch, to be collected from the condensator’ (Hunt 1907: 99). Additionally, the acid recovered ‘is a very powerful astringent lie, far superior to all kinds of bark in tanning skins, &c., estimated only at triple value of the coals’ (Hunt 1907: 100).

Therefore, substantial quantities of by-products from coal gas production could be collected for profitable resale, including coke, tar and ammonia liquid:

Coke could be broken into pieces of small, uniform size and sold for domestic use with the benefit that it would produce heat without the polluting black smoke of coal fires. Tar could be mixed with clinker, ashes and ground granite for surfacing footpaths, and processed to make creosote to preserve railway sleepers. Ammoniacal liquor from the gas scrubbers could be converted into sulphate of ammonia for use as a powerful agricultural fertiliser. Sale of the residual coke and other by-products from the gas making process could recoup about half of the cost of coal. (Hide 2010: 6–7)

Even the lime used in the purifiers of early gasworks could be resold, after use, as a fertiliser, though this was unfortunately a means of spreading pollution (Thorsheim 2006: 141).

One of the major products of gas production, coal tar was ‘much in demand for naval purposes’ and was used to protect roofs (Butt 1967: 148). Naphtha was of more value than tar or liquor, as it was used ‘as a solvent, especially for Macintosh’s rubberized fabrics’ (Cotterill 1980: 32). Macintosh discovered that coal-tar naphtha produced in the distillation of pitch from tar ‘could be used as a solvent for India-rubber and therefore was essential for waterproofing textiles’ (Butt 1967: 149). He patented in 1823 ‘his double-layered cloth’, using ‘about six thin coatings of rubber in naphtha brushed onto the interior side of both layers to allow thorough solvent evaporation and “drying” before sealing them with a final sandwich of solution’ (Cotterill 1976: 544).

4.2.2 Development of new techniques

In the early 1870s, Professor Thaddeus Lowe invented a process for the production of water gas ‘comprising hydrogen, carbon monoxide and certain other substances’ with a high calorific value but unfortunately ‘little illuminating power’. In order to increase both these qualities ‘the gas was fed into a carburettor, a brick checker work chamber’ and enriched with oil to produce carburetted water gas (CWG) (Peebles 1980: 13–15). This technique spread so that ‘most medium and large town gasworks in Britain operated water gas plant at some point during their operational history’ (Thomas 2014b: C5). The water gas production process ‘generated gas through the action of steam upon red-hot carbon (generally in the form of coke). The generator would be filled with fuel, ignited and brought to temperature through the “blow” phase. Once brought to temperature, the system would enter the “run” phase and steam would be admitted. The gas was produced on the principle that heated carbon acted as a reducing agent for the steam as it passed through, the oxygen in the water combining with the carbon and giving off hydrogen gas’ (Thomas 2014b: C5). Furthermore, ‘the plant used to purify water gas was similar to coal gas, but additional plant was used to attempt to separate the CWG tar from water, eg tar separators and settling tanks’ (Thomas 2014b: C12).

Regenerative firing was introduced in Britain around the same time as carburetted water gas and was a cost-saving technology that reduced wear and tear on gasworks plant. In regenerative firing ‘the fuel gas is heated within the [retort] setting by a secondary air supply, previously heated recuperatively by the waste gases of combustion’ (Webber 1918: 22–3). This technique reduced coke fuel consumption and ‘more evenly heated the horizontal retorts, increasing their lifespan’ (Cotterill 1980: 27). Herring, describing the use of this system late in the life of the New Street works, notes that half of the air supply used for carbonising coal was ‘primary air’ while half was heated by recycled hot waste gases, using the gaseous-fired system first applied by Sir William Siemens in Germany (Herring 1907: 81) in the late 1850s to ‘increase furnace efficiency’ (Cotterill 1980: 26–7). This technological advance was facilitated within

gasworks by the introduction of more heat-resistant fireclay retorts from around the 1850s.

4.3 The development of the gas industry in Scotland and the beginnings of Edinburgh's gasworks

It was in the provision of street lighting that coal gas found its first major utility in the early 19th century. According to the *New Statistical Account*, attempts had been made as early as 1554 to introduce street lighting to Edinburgh, 'by hanging out bowets or lanterns from certain places fixed upon by the magistrates, which were to be kept lighted for four hours' (NSA 1845: 758). The town's magistrates further ordered, in 1684, that 'a lantern with a burning candle ... was to be hung out at the first story [sic] of every house, under a penalty of five merks' and 'in later times, the streets were pretty well lighted up by means of oil lamps till the introduction of coal gas' (ibid). In 1701 Edinburgh Town Council appointed the first public lamplighter in the Old Town and by 1786 the Council maintained 307 lamps (Shakhmatova et al 2012: 4–5) while the Committee of Police Commissioners in August 1820 wanted contractors to use 'the best Greenland whale oil' for street lighting (ibid: 7).

The origins of gas production in Edinburgh can perhaps be traced to James Milne, 'a journeyman brassfounder, who in about 1816 built gas apparatus both for his own Edinburgh premises, and to light the three main shops in that city' (Cotterill 1976: 82). In 1817, it was reported that 'in the course of the last and present years, manufactories, shops and private houses, in Edinburgh and its vicinity, have been lighted up with the gas from pit-coal; and extensive gas-works are now in progress for the purpose of lighting the public streets' (Edinburgh Observer 1817: 5–6). Early use of coal gas in Edinburgh and its environs appears to have included the erection of 'apparatus on the improved construction for the purpose of lighting up his own works and dwelling-house' by 'Mr Gutzmer, proprietor of the Foundry on Leith Walk' (ibid). Mr Gutzmer then built similar apparatus for other commercial premises including: 'Mr Haig's extensive distillery at Lochrin'; 'Mr Blackwood's shop in College Street'; 'the spacious shop and large warehouses of Mr Henderson, grocer' and

'the shop of Mr Scott, apothecary' (ibid). The latter two establishments are said to have used gas lighting during the winter of 1816–17 in order to produce 'a most brilliant illumination', and further 'elegant shops' were planning to make use of gaslight for display. Mr Gutzmer also provided gas apparatus for 'Messrs Lizars, engravers, St James's Square', providing not just lighting but also 'heat for the plates; and thus the use of stoves or small furnaces for the same purpose, a necessary but oppressive appendage for the workmen, is now entirely superseded' (ibid).

Thus Edinburgh found itself at the vanguard of the development of the commercial use of gas and similarly of gasworks technology. Edinburgh and its municipal rival Glasgow set up the first gas companies in 1817, five years ahead of any other Scottish burgh (Cotterill 1976: 121). Apart from London, only a few towns in England had by that time already developed a public gas supply, including Preston, where an Act of Parliament in 1815 led to the forming of the Preston Gas Light Company, and where Samuel Clegg's assistant John Grafton acted as engineer (Awty 1974; Thomas 2014a: A6); Grafton would go on to have a major role in the development at New Street.

In 1816 Kincaid Mackenzie, merchant and chief magistrate in Edinburgh, led a deputation of ten local merchants and tradesmen to petition Edinburgh Council for permission to supply gas in the city. The members ... owned property or were residents in the city and had first met in May 1816. (Cotterill 1976: 153)

In a recent study of the English gas industry (which is of use in understanding the wider British industry), Russell Thomas has described the development of the ownership of these enterprises, with the running of the industry moving from private individuals, to private companies operating in municipalities (such as Birmingham), before commonly being taken over from the late 19th century onwards by municipal authorities in order to better organise the ever increasing supply (Thomas 2020a: 2). The ownership models included 'private ownership, company ownership and municipal ownership' and 'most [early] gas undertakings had

statutory powers resulting from an Act of Parliament to break open the streets, lay gas pipes and provide gas lighting, though many small undertakings were established without these powers' (ibid). The Edinburgh Gas Light Company was one such private company, which required its own Act of Parliament to function in Edinburgh. It was established in 1817 (NSA 1845: 758), with a Prospectus being issued in March 1817 (NRS GD504/3/97/11). Its preamble optimistically noted that, 'The use of Inflammable Air from Coal, as a substitute for oil or tallow, in lighting Streets, Warehouses, Shops, Manufactories, Public Offices, and Dwelling-Houses is now completely established in London and elsewhere in England, and from its economy, safety and brilliancy, bids fair, in a great measure, to supersede every other mode of lighting.' The Edinburgh Gas Light Company initially aimed to raise £20,000 sterling capital divided into 800 shares of £25 each, which it was believed was sufficient for 'erecting the Works and Apparatus, Laying the Mains and Branch Pipes' and also 'to light with Gas such a proportion of the principal Streets, Shops, &c, in the City, as will enable the Subscribers clearly to ascertain how far this mode of lighting will prove beneficial to the Public at large and yield an adequate return to the Company'. However, even at this early stage the Prospectus envisioned a potential need for further 'New Stock ... to embrace the lighting of the whole of the Old and New Extended Royalty, and Places adjacent' (NRS GD504/3/97/11: 1). The company's business was defined as the 'manufacture of Gas or Inflammable Air from Coal, and lighting therewith the Streets, Lanes, Shops, &c of this City, disposing of the Coke, Oil, Tar, Pitch, Asphaltum, Ammoniacal Liquor, and Essential Oil, the produce of the manufacture' (NRS GD504/3/97/11: 2).

In 1818 an Act of Parliament allowed for gas production to light the city of Edinburgh (NRS GD504/3/97/14). The Act of 1818 noted the benefits to Edinburgh's citizenry of the better lighting of 'Streets, Squares, Public Passages and Places, and Houses, Shops and Manufactories' and that inflammable air from coal could be 'safely and beneficially used for lighting'. It permitted the company to raise money to erect and keep gasometers 'and all other Works and Conveniences belonging or requisite thereto' (NRS GD504/3/97/14: 1, 3).

On incorporation in 1818 the original governor of the company was Kincaid Mackenzie, then Lord Provost of Edinburgh, while its deputy governor was Sir John Marjoribanks, Baronet of Lees, who had been Lord Provost between 1813 and 1815. The desire of citizens of high status to be associated with the company is clear from a list of its founding subscribers contained within the 1818 Act, which includes William Arbuthnot, another former Lord Provost (between 1815 and 1817), and Alexander Henderson, Lord Dean of Guild, and many more significant officeholders and academics (NRS GD504/3/97/14: 2, 23; Mullan 1996: 208). The Company was led by a group of men from the aristocracy, professional and mercantile classes, commonly resident in Edinburgh. The nature of the company's investors in 1821 has been analysed by Cotterill:

Of the twenty-five Directors listed in the Edinburgh company's Act of 1818, only Sir George MacKenzie of Coul had withdrawn his support by 1821. All of the remainder were genuine investors, many of them still Directors. Bankers invested only small cautious sums in the company ... The main centre of support was nevertheless the professional classes and the gentry. 79 investors from the former included 31 solicitors and lawyers, and the professional class dominated the highest investment bracket. As heavy investors they were closely followed by the gentry of whom 88 invested over all categories ... The third principal source of finance was from retail shopkeepers with 41 investors including 10 in the highest bracket, followed by wholesale merchants, and then industrialists. (Cotterill 1976: 205)

Additionally, 'very few investors lived outside Edinburgh, and the Rev. J Abernethy (III) of Bolton and J Barker (III) of Oldham were the only Englishmen' (ibid: 206).

