ULSTER ARCHAEOLOGICAL SOCIETY

Survey Report: No. 24

Survey of Gasworks, Castle Ward, County Down UAS/10/02

In association with

THE NATIONAL TRUST

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1. Summary

1.1 Background

The Castle Ward demesne (now in the care of the National Trust) was owned and enhanced by the Ward family for more than three centuries. During the nineteenth century a gasworks plant was added to provide gas-lighting using coal shipped to the adjoining quay.

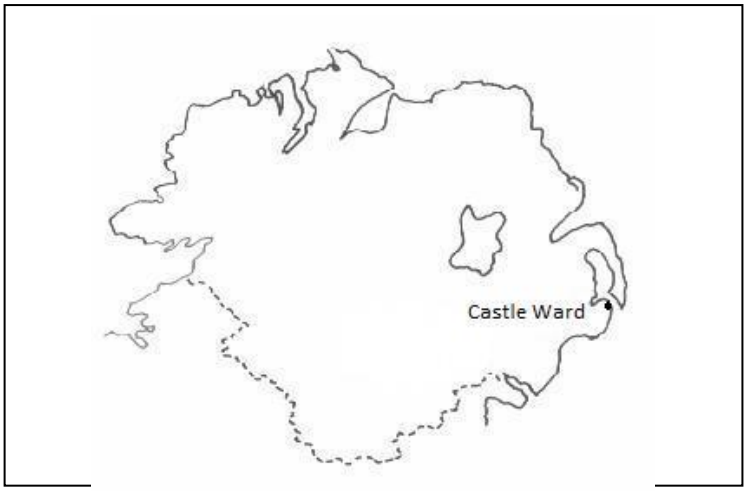


Fig. 1: Location of Castleward within Ulster

1.2 Survey

A plan and two elevations of one wall were produced and photographs taken in 2010. Infrastucture improvements in 2011 exposed more features and added to our understanding of the site. These findings are combined in this report.

Fig. 2: Castle Ward House from Dickson's Island. The Coal Quay is to the left of the gate and the gasworks is screened by the crennellated wall.

2 Introduction

2.1 Background

In consultation with Malachy Conway, Archaeologist with the National Trust, it was decided that the UAS Survey Group would record remains of the gasworks which served Castle Ward House. The survey was made on 24th April 2010.

Fig. 3: The gasworks as it appears on the 1922 OS plan 31-8

During the winter of 2010-2011 contractors engaged by the National Trust made a bicycle track around the estate grounds. Part of this contract was the installation of a bicycle wash in the former coal store and associated soak-away within the walls of the gashouse, over which hard-standing would provide several car parking spaces. This would involve clearance of building rubble and organic soil levels before backfilling with stone. Mr Conway arranged that the operations of clearing and backfilling would fall either side of a weekend so that the UAS team could re-assemble on Saturday to survey whatever additional features were revealed. Unfortunately a severe weather warning for Saturday 12th March caused the cancellation of the team survey visit. Mr Conway made the survey. Exposed were footings of the south and west walls of retort and purifier rooms, ashpits, and also two portions of cast-iron pipe, contributing to our understanding of the site.

2.2 Objectives

To produce an accurate plan of the site and elevation of the north wall of the retort house, carry out a photographic survey, compile this information into a report, and submit copies to the National Trust and NIEA.