The New Street Gas Works was built soon after the passing of the Act of 1818 and was one of Britain's earliest gasworks, following the development of a system for using gas for lighting by the German chemist Friedrich Accum (Adamson et al 2016: 151). John Grafton, a pupil of Samuel

Clegg at the London Chartered Gas Co (Cotterill 1980: 20), was the first trained specialist at the New Street Gasworks and is believed to have ‘designed and overseen the building of much of the gasworks’ (Adamson et al 2016: 189). This was an example of the importing of skill in gasworks to Scotland from London, the focus of the early industry (Cotterill 1976: 104). Prior to the passing of the Act of Parliament of 1818, Grafton arrived to ‘survey Edinburgh and estimate the costs of a gasworks’ (ibid: 153–4). Roofed buildings would have covered the retorts, lime stores, purifying apparatus and coal stores of the works as well as the gasholders, which ‘at this time would have been of wood on an iron frame suspended above a water-filled pit’ (ibid). The manager of the New Street Gasworks from 1818 to 1859 was John Watson, ‘... a non-scientist but an acute businessman who left the technological aspects to J Grafton’ (ibid: 157).

In Edinburgh responsibility for street lighting had passed in 1785 to the Police Commissioners. The Commissioners’ Minute Books for November 1819 note, ‘... that part of the High Street from the Tron Church to the Parliament Close shall on both sides be forthwith lighted with gas’ (Shakhmatova et al 2012: 6–7). In 1821, the governors and directors of the Gas Light Company intimated that there had been several meetings between the directors of the company and the committee of the Commissioners of Police with regards to the lighting of Edinburgh’s principal streets, which had led to ‘part of the High Street, the North Bridge, and the corners of several of the streets from Prince’s Street to George Street, &c’ being ‘for some time lighted with gas by mutual consent of the Committees by way of experiment’ (NRS GD504/3/97/7: 2). A year later the governor and directors reported that they had made an arrangement with the Commissioners of Police ‘to light the whole of the High Street, North and South Bridges, and Nicholson’s Street, and latterly Prince’s Street, Charlotte Square, George Street (both sides), York Place, and Picardy Place, &c.’ (NRS GD504/3/97/5: 1).

The New Street site was developed ‘as the centre for Canongate’s supply’ (Adamson et al 2016: 151) and ‘in the spring of the following year [c 1818], the shops on the North and South Bridges were lighted up with this brilliant light’ (NSA 1845: 758). One source indicates that on 20 April 1818

‘the company commenced giving this brilliant light to such shops as had taken branches from the pipes in the principal streets. The theatre commenced lighting with gas on the 3rd December 1818; and now all the streets in the city are furnished with gas lamps’ (Stark 1834: 306). An advertisement in *The Scotsman* newspaper of March 1823 indicates that gaslight was being used to illuminate an exhibition of ‘Belshazzar’s Feast and Joshua’ at the Calton Hall on Waterloo Place, Edinburgh (Edinburgh Corporation 1926: 17, Advertisement from *The Scotsman*, March 1823).

The NSA (1845: 758) further describes the rapid and broad spread of gas lighting through Edinburgh as ‘next winter [c 1819] the theatre and public streets were lighted up, and in a short time, gas was very generally introduced into private houses’. By 1830 it is said that there were 5,300 gas street lights in the city (Chambers 1830: 89), though Shakhmatova et al (2012: 20) suggest that by 1847 the number of public gas lamps in Edinburgh was up to 761, and perhaps a proportion of the street lights in 1830 were still fuelled by oil.

4.4 The further development of the New Street Gasworks

In Edinburgh, by the 1840s, the various ‘Flesh, Fish, Poultry and Vegetable Markets’ set up in proximity to the New Street works in 1819, were ‘fitted up with gas’ (McDowall & McDowall 1842: 99). As well as supplying gas for lighting public spaces, the New Street Gasworks also supplied private houses, as a letter from the company notes the use of meters for ‘large Establishments and Private Houses’ (NRS GD1/1246/1_c). The introduction of gas supply to ‘a number of Private Houses’ is confirmed in a letter of March 1825 (NRS GD1/1246/1_g). Indeed, Cotterill suggests that in the 1830s progress in the lighting of dwelling houses was much greater in Edinburgh in comparison with London (Cotterill 1976: 1218). Another early use found for gas was the lighting of public clocks, as ‘the clock on Edinburgh Tron steeple was lit in 1823’ (Cotterill 1976: 1249).

As early as June 1821, at a meeting of the Edinburgh Gas Light Company’s proprietors, it was being stated that increasing demand for gas had necessitated ‘a further expansion of the Company’s Works’ and that at their last meeting (in 1820),

the company 'had entered into Contracts for the erection of an additional Retort House, a New Flue or Chimney, Four New Gasometers, and Tanks, and corresponding Buildings, and additional Pipes, &c, the estimated expense whereof was calculated at £18,000 Sterling'. Although these works were nearly completed by June 1821, they led to a new share subscription (NRS GD504/3/97/7: 1). Other alterations to the Gasworks site noted at this time included a new road entrance to the works and to the High Street, which had transferred entry to the east boundary of the works, as an old road was 'occupied by, or included in the sites of the four new Gasometer-Houses'. Additionally, the construction of a new wall along the North Back of the Canongate meant that the east and the north sides of the works were to be wholly enclosed, having formerly been open (NRS GD504/3/97/7: 2). The expansion of the works appears to have been completed by June 1822, when it was reported that the 'Four New Gasometer Houses and Cisterns, – an additional Retort House, – a New Flue or Chimney, – and a Steam Engine, not only for a supply of Water to the Works from a pit-well, but also constructed as to turn the Lime Purifiers' were completed and operational (NRS GD504/3/97/5: 1).

A questionnaire filled out by the company in November 1825 gives some details of the workings of the retorts at New Street. Each 'oven' is described as having five circular retorts, 12 inches in diameter. An average of 140lb of cannel or parrot coal was used in each charge of the retort, with 46lb of coal used in the furnaces for each charge of the retorts. Each charge is said to take between four and a half and five hours to work off, and the retorts, which were worked constantly, lasted seven or eight months (NRS GD1/1246/1_j). New Street was unusual in its use of advanced technology, as generally Scotland appears to have 'lagged behind' England in such multiple retort technology, with direct heating of single retorts being normal practice in the 1820s and 1830s. As early as 1817, A Rackhouse's 'oven plan' had been developed in London, with three or more retorts heated together by controlled 'indirect heating' (Cotterill 1980: 25).

However, another potential innovation was not taken up at New Street at this early date – the use of fireclay rather than cast iron in retorts. This was in spite of John Grafton, the New Street works'

specialist, having 'devised a fireclay lining for iron retorts in 1818', and having created retorts made entirely of fireclay in 1820 (Cotterill 1980: 25–6). The cast iron retorts first used in the production of 'town gas' were 'costly and short-lived in consequence of the perishing of the metal' (Webber 1918: 9–10). Cotterill notes that 'cast iron retorts were an expensive aspect of early working costs because they corroded rapidly at high temperatures or cracked in half when cooling ... Clay retorts were only one-sixth as expensive, and their widespread adoption was an important stimulus to the Scottish gas industry. The problems with iron retorts led John Grafton to experiment with fireclay while employed on the construction of Edinburgh gasworks ... The new Edinburgh company was unwilling to try this radical design, but Grafton persuaded several English gasworks to experiment with it' (Cotterill 1976: 280–2). However, in 1832, clay retorts were introduced at the Edinburgh Gas Light Company, which entirely superseded iron by 1838 (ibid: 290).

The Gasworks was located on the heavily occupied ridge between the Old Town and Holyroodhouse. This central location would have 'reduced the amount of pumping needed to move the gas to its customers' (Adamson et al 2016: 189). It was also at not too great a height as 'the expanding properties of rising gas ... required forceful pumping to reach the lower level supply zone' (Cotterill 1976: 132). The NSA provides an early description of the Gasworks in the Canongate, noting that they were 'extensive, and contain eight gasometers'. It also records that in 1825 the Edinburgh Gas Light Company purchased the works at Tanfield, where a failed attempt had been made to manufacture gas from oil rather than coal, the Tanfield site being used by them 'for the supply of the northern portion of the town' (NSA 1845: 758). Other sources indicate that this purchase occurred in 1829 (Edinburgh Corporation 1926: 17). McDowall's *New Guide* of 1842 states that the early New Street Gasworks were 'distinguished by their three lofty chimneys' (McDowall & McDowall 1842: 39).

The Edinburgh Gas Light Company initially faced competition from various sources, notably the Edinburgh Oil Gas Company set up in 1824 with their works in the Tanfield area of Edinburgh (Edinburgh Magazine and Literary Miscellany 1824; Groome 1884: 526; Edinburgh Corporation

1926: 17). Another competitor in the early days of the New Street works was the Leith Gas Light Company, formed by an Act of Parliament of July 1822 to supply gas in Leith; in 1824 it obtained a contract to supply gas to public lamps (McGowan 2012: 263).

The letter book of the Edinburgh Gas Light Company held in the National Records of Scotland (NRS), written between 1823 and 1829 (NRS GD1/1246/1_a), details the company's correspondence, commonly concerning competition with the Oil Gas Company at Tanfield and others. A letter in November 1823 remarks on fears of the opposition of the 'Oil Gas Establishment', but also notes concerns about the Leith Gas Light Company, the 'neighbours in Leith', who 'finding they are to do no good there (in Leith), have resolved to try the more prolific territory of this city, and run the hazard of stepping beyond the power of their Act of Parliament' (NRS GD1/1246/1_d). There appears to have been some public debate on the relative merits of whale oil and coal gas for producing light, for example in *The Edinburgh Magazine and Literary Miscellany*, where a series of letters describe the competing claims of the gas supply companies with regard to their 'illuminating powers' and cost value (Edinburgh Magazine and Literary Miscellany 1824: 736). A letter of May 1824 indicates that the Oil Gas Company had purchased ground at Tanfield and issued specifications for gasometers, tanks and pipes and notes that they 'promise light to the public early next winter'. This letter indicates that an 'Oil Gas Work' had been in operation in Leith 'since August last', as the Leith Gas Light Company also utilised whale oil (NRS GD1/1246/1_f). A letter dated March 1825 indicates that the Edinburgh Gas Light Company 'now [had] two Oil Gas Companies to compete with, the one from Leith, and the other a very extensive one in Edinbr.' (NRS GD1/1246/1_g). The Tanfield operation was chaired by Sir Walter Scott, and this letter opines that he 'knows much more of bookmaking than Gas making' (ibid). Another letter of 1825 notes with a degree of *Schadenfreude* 'a dreadful explosion which took place here from Oil Gas on last Wednesday evening', noting that the explosion occurred in a private house supplied by oil gas and that 'there can be no doubt Oil Gas will explode much sooner, and with far greater violence than coal gas' (NRS

GD1/1246/1_h). The public feared suffocation or explosions from leaking gas from gasworks as 'accounts of such events appeared with disconcerting frequency in newspapers and magazines' (Thorsheim 2006: 142).

As a result of all these factors, the operations of the Oil Gas Light Company at Tanfield were unsuccessful and by 1829 the Edinburgh Gas Light Company owned the defunct Oil Gas Company's works at Tanfield, although an Act of Parliament of 1829 indicates that at that time they were not permitted 'to manufacture Gas from Coal at their works at Tanfield' (GD504/3/97/2: 12). Gas was conveyed by pipes from the New Street works to four gasometers at Tanfield, while there were eight gasometers at Canongate (Stark 1834: 306). By 1834 more than 202,739 cubic feet of gas were being produced at New Street Gasworks daily (ibid).

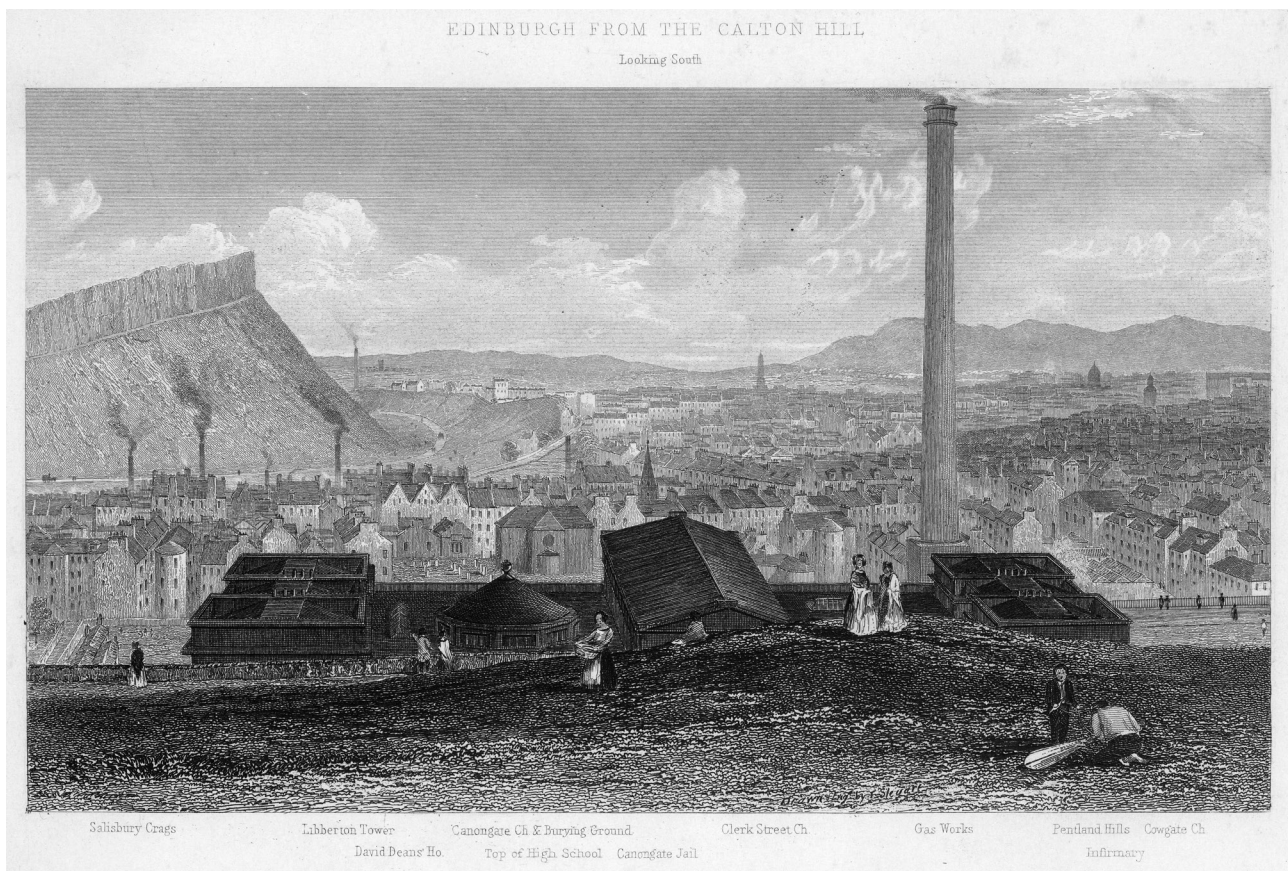
The Gas Light Company therefore appears to have held a near monopoly on gas supply within Edinburgh (but not Leith). In 1829 an Act of Parliament was passed to permit the Edinburgh Gas Light Company to raise further funds, as the original sum raised (£100,000) had been expended (GD504/3/97/2: 1). The requirement for further funding appears to have been caused by the expansion of Edinburgh as its 'Suburbs are in a state of constant increase, in consequence of which a larger supply of Gas has been required' (ibid). The Company was permitted to raise a further £50,000 sterling, and to 'produce Gas ... from any Materials capable of producing the same' (ibid: 2, 4).

Later competition for the New Street Gasworks took the form of the 'Edinburgh and Leith Gas Company', set up in 1839 which, working from a gasworks in Leith, supplied both Edinburgh and Leith (NSA 1845: 758). It was also known as the Edinburgh and Leith Gas Light Company (Edinburgh Corporation 1926: 17). This company 'purchased the gas-works in Leith, belonging to a previous company', the works of the ultimately unsuccessful Leith oil gas concern (Groome 1884: 526). Cotterill notes that it was an unusual early example of competition in municipal gas supply and that 'great difficulty was found in obtaining permission for a gasworks in Edinburgh, until the small existing supply from the Leith company was exploited as a flaw in the defensive monopoly of the Edinburgh company' (Cotterill 1976: 1128).

Cotterill notes the existence of further competing companies in the mid-1840s, including the Union Gas Light Company, the Edinburgh New Gas Light Company and the City of Edinburgh Gas Light Association (ibid: 1138–9). The Edinburgh Gas Light Company continued in direct competition with the Edinburgh and Leith Gas Light Company during the mid-1800s, to the extent that ‘duplicate mains were laid in all the principal thoroughfares, as well as separate service pipes to shops, houses and tenements’ (Edinburgh Corporation 1926: 17). This continued until 1866 when a ‘districting agreement’ divided the Edinburgh and Leith area between the companies (ibid).

A major expansion of the New Street Gasworks occurred in the 1840s, which is represented in the 1854 Ordnance Survey map, surveyed in 1852 (Illus 8). It appears that there were as many as 68 furnaces in operation following the Gasworks’ redevelopment in the 1840s, when George Buchanan constructed the works’ major chimney (Civil Engineer and Architect’s Journal 1851: 34). These 68 furnaces used 34 tons

of coal every 24 hours and required ‘a current of air at the rate of 10,000 feet per minute, which the old chimneys were incapable of drawing’ (ibid). The new chimney was a highly visible element of the Edinburgh townscape for many years (Coghill 2008), and survived until its demolition in 1930 (Adamson et al 2016: 151). Buchanan was a civil engineer who had a reputation for building harbours and bridges, and in 1848 he ‘... began the work of erecting the huge chimney, nearly 400ft in height, of the Edinburgh Gasworks ... [and] he carried out an exhaustive series of experiments to ensure its stability’ (Skempton et al 2002: 93; Illus 13 & 14). The chimney base measured 40 feet 6 inches (12.34m) square at the bottom, which was 12 feet (3.66m) below the ground surface. At the ground surface it measured 32 feet 6 inches (9.90m) (Taylor 1851: 35). The chimney was ‘an important source of motive power, because as hot air escaped up it a draught of fresh air was drawn in to ventilate the retort house and fire the furnaces. Edinburgh found three chimneys, up to 148 feet high, quite inadequate



Illus 13 Engraving of the city of Edinburgh from Calton Hill showing the New Street Gasworks Chimney (© HES)



Illus 14 The New Street Gasworks main chimney seen through the Edinburgh smog in the late 19th century (© HES)

for the sixty-eight furnaces and 178 retorts which were in service' (Cotterill 1976: 310).

It appears that the expansion of the works did not go entirely to plan as, according to *The Satirist* of 3 February 1849, a 'destructive explosion' occurred 'at the works of the Edinburgh Gas Company, which resulted in the almost entire destruction of the splendid new gasometer latterly erected on the ground which once formed the garden of the late Dr Buchanan, minister of Canongate parish' (Satirist 1849). Cotterill expands on this, noting that 'Edinburgh installed the largest Scottish telescopic gasholder in 1848, 100 feet in diameter, forty feet high, with a capacity of 300,000 cu ft. The following year, however, a guide rod snapped and friction ignited the gas which destroyed the holder and nearby houses' (Cotterill 1976: 325). These new works, when completed, were of some interest to the public, including aristocracy; in 1859 the Prince of Wales 'made a point of visiting the works of the Edinburgh Gas Company' (Ladies' Treasury 1859).

While originally the Gasworks at New Street

was set up as a private enterprise, in common with many towns and cities, the gas supply was taken over by the local authorities of Edinburgh and Leith under the Edinburgh and Leith Corporation Gas Commissioners in 1888, when the Edinburgh Gas Light Company and the Edinburgh and Leith Gas Light Company were joined together (Scottish Gas Board 1960: 3). In 1920 the Commission would in turn be dissolved and its role taken over by Edinburgh Corporation (Edinburgh Corporation 1926: 21).

On coming under the management of the Edinburgh and Leith Commissioners in 1888, major renovation works were required at New Street, as 'the Edinburgh company had allowed New Street gasworks to fall into disrepair ... This included a new bench of forty ovens each with eight retorts, heated by carbonic-oxide combustion from producers' (Cotterill 1976: 1064–5).

One of the main incentives for the growth of carburetted water gas (CWG) and other technologies in Britain around 1890 was the increasing expense of cannel coal (Webber 1918: 14–16), previously

utilised for the production of carbonised gas with a high candle power or ‘calorific’ content. The ‘cannel coal crisis’ of 1892 led to the use of poorer-quality coal, which produced gas of a lower candle power (Cotterill 1980: 28). The impetus provided by increased coal prices and lower quality led to ‘the adoption of oil-gas enrichment processes, followed by water-gas to reduce working costs’, with the raising of coal prices between 1891 and 1893 (in part due to rising miners’ wages) even leading to ‘uneconomic experiments with peat carbonization ... in 1893 by Edinburgh Gas Commissioners’ (ibid: 22). By 1893, oil was used to enrich gas at New Street, a process requiring the use of ‘complex and expensive oil carbonization and re-cycling apparatus ... entirely separate from the coal gas retorts’ (Cotterill 1980: 28). It could use surplus coke ‘made available by regenerative firing’ and such plant was installed in Edinburgh in 1895 (ibid).