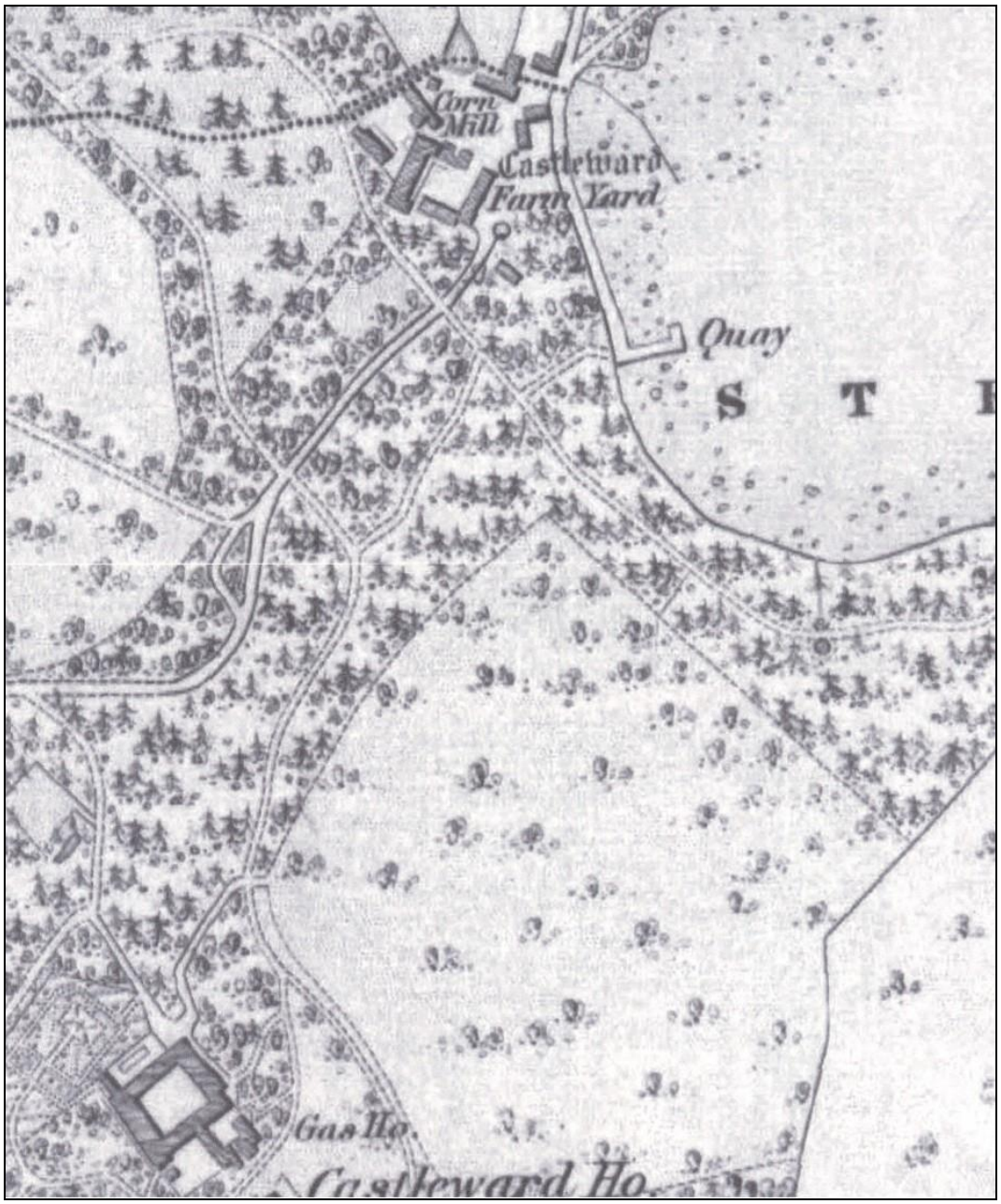


Fig. 4: Detail from 1859 OS Sheet 31 showing the Gas House beside the stable block.

2.3 Location

The site is in the east of County Down, in the townland of Castleward and the borough of Down, 1.4 km. west of Strangford village. It is beside Strangford Bay (OS maps) also known as Castleward Bay (Admiralty Charts), a small inlet of Strangford Lough, and near its opening to the Irish Sea. Irish Grid Reference J5745 4976. Castle Ward House is at a distance of 450m SW, and about 100m to the north is the tower house built in 1610 (SMR No. DOW 031:005), the farmyard, corn mill, and sawmill (figs. 5 & 6). Altitude is 6m above the Poolbeg datum. The gasworks is built against the demesne perimeter wall. The wall curves to match the line of the shore, from which it is separated by a grassy carriageway 8m wide. The carriageway leads to the Coal Quay (SMR No. MRD 206:207) and,

next to the quay, ends in a ramp descending to the inter-tidal shore. From the carriageway the quay runs out into the bay 28m and turns to form an L-shape. At low tide the quay is dry and the main channel of the bay is left with only 2 fathoms of water. Audley Road is off the mouth of the bay. Behind the quay an arched gateway gives access through the demesne wall. From the gateway to the chute of the coal store (para. 3.3.3) is a distance of 35m.

Other features recorded on the SMR are an oyster tank (MRD 206:021) 150m to the NNE and a probable ballast dump (MRD 206:022) 75m SSE.

2.4 Previous archaeological surveys

None known. The Industrial Heritage Register has allocated the number IHR3251.

2.5 Cartographic Evidence

OS Co. Down, 6 Inches to 1 Mile, Sheet 31, 1834 (1st. Edition)
Nothing is built on the site, but the Coal Quay is much as it is today.

OS Co. Down, 6 Inches to 1 Mile, Sheet 31, 1859 (1st. Revision)
Nothing is built on the site. Mixed woodland is shown inside the demesne perimeter wall (fig. 4).
A square adjunct on the stable block (close to Castle Ward House) is annotated "Gas Ho." (IHR3252).

Fig. 5: Detail from 1901 OS Sheet 31 showing the Gasworks.

OS Co. Down, 6 Inches to 1 Mile, Sheet 31, 1900-1 (2nd. Survey)
The enclosed yard is shown with a circle for the gasholder and roofed buildings for the gashouse (retort and purifier houses) and coal store. This grouping is annotated "Gasometer". Narrow roofs run along the demesne wall to the north of the yard. At the stable block the annotation "Gas Ho." has gone.

OS Co. Down, 1:2500, Plan 31-8, 1922
The group is shown as before, but without any annotation (fig. 6). The narrow roof to the north of the yard and against the demesne wall is clearly depicted as open-fronted.

OSNI 1975-6, 1: 10 000, Sheet 206
The enclosed yard is shown with the north wall only of the gashouse and with coal store and circle roofless. The only annotation is "Tk" for the gasholder tank.