The introduction of CWG plant occurred late in the life of the New Street Gasworks (Herring 1907: 213) and appears to have been part of a major technological overhaul of the New Street works,

as they were ‘equipped in 1896 with mechanical stokers driven by hydraulic power, coal breaking and elevating machinery’ (Edinburgh Corporation 1926: 19). By the 1890s, the New Street Gasworks also utilised the technologically more efficient gaseous-fired or regenerative system, rather than the direct-fired system of heating retorts (Herring 1907: 80–1; Cotterill 1980: 27).

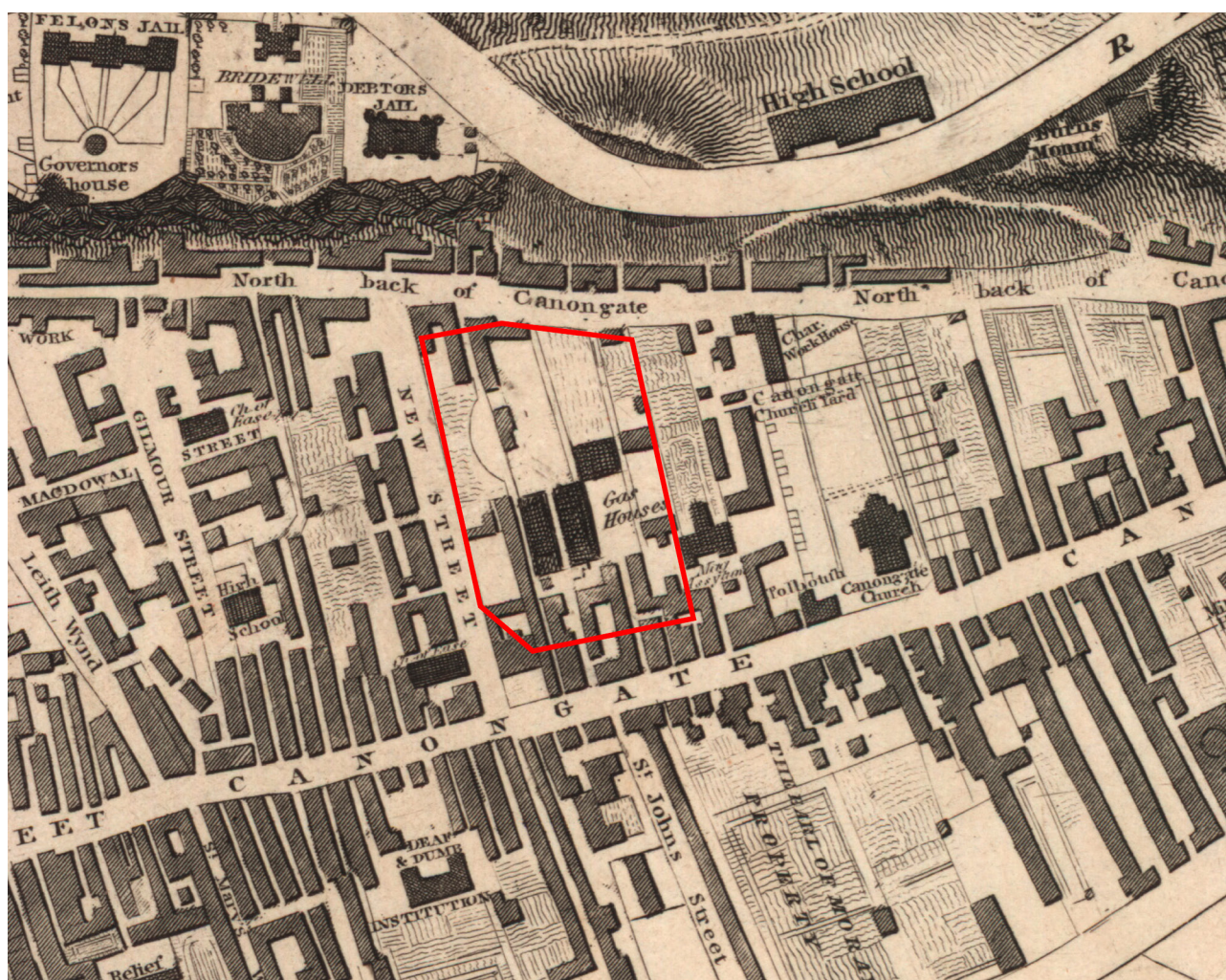
By the end of the 19th century, the New Street site was being employed to its full capacity and was unable to cope with increasing demand. New Street was one of three ‘manufacturing stations ... in a most congested state’ (Herring 1907: v) in Edinburgh, supplying half a million people, its cramped site prohibiting its expansion. Gas production at New Street in the late 1890s was 6,920,000 cubic feet per day on a 4.5-acre site. At this time the New Street works did not utilise on-site gasholders, supplying gas directly with surplus gas being held at ‘six different depots’ in Edinburgh and Leith (ibid). With the employment of Walter Ralph Herring by the Edinburgh and Leith Gas Commissioners as the engineer in charge



Illus 15 Removal of the horizontal retorts in 1911 (© HES)

of Edinburgh's gas supply in 1897 (Scottish Gas Board 1960: 3), it was decided that Edinburgh's gas-producing plants required complete reconstruction to facilitate adequate gas supply for the city (Herring 1907: v). Ultimately, this led to the closure of the New Street works and the construction of the new gasworks at Granton (Scottish Gas Board 1960: 3). These were constructed in two stages (1899–1902 and 1903–10) (Sproat 2006: 36) and were formally opened on 27 February 1903, with gas manufacture having commenced in 1902 (Herring 1903). It had originally been planned to keep the New Street works as a reserve source of power (Herring *c* 1906: 18) but in 1902 the Gas Commissioners decided to expand the Granton works with a 'second section of the works' in order 'to free the city of the incubus of the [New Street] works' (*ibid*: 18–19).

The New Street Gasworks was therefore demolished from around 1906 (Edinburgh Corporation 1926: 17) and images of the dismantling of the buildings on the site are held by Historic Environment Scotland (Illus 15), which show the removal of horizontal retorts in 1911. A few of the smaller buildings had been removed and only one rail track was present by the time of the 1914 Ordnance Survey mapping (not illustrated). After its closure, the Gasworks site was used in part, between 1900 and 1925, as Bathgate Park, a football pitch for junior team Edinburgh Emmet (Adamson et al 2016: 46). The edge of this 'Football Ground' is indicated on a plan dated 1923 of a proposed new workshop to be erected on the north-east corner of the Gasworks site (HES EDD 747/3).



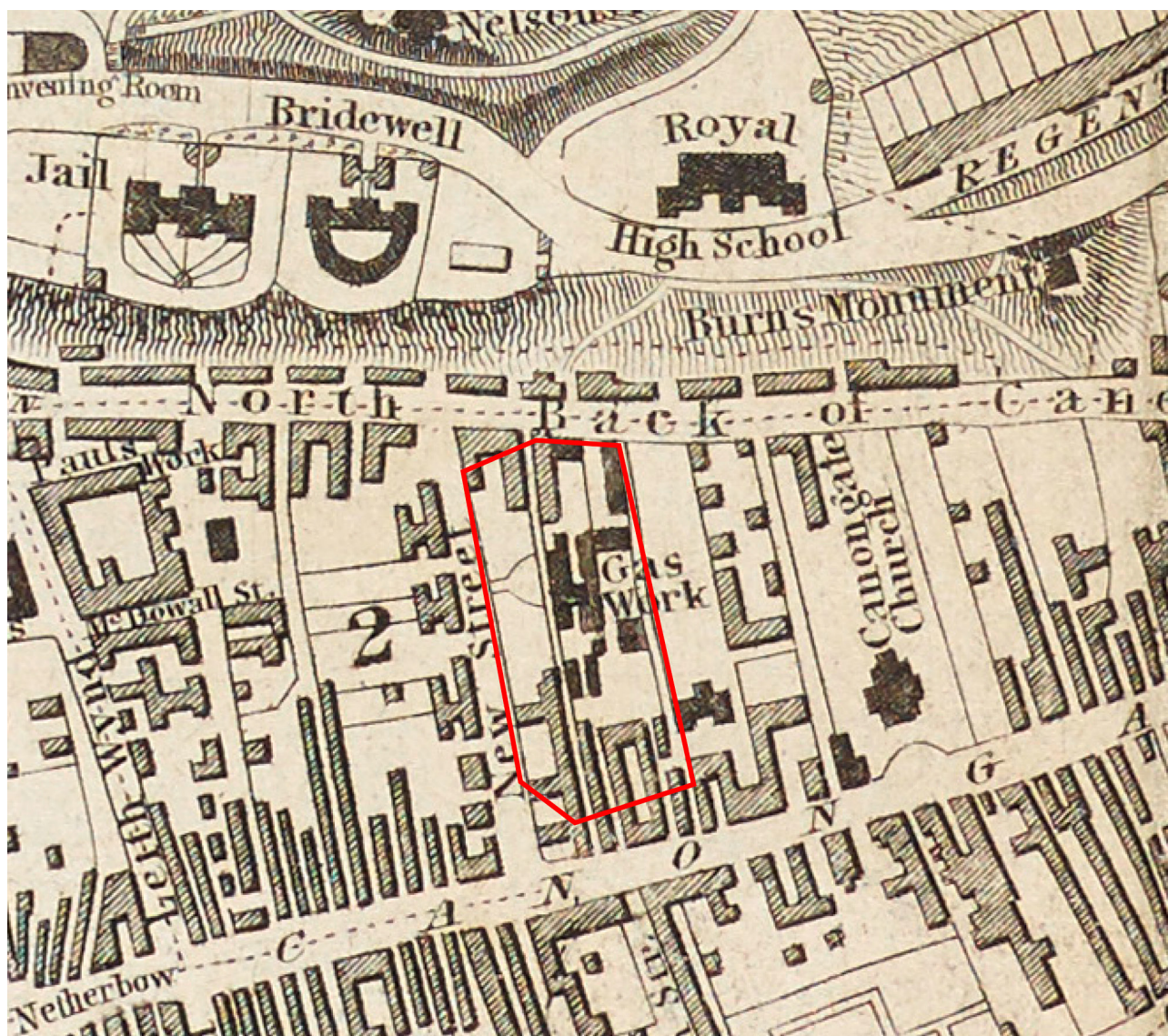
Illus 16 Detail from J Wood's 1823 *Plan of the City of Edinburgh, including all the latest and intended improvements*, Edinburgh: P Brown & T Nelson (Reproduced with the permission of the National Library of Scotland and under Creative Commons (CC BY 4.0))

4.5 The Gasworks and its surroundings: evidence from historic maps and plans

Prior to the Ordnance Survey maps of the mid-19th century, historical maps are varied in detail and ambiguous in the depiction of the development of the structures of the Gasworks. A constant in most mapping of this era is two parallel north/south-aligned blocks in the south-west of the area, while to their north-east is a major block, which had west, north and east wings around an open area to the south (roughly an inverted U-shape). Kirkwood's plan of Edinburgh of 1821 (Illus 7) depicts several buildings of the 'Gas Works', in the

centre of the area between New Street and Tolbooth Wynd, including those just mentioned, as well as a building (shaded in the same way) to the north-east, fronting on the North Back. However, it gives no indication of the functions of the various structures, though one was undoubtedly a retort house for the burning of coal to produce gas. The area, at this period, is far from wholly industrialised, with open areas representing gardens or cultivation depicted fronting on New Street to the west and north of the Magdalene Asylum (Canmore ID 133031), a psychiatric hospital founded in 1807, to the east.

The 'Gas Houses' appear behind the northern Canongate frontage buildings on Wood's map of



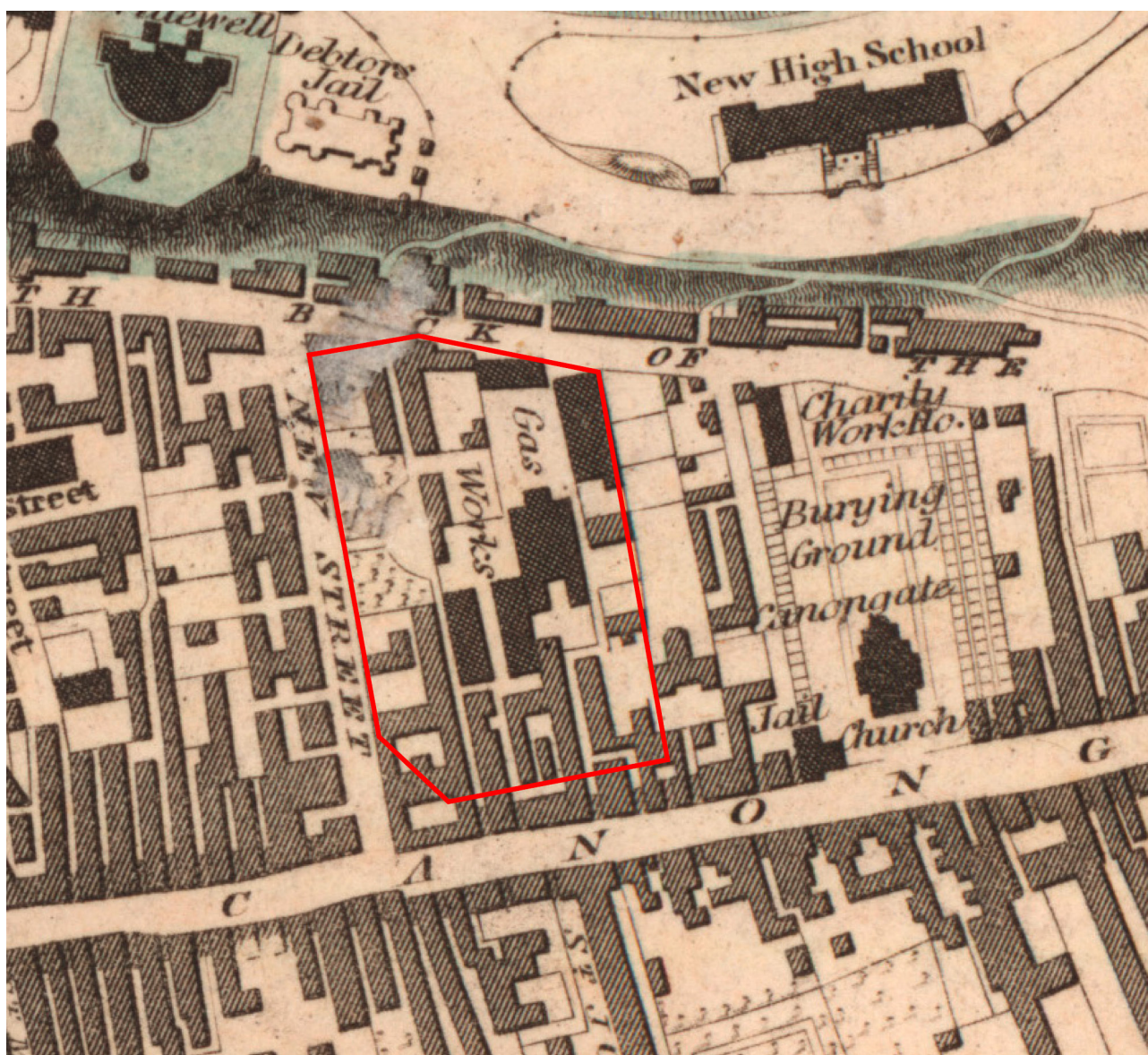
Illus 17 Detail from *Plan of Edinburgh and Leith. From the best Authorities. Engraved expressly for the Letter Carriers Directory, By W.H. Lizars, 1835* (Reproduced with the permission of the National Library of Scotland and under Creative Commons (CC BY 4.0))

1823 (Illus 16). The potentially associated building shown on Kirkwood's earlier map (shaded dark, like the other buildings of the Gasworks) on the south side of the North Back of the Canongate is not visible on Wood's map, suggesting its removal.

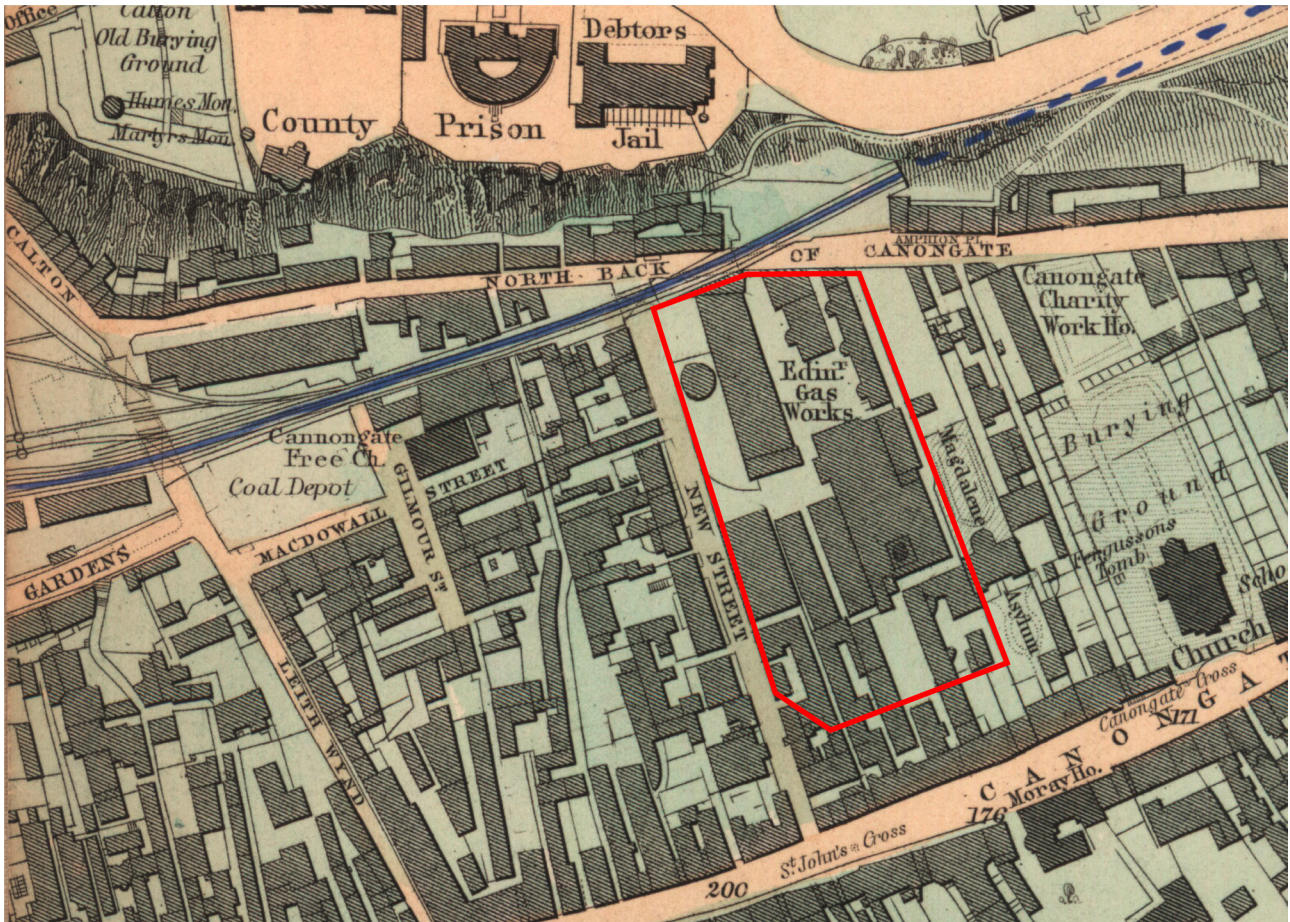
A map published by Hunter and Smith in 1828 (not illustrated) lacks detail but may indicate a new structure to the north of the main Gasworks block. However, the Lizars maps of 1835 (Illus 17) and 1837–8 (not illustrated), perhaps erroneously, indicate a much-altered arrangement of buildings in the 'Gas Works', with only two parallel north/south-aligned buildings still clearly recognisable from earlier maps. While not detailed, these appear

to show an expansion of the structures formerly present further north.

Kay's relatively detailed 1836 map (Illus 18) shows the 'Gas Works' with a similar layout to earlier maps, apart from a new building on the south side of the North Back (although James Kirkwood had actually depicted a building in this area in 1821). Lancefield's (1851) is the earliest map (Illus 19) to depict the alterations of the mid-1840s, with much of the area of the 'Edin. Gas Works', covered by major buildings. The location of the huge chimney that was a major element of the Edinburgh skyline into the 20th century is recognisable, and a gasholder is depicted to the north-west. There is



Illus 18 Detail from J Kay's 1836 *Kay's Plan of Edinburgh* (Reproduced with the permission of the National Library of Scotland and under Creative Commons (CC BY 4.0))



Illus 19 Detail from A Lancefield’s map, *Johnston’s plan of Edinburgh & Leith*. Edinburgh: W & A K Johnston, 1851 (Reproduced with the permission of the National Library of Scotland and under Creative Commons (CC BY 4.0))

some continuity in Lancefield’s plan with earlier maps – the two parallel north/south-aligned buildings in the south-west of the Gasworks are still depicted, though the distinctive outline of the major building formerly visible to its east (with its open area to the south) is not visible, replaced by a major building block (with its chimney), representing the likely reconfiguration of the Retort House.

The Ordnance Survey map of 1854, the First Edition, surveyed in 1852 (Illus 8) shows numerous substantial structures of the ‘Edinburgh Gas Works’, including the circular ‘Gasometer’ to the north-west, near the ‘Condensers’, coal sheds and the ‘Meter House’. Further, rectangular, gasholders and a smithy are located in the north-east of the area, while the south of the site contains further gasholders, two buildings labelled ‘Purifying House’, a ‘Lime House’ and the ‘Fire Department Retorts &c.’. The presence of rectangular gasholders at this

date is unusual, as they apparently represent late survivals of early gasholder technology. Thomas notes that ‘the first gasholders were rectangular and over-engineered, being constructed of iron with a heavy wooden frame’ and that such designs were used by Samuel Clegg in his early gas installations (Thomas 2020b: 191–3, fig 3.162). The two north/south-aligned blocks in the south-west of the Gasworks appear still to be present – functioning as a block of ‘Gas Holders’, to the east, and a ‘Purifying House’ with ‘Gas Holders’ to the west.

Due to the industrial development of this area north of the Canongate, by 1852 the closes that formerly linked the Canongate with Calton Road had been blocked (with the exception of Shoemakers’ Close) or only functioned as access points for buildings. A small ‘Tobacco Pipe Manufactory’ stood to the south of the Gasworks, with the ‘Canongate Foundry’ to the east. Clay tobacco pipe makers are

known to have worked in the Canongate since at least 1622, when the manufacturer William Banks is noted as a prominent pipe manufacturer until his death in 1659 (Gallagher 2008: 1). Another prominent clay pipe manufacturer appears to have later been located south of the Gasworks: Thomas White & Co, which operated from c 1825 to 1867 (Gallagher 1987c).

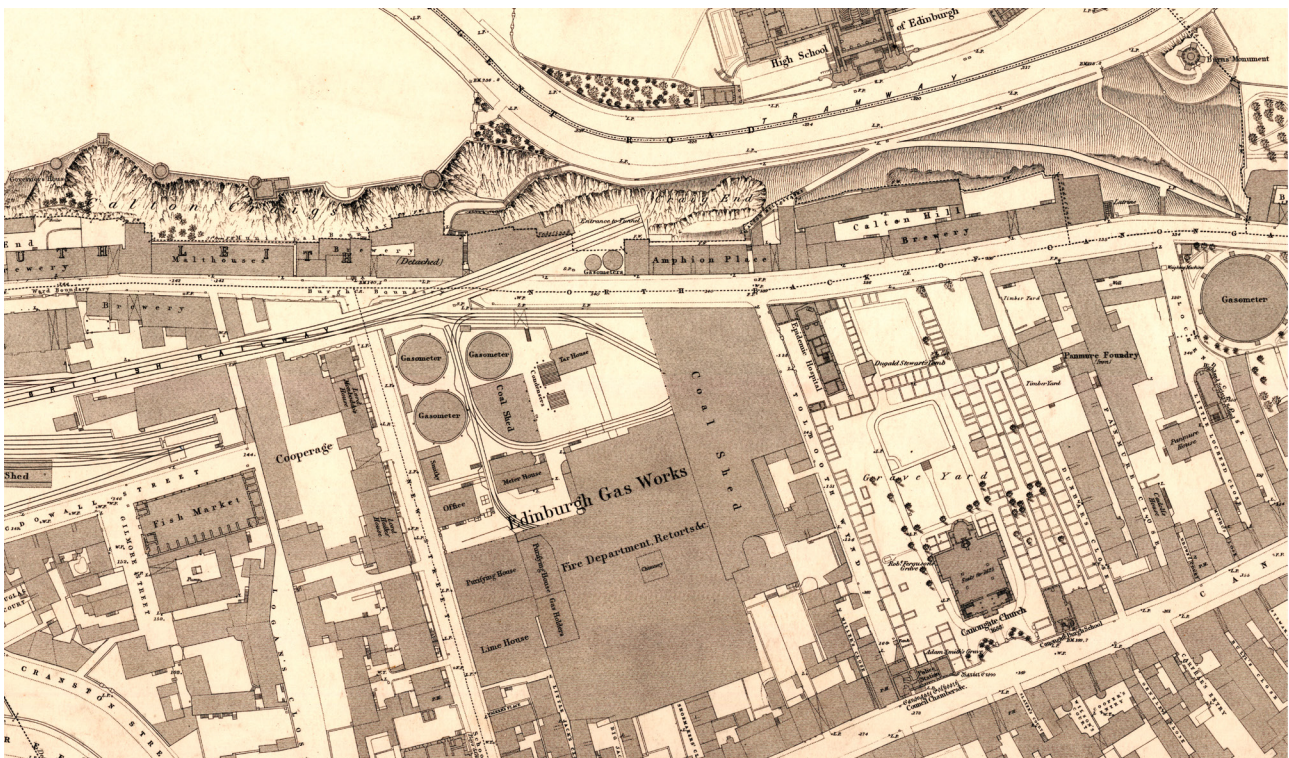
The North British Railway Company was established in 1844, and the East Coast Main Line between Edinburgh and Berwick-upon-Tweed was completed in 1846 (Adamson et al 2016: 50). On the First Edition mapping (Illus 8), the lines of the North British Railway Company are shown, with the main route to the east from Waverley disappearing beneath Calton Hill. On this detailed mapping, sidings running off the main line are clearly visible, entering the north end of the Gasworks, with a western siding ending to the north of the coal sheds, and an eastern siding ending adjacent to unlabelled buildings and Gasholders.

The Ordnance Survey 1877 map, published in 1881 (Illus 20) shows the Edinburgh Gas Works 'Coal Shed' has expanded eastwards, now covering the site of the former Canongate Foundry; the

Magdalene Asylum can clearly be identified, now subsumed within the Gasworks. The outline of the coal shed's plan and it has been suggested that the Gasworks incorporated such existing buildings, 'rather than knock down and rebuild' (Adamson et al 2016: 47).

Adamson et al (2016) have identified various 19th-century iron foundries in the area to the north of the Canongate. In Post Office Directories, the period 1838–53 saw James Blaikie & Sons, founders and engineers, listed at Panmure Foundry. From 1853 to 1859 they were listed as iron founders at Canongate Foundry in Tolbooth Wynd (ibid: 49–50). This is likely the foundry overbuilt by the Gasworks. The tobacco pipe factory is no longer present on the mapping of 1877, as the 'Fire Department' of the Gas Works had expanded southwards as had the 'Lime House'.

The coal shed and 'Fire Department, Retorts, &c.' are indicated as being supplied by an extensive complex of rail tracks entering from the north, connecting with the North British Railway, likely for the delivery of coal and the extraction of waste and saleable by-products (Illus 21). The depiction



Illus 20 Ordnance Survey 1881 (Revised 1877) *Edinburgh* Sheet 30, scale 1:1056 (Reproduced with the permission of the National Library of Scotland and under Creative Commons (CC BY 4.0))



Illus 21 The coal shed in operation prior to demolition (© HES)



Illus 22 Above-ground piping of the New Street condensers prior to demolition (© HES)



Illus 23 Detail from Ordnance Survey 1895 (Surveyed 1894) *Edinburgh* Sheet III.8.12, scale 1:500 (Reproduced with the permission of the National Library of Scotland and under Creative Commons (CC BY 4.0))

of stairways illustrates that the Gasworks operated on different levels. The layout of the buildings in the north of the Gasworks has altered somewhat by the late 1870s. The works has been joined by two additional gasholders (annotated as gasometers) to the north-west side, one of which necessitated the partial removal of the adjacent coal shed (Illus 20). A smithy has also been erected to the south of the westernmost gasholder. The ‘Condensers’ (Illus 22) now occupy a more central location,

adjacent to the ‘Tar House’. The western of the two north/south-aligned blocks, visible on mapping since at least 1821, are still present.

The date of extension of the coal shed, at the corner of the North Back of the Canongate and Tolbooth Wynd, the area formerly occupied by the foundry, is indicated by a plan dated October 1874 (HES EDD 747/5).

The 1894 (published 1895) Ordnance Survey mapping (Illus 23) shows the Gasworks in the last

years of the 19th century, dominated by a single roofed area incorporating a chimney. It appears to have only one major gasholder, the edge of which is visible on Illus 23 to the north-west of the complex (the other two present in the 1877 maps appear to have been removed). The Ordnance Survey map of 1905 (published 1908) depicts the 'Old Gas Works', suggesting that the complex had already ceased to be functional by this time (Illus 24). An additional circular oil storage tank has now been built to the north of the existing holder on the 1894 map. Mapping of 1914 (not illustrated) depicts the area of the 'Old Gas Works' as largely unchanged from 1905, although the two gasholders to the north-west are not shaded and therefore likely no longer in use.

The division of activities in the Gasworks site prior to its demolition in the early 1900s is indicated in more detail on a plan of 1915 (Illus 9) (HES EDD 747/1). This shows that in the north-west of the site there were two circular tanks (as noted above), one for oil storage and the other a gasholder. Immediately east of these was an apparently unroofed area of 'Purifiers'. The offices of the Gasworks stood south of the tanks, on the western boundary of the site (as depicted on earlier maps) and incorporated a 'Meter House'. The major area of Purifiers was a rectangular 'Purifying House', divided into four areas (A to D) covering the south-west of the Gasworks. The largest roofed element of the Gasworks covered the central and eastern zone of the site and was



Illus 24 Detail from Ordnance Survey 1908 (Revised 1905) *Edinburghshire Sheet 003.08* (includes: Edinburgh), scale 25 inch to the mile (Reproduced with the permission of the National Library of Scotland and under Creative Commons (CC BY 4.0))

subdivided into areas E to J; it incorporated a small area marked 'No Roof Over This Portion', which appears to correspond with the site of the chimney on later 19th-century Ordnance Survey mapping. The north-west corner of this structure incorporated a Boiler House, south of a building labelled 'Power and Boiler House'. In the south-west of the Gasworks, accessed from Gladstone Court to the south, was a building divided into a Testing Shop (to the south) and an area labelled 'Meter', the largest still-surviving (2017) element of the Gasworks, while a smaller (still-surviving) building to its east was a 'Workshop' in a 'Pipe Yard'. A lack of clarity in labelling means that it is possible that the larger building was a 'Meter Testing Shop'.

4.6 The Gasworks and contamination

4.6.1 Problems with pollution

The production of gas from coal is a process that produces noxious by-products, and contamination of the environment was a major problem which dogged the New Street works throughout its operational life. In the early days of the Gasworks, it appears that 'by-products such as tar, ammonia and sulphur compounds were not processed or recycled and tended to be collected and dumped' (Adamson et al 2016: 189). As early as 1817, there were objections against 'the offensive smell of some of the products of the distillation' (Edinburgh Observer 1817: 6). By-products included 'a liquor impregnated with ammonia ... a portion of tar and carbonic acid ... and sulphuretted hydrogen ... driven off in the form of elastic fluids'. These impurities could be condensed out by passing the gas through a cold body of water, either mixing with the water or falling to the bottom of a vessel. In the earliest attempts at using gas commercially, all the by-products were collected together 'and from the extremely offensive smell of some of the substances, the operation itself, and the combustion of the gas thus prepared, were quite intolerable' (ibid: 27). Fears of such pollution led the 'inhabitants of New-Street, North Back of the Canongate [to bring] the subject under legal discussion, for the purpose of preventing the erection of the Gas Works ... as a public nuisance'. The dispute was settled by Lord Reston in 1817, who visited New Street and other established private works, deciding that 'the Works

alluded to were not to be regarded as a nuisance' (ibid).

However, by 1817 the various by-products could be collected separately and safely, 'the tar and ammoniacal liquor being received in close vessels, and the sulphuretted hydrogen combining with the water in another vessel connected with the apparatus, the two substances which give out the disagreeable odour are in this manner separated from the gas ... and thus every objection to it as a nuisance, on the score of the offensive smell, may be completely obviated' (Edinburgh Observer 1817: 27). The 'strong eggy smell' associated with gasworks came from the purifiers, where hydrogen sulphide was removed from the gas (Historic Environment Scotland 2017). In the early days of the industry there were two methods of purification of the corrosive carbonisation products, the 'cream' method, using water and quicklime purifiers, and the 'dry' method, using dry lime. The former led to the production of a noxious by-product, 'blue billy' as noted above, which appears to have found its way into Edinburgh's sewers in the 1820s (Cotterill 1980: 34).

Unfortunately, the smell and other polluting effects of the early Gasworks was not entirely dealt with. An anonymous representative of one of the competitors of the coal gas industry, the Oil Gas Works at Tanfield, wrote in 1828 a pamphlet on the *Nuisance in Coal-Gas Works* (Anon 1828). This partisan document sought to inform of the greater polluting effects on residential areas from coal gasworks in comparison with oil gas establishments. It cited people who lived in the vicinity of the Peter Street Gas-work in Westminster such as Mr A D Stewart, who noted that he was 'much annoyed by smell and smoke, proceeding both from the chimney and from parts of the work below the chimney; the smoke is equal to that from a brewery or distillery, and is often connected with a very offensive smell', indicating his intention to move out due to the effects on his family's health (ibid: 11–12). The anonymous author notes that 'the Edinburgh Coal-Gas Work, like those of London, must create similar annoyances to those who dwell in its vicinity, and occasion a similar depreciation of their property' (ibid: 21). A witness from Edinburgh, a Mr Thomas Meggat, Writer to the Signet, who lived in New Street until 1819, but then moved out to

Drummond Street, describes the impact of the coal gasworks on local residents which adversely affected both their health and the value of their properties. Meggat stated that ‘previous to the establishment of the works, New Street was inhabited by professional people and landed gentlemen – but after that period, the class of person inhabiting that street entirely changed’. He further notes that ‘this nuisance arose partly from the gas which escaped in drawing the retorts, and which ... was driven into the houses; and partly from the lime-water, used in purifying the gas, getting into the common drains, and coming up into every house’ (ibid: 22). He suggests that ‘since the establishment of the gas-work, every inhabitant of the respectable class, formerly living in New Street, has quitted it: that the property has been depreciated to at least one-fifth’, and notes his difficulty in selling his New Street property (ibid: 23). The tendency for people, if able, to leave the vicinity of gasworks was noted around the Gas Light and Coke Company’s works in Westminster and elsewhere as ‘gasworks filled their neighbourhoods with smoke and foul smells ... Over time, such localities became occupied almost exclusively by poor and working-class people’ (Thorsheim 2006: 140).

In the Act of Parliament facilitating the expansion of the Edinburgh Gas Light Company’s operations in 1829 it was indicated that pipes and other conduits for conveying gas were to be ‘laid at the greatest practicable Distance from the nearest Part of any Water Pipe ... for the Conveyance of Water’ (GD504/3/97/2: 5). This was backed up by a potential fine of up to £20 when gas contaminated the water supply, with an additional £10 fine for each day the water remained ‘contaminated, tainted, or affected by such Gas’ (ibid: 7). Additionally, escapes of gas were to be stopped by the company, with a fine to be imposed if this was not done within 24 hours (ibid: 8–9). The desire to avoid contamination led to the following statement within the Act:

If the said Company shall at any Time empty, drain, or convey, or cause or suffer to be emptied, drained, or conveyed, or to run or flow any Washings or other waste liquids, or any noisome or offensive Liquids, Substances, or Things whatsoever which will arise or be produced in The Gas Works of the

said Company ... into any River or Brook, or Running Stream of Fresh Water, Reservoir, Canal, Aqueduct, Feeder Pond, Springhead, or Well, or into any Drain, Sewer, or Ditch communicating therewith ... then and in every such case the said Company shall forfeit and pay for every such Offence the Sum of Two Hundred Pounds.

Additionally, the Company would cover the costs of such suits against them and was liable for a £20 per day penalty for not fixing the discharge of washings and waste liquids (ibid: 9–10).

A pamphlet of 1840 describes the polluting effects of the ‘Coal Gas-works in the Canongate’ on a watercourse, a ‘foul burn’ used for irrigation of agricultural land. The Gasworks is said to produce ‘an abundant stream, the odour of which is no doubt extremely offensive, being the most nauseous of all compounds. This flows into a principal feeder of the old foul burn at the south back of Canongate’ (Anon 1840: 8). The author laments that Canongate has ‘gradually ceased to be the fashionable end of town’ (ibid: 126). The pollution of watercourses by gasworks was a common issue as ‘derivatives that appeared to have no commercial value were often allowed to simply drain into the nearest stream or river’. This led in 1821 to one of the earliest episodes of gasworking-related water pollution in Britain, ‘when fish and eels in the Thames were reportedly killed’ (Thorsheim 2006: 141).

4.6.2 The wells

In 1821, the governors and directors of the Edinburgh Gas Light Company had reported that they were ‘in progress of securing a competent supply of water within their premises, which will be drawn from a pit-well by a small steam engine, and which is so constructed as to turn the lime-purifiers, whereby much manual labour and expence [sic] will be saved to the Company’ (NRS GD504/3/97/7: 1). It appears that the requirement for this new water supply was caused by contamination issues. Following a statement regarding ‘Actions of Damages against the Company’, where it is found that ‘certain of the pursuers [were] entitled to £650 of damages ... for deterioration of their properties’, it was noted that ‘considerable improvements’ had been made

to the ‘purifying-apparatus’ and that the company would soon be in possession of a ‘great command of water’ with ‘no reason in future to complain of the effluvia from the lime-water’ (ibid: 1–2). The steam engine was completed and operational by June 1822 and all lawsuits with claimants ‘(for deterioration of their property), from the operations of the Company [had been] fully settled by arbitration’ (NRS GD504/3/97/5: 1–2). This may have been the result of ‘stench from lime containing hydrogen sulphide which escaped into town sewers in 1820 [and] caused great opposition’ (Cotterill 1976: 244).

4.6.3 Contamination of brewery water supply

In its last years, ‘a series of contaminations occurred ... which affected the water supply for the breweries adjacent to the gasworks’ (Adamson et al 2016: 49). In 1890 ‘the chemicals involved in the production of gas were contaminating brewery wells’ (Dennison 2005: 137) and the Edinburgh and Leith Gas Commissioners were sued by James Muir & Son, who ran the Calton Hill Brewery in the North Back of Canongate, between 1905 and 1908. The Gasworks had contaminated the water supply for the brewery, rendering it unfit for use in brewing, and therefore damages were paid to sink new wells for the affected breweries (Thorsheim 2006: 142; Adamson et al 2016: 49). Muir’s Brewery was located to the north of the North Back of the Canongate, covering a large area east of Amphion Place, roughly adjacent to PA1(B) (see Appendix 1). It appears to have been a late occupation of the 19th-century Calton Hill Brewery (NRS GD283/6/233_a). Muir’s brewery was affected by the pollution of both the ‘Brewery Well’ and, earlier, the Stable Well; it was compensated £3,730 for pollution of the ‘Stable Well’ (NRS GD283/6/233_b: 1, 10 and 16).

4.6.4 The use of by-products at New Street

A means by which the negative properties of the commonly highly noxious contaminants produced as by-products in the gas industry could be turned to the good was in the reuse of the by-products, whether recycled as fuel or utilised in other industrial processes. From its earliest days the potential for utilising by-products such as ammonia and coal tar was recognised in the Act

of Parliament of 1817 by which the New Street Gasworks was set up, where it was stated that ‘Coke may be beneficially employed as fuel’ while ‘Oil, Tar, Pitch, Asphaltum, Ammoniacal Liquor and Essential Oil, may be used and applied in various other ways with great Advantage’ (NRS GD504/3/97/14: 1–2).

In 1817, the ways in which impurities were dealt with were described as the New Street Gasworks was being constructed (Edinburgh Observer 1817: 27). This notes that:

the different products of the distillation are collected in separate vessels before they reach the gas-holder. The tar and the ammoniacal liquor are conveyed along cast iron tubes of considerable length, in which they are condensed, and received in a proper vessel; the carbonic acid or fixed air and the sulphuretted hydrogen pass along the tubes to another vessel, where they are absorbed by lime water; and thus freed from the different ingredients from which the offensive smells proceed, the carburetted hydrogen is admitted to the gas-holder, from whence it is distributed for the purposes of combustion.

At New Street, from at least 1819, the coal used for the retorts was described as producing coke that ‘appears to be excellent but as we consume it in our own Furnaces we cannot distinctly state how it might answer others’ (NRS GD1/1246/1_b). The coke produced in the retorts was thus recycled within the New Street works itself and was not sold on. Cotterill notes that from around the 1840s the use of another by-product, tar, as a furnace fuel was developed (Cotterill 1980: 25), and this is likely to have been used at New Street.

Prior to this, in May 1824, by-product tar was supplied by New Street for rubber production as ‘Edinburgh gas company signed a contract for twelve years supply of tar to Dr John Wilson Anderson of Edinburgh, for whom [Charles] Macintosh stood as security’ (Cotterill 1976: 545). An extra market for naphtha opened up in Edinburgh in 1856 when the North British Rubber Company purchased the former Castle Silk Mills to begin the production of cheap rubber shoes (ibid: 549).

4.7 Working conditions and the labour force

While Albert Winsor is said to have claimed in the early 1800s that ‘he had cured himself of a constitutional asthma by superintending the work at his stoves, and inhaling the “hydro-carbonic gas”’ (Hunt 1907: 101), the atmosphere of a gasworks plant was not salubrious. According to a handbook of 1878 quoted by Thorsheim, sulphuric acid fumes filled the retort houses which ‘could eat through unprotected iron’, and ‘even galvanized nails had to be coated with tar to prevent their being “rapidly destroyed by the action of the gases and vapours”’ (Thorsheim 2006: 139–40).

Thorsheim quotes Will Thorne, a Labour MP who had worked at the Saltley gasworks in Birmingham, as stating that work in the retort house ‘was hot and very hard. As the coke was drawn from the retort on to the ground, we threw pails of water on it, and the heat, both from the ovens and the clouds of steam that would rise from the drenched coke was terrific’ (Thorsheim 2006: 138). The job of a gasworks stoker was ‘hot, dirty and dangerous’, and ‘due to the heat they worked with the minimum amount of clothing on, shirt, trousers, gloves and clogs, plus a cap’ (Bird & Nabb 1989: 51).

It appears that the Edinburgh Gas Company by the late 1800s had recognised the health of its workforce as an issue to be addressed, as in 1881 ‘John K Watson, Esq Manager Edinburgh Gas Light Company’ is listed in an advertisement as one of the directors in Scotland of a newly formed company called ‘The Employers’ Liability Assurance Corporation (Limited)’. This assurance company had been set up as a reaction to the Employers’ Liability Act, 1880 as ‘Employers of labour of every description, from and after the 1st day of January, 1881, are held liable to make compensation for personal injuries suffered by workmen in their service ...’ (Capital and Labour 1881). The risks in coke plants and gasworks included lost limbs, crush injuries and burns; in 1930 it was recorded that ‘over half of the “notifiable causes of cancer” in Britain resulted from exposure to by-products created by the carbonization of coal in gasworks and coke ovens’ (Thorsheim 2006: 138). Other health problems present in gasworkers even as late as the

1950s included ‘eczema, warts and melanoma’ (ibid: 140).

Cotterill has analysed the 1861 census to identify the number of ‘Gasworks Services Employees’, including managers, stokers, labourers, etc, across Scotland and found that there were 222 individuals employed in this trade in Edinburgh that year (Cotterill 1976: 688). The various gasworks employees in Edinburgh in 1866 included: Gas Maker (Foreman); Stokers; Retort Men; Coke Men; Engineers; Joiners; Bricklayers; Smiths; Pipe Layers; Gas Fitters and Labourers (ibid: 704). In part, workers’ wages reflected the conditions and skill needed in the work undertaken, with ‘retort men’ paid considerably more than ‘barrow men’ or ‘yard men’. In 1873, for example, the retort workers earned 7½d or 6d per hour; barrow men 6d, and yard men 5½d (ibid: 697–8). Stokers were viewed as a semi-skilled workforce as ‘experience was important in obtaining a high yield of gas from the coal ... The retort house workers came to be regarded – and paid – as semi-skilled operatives rather than general labourers’ (Bird & Nabb 1989: 3–4).

The National Union of Gas Workers and General Labourers of Great Britain was formed in March 1889 when ‘the first effective attempt was made to organise gas workers’. The union ‘grew out of a mass meeting held at Canning Town, London’, where a reduction in shifts from 12 to 8 hours was secured (Bird & Nabb 1989: 3). The 1880s saw industrial agitation in Scotland as workers at the Edinburgh Gasworks ‘threatened to walk out in September 1888 because of bad working conditions and excessive heat’ (ibid: 720). Agitation grew in ‘Glasgow, Edinburgh, Leith, Greenock and Perth’ in 1889 for better working conditions, shorter hours and better wages. Ultimately, branches of the National Union of Gas Workers were opened in both Edinburgh and Glasgow in 1891, and Edinburgh Gasworks saw shifts shorten from 12 to 8 hours in 1890 ‘without altering wages’ (Cotterill 1980: 23). However, agitation among stokers for shorter hours and higher wages acted as an impetus for their replacement by machinery (Cotterill 1980: 23), perhaps ultimately being a factor in the replacement of the New Street works by those at Granton.

4.8 Survival of Gasworks structures

Cartographic and bibliographic sources indicate that two of the buildings that occupy a site at 179a Canongate, Edinburgh are late 19th century/early 20th century in date and were associated with a late extension of the New Street Gasworks, confirmed by historic building assessment undertaken in 2017 and 2018. These structures were identified as a large courtyard building of 1877–94 and a smaller workshop building of 1894–1908 (Bradley-Lovekin et al 2018: 6–7; Bradley-Lovekin et al 2019: 5). Adamson et al (2016: 47) note that ‘part of the gasworks’ boundary to Old Tolbooth Wynd survives and is seen in the arched brickwork of the boundary wall here. Other buildings have been reused for later industrial purposes, and some have been incorporated into modern developments along Old Tolbooth Wynd’ with a ‘range of recessed arched blind openings in a brick wall’ also visible on the west side of Old Tolbooth Wynd (ibid: 151), part of the eastern boundary of the Gasworks (Illus 25).

The larger surviving (courtyard) building of the Gasworks is located in an area behind the Canongate frontage, which is depicted as being in part covered by a ‘Bowling Green’ on Edgar’s map of 1765 (Illus 5). The historic buildings assessment of 2018 ‘identified a number of upstanding walls that appear to represent structural survivals from the buildings which preceded the gasworks’ (Bradley-Lovekin et al 2019: 33). These earlier wall features were ‘limited to the lower portions of the eastern external wall of the 1877–1894 [courtyard] building ... and the eastern part of the of northern boundary wall [of the courtyard area] ... although they are fragmented and with the exception of the probable fireplace within the northern boundary wall, hard to interpret’ (Bradley-Lovekin et al 2018: 23).

In this area, Robert Kirkwood’s plan of 1817 and James Kirkwood’s plan of 1821 (Illus 6 & 7) both depict a building that may be the lodge of the ‘Magdalene Asylum’ (Canmore ID 133031). On the Ordnance Survey map published in 1852 (Illus 8),



Illus 25 Blind openings in eastern external wall of Gasworks on Tolbooth Wynd

the area behind the Canongate frontage buildings at the corner with Tolbooth Wynd is occupied by gardens, likely the former bowling green depicted by Edgar, and a 'Lodge' associated with the Magdalene Asylum, as well as, to the east adjacent to the wynd, buildings and unroofed enclosures or yards accessed from Miller's Close. The Ordnance Survey map of 1877 (Illus 20) indicates that the former 'Lodge' of the Magdalene Asylum was still apparent (though unlabelled) in a still relatively undeveloped area, while to the east, against Tolbooth Wynd, buildings and yards were accessed from Miller's Close. The Ordnance Survey map of 1895, surveyed 1894 (Illus 23), indicates that the structures earlier present around Miller's Close had been removed, likely as a result of it being overbuilt by structures associated with the Gasworks to the north, from where a group of rail tracks can be seen to exit the large main building of the Edinburgh Gas Works. To the west, the formerly open area south of the former location of the asylum is covered by a large unlabelled building, again apparently associated with the Gasworks; it is also present on later (20th century) Ordnance Survey maps of 1908 (Illus 24), 1914 (not illustrated) and 1931 (not illustrated). This is the larger of two still-surviving buildings of the Gasworks. Ordnance Survey mapping of 1948 (not illustrated) shows the large (surviving) Gasworks building visible since 1894 with two smaller structures to its north-east, potentially all late elements of the Gasworks. Present-day mapping shows the large building visible on late-19th-century maps to still be present, as is one of the late-19th/early-20th-century buildings to its north-east. A more recent rectangular building is also present, identified as a 1980s extension to the courtyard building during standing building assessment works (Bradley-Lovekin et al 2017: 25; Bradley-Lovekin et al 2018: 19).

The large late-19th-century building, and the smaller late-19th/early-20th-century building, constitute the only substantial surviving roofed elements of the Gasworks, though surviving walls can also be found along the west side of Tolbooth Wynd, sometimes incorporated into later developments. According to Adamson et al (2016: 160), 'the four- and six-storeyed development at the foot [north] of Old Tolbooth Wynd' incorporates material from the former Gasworks (and the earlier

Canongate Foundry). Additionally, an east/west running southern wall of the former Gasworks site exists as a patchwork wall of brick and stone, photographed by the RCAHMS in 2014 (HES DP 207861 – DP 207863), as well as a boundary wall north of the buildings at 179a Tolbooth Wynd (HES DP 207866 – DP 207867). The building recording works of 2017 and 2018 identified that 'the central and western parts of the ... boundary wall, in all probability originated as the northern boundary of an intermediary post 1877 expansion to the gasworks, although the original core of the gas works was located to the northwest beyond the Magdalene Asylum' (Bradley-Lovekin et al 2018: 22). The various boundary walls of the courtyard have several phases of build. The boundary wall on its east side 'has a set of quoin stones marking an original entrance ... presumably creating access to and from the gasworks site ... This has been infilled with brick on the internal side' (ibid: 20). An entrance through a brick wall from the south of the courtyard building of 179a Tolbooth Wynd (HES DP 207855) was also identified by the RCAHMS as a gateway leading into the site of the Gasworks; also photographed was the smaller surviving building (HES DP 207864 – DP 207865).

The function of these surviving structures is indicated by a plan of the New Street Works, by Alexander Masterson, dated February 1915 (Illus 9), shortly after the works had ceased activity (HES EDD 747/1). This indicates that the smaller structure functioned as a 'Workshop', while the larger building was divided into an area labelled 'Meter' to the north, and a 'Testing Shop' to the south; it is possible that the larger building was actually a 'Meter Testing Shop'.

The large surviving courtyard building takes the form of west, north and east ranges set around an unroofed courtyard, with a wall to the south enclosing it; mapping evidence indicates that the central courtyard area was once roofed. It is constructed of 'dark red brick in an English Garden Wall Bond' and is approached from the south 'through a large archway ... from Bowling Green Close, which is located between Nos 177–183 Canongate' (Bradley-Lovekin et al 2017: 25). Also noted was that the 'interior of the building' retained 'little of its original character and [its] internal layout ... with the addition of



Illus 26 Workshop building from the south-east

stud partition walls, gantry stairs and replacement windows’ (Bradley-Lovekin et al 2018: 16). The smaller, workshop, building to the east (Illus 26) is recorded as abutting the courtyard building at its northern end. It is described as ‘a three-bay by two-bay double height building constructed of a lighter beige brick than its neighbour in an English Garden wall bond’. Of interest is that ‘the rear wall of the building has incorporated another older wall into its build ... with the brick patching to consolidate the stone wall in the internal north-west corner of the courtyard ... The rear north elevation then shows the upper part of the building over the earlier stone building with a thin central chimney’ (ibid: 18).

4.9 Scottish Motor Traction

Ordnance Survey mapping of 1931 (not illustrated) depicts the Scottish Motor Traction (SMT) ‘Bus Depot’ covering much of the former Gasworks area. This depot was built as a garage to accommodate and maintain 300 buses on two floors for the Scottish Motor Traction Company. This was ‘the largest private bus company in Scotland, operating in its own name and through its ownership of W Alexander and Sons, Central and Western SMT ... by the 1930s it had around 2,500 buses’ (Knox 2014: 7). SMT had purchased the site by 1926 (Edinburgh Corporation 1926: 17) and the bus depot on New Street was constructed in 1928 and

extended around 1934 (Adamson et al 2016: 46).
A contemporary account notes:

the Scottish Motor Traction Co., Ltd., of Edinburgh, which not only maintains a vast network of motorbus routes in the south-eastern portion of Scotland, but also carries out pleasure tours on a very extensive scale from the Scottish capital, has recently still further improved its big organization by opening an extensive new garage and depot, probably the largest in the kingdom ... the company has had constructed a garage providing 90,000 sq. ft. of floor space, and having adjoining it a site nearly half as large as this area for developments which

may become necessary. (Commercial Motor 1928)

This development formed part of the Canongate Improvement Scheme of 1930–1 under the City Architect, Ebenezer James MacRae (Adamson et al 2016: 17, 22). The garage originally covered only part of the former Gasworks, but a plan of 1935 shows that the original SMT garage of 1928 was then planned to be extended to the north, an area formerly covered by circular storage tanks (HES DPM 1930/195/1/3). The garage became the SMT's main depot when one at Fountainbridge closed but by the mid-1990s had ceased to function as a depot and saw use as an indoor market (Mullay 1996: 133).