2.6 Archiving

Copies of this report are to be deposited with the National Trust, the honorary archivist of UAS, and the Northern Ireland Environmental Agency.

2.7 Credits and Acknowledgements

The Survey was led by Harry Welsh and other members of the team were June Welsh, William Dunlop, Colin and Hilary Boyd, Chris Conway, Ian Gillespie, Michael Catney, George Rutherford, Ken Pullin, Chris Ayers, Duncan Berryman, Pat O'Neill, Noleen Khawaja, and Liz McShane.

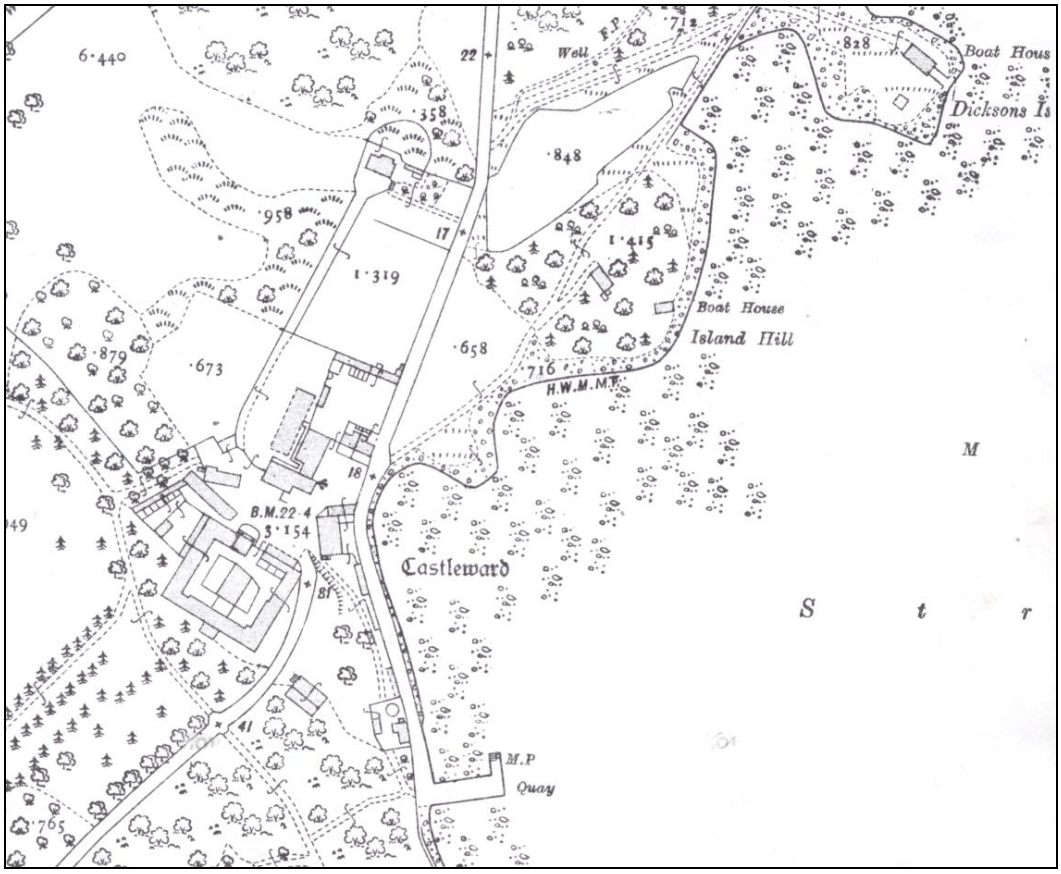


Fig. 6: Detail from 1922 OS plan 31-8.

UAS are grateful to Malachy Conway, Archaeologist of the National Trust, for all his support throughout the exercise. Miriam McDonald of the RCAHMS provided information on Scottish brick and Paul Davies and Brian D. Hodnett likewise on Buckley brick. Thanks are due to Maureen Dillon and Fred Hamond, who made available their respective reports on *Lighting in Castle Ward House* and *Mount Stewart Gasworks*. Also to Ian West of the Country House Technology Project,

University of Leicester, and Brian McKee, director of The Carrickfergus Gasworks Preservation Society Ltd., for their advice and comments on technical issues, and to Roger Greene of Malahide Historical Society, and the helpful staff of PRONI. Viscount Coke and the Holkham Estate kindly permitted reproduction of detail from the scaled drawing for the Holkham gasworks.

3 Survey

3.1 Methodology

A plan was produced using the Society's Leica Sprinter 100 and drawn on site to a scale of 1:500. A plumb line and tapes were used to draw an elevation of each side of the north wall of the retort house. In March 2011 further details were measured with a tape for inclusion in the general plan.

3.2 Photographic Archive

A photographic record of the site and surroundings was made with a digital camera and a record sheet compiled (See App. 1). Results were saved to a DVD.

Fig. 7: General view of gasworks from SW. (RIMG0003).

3.3 Description of Structures

3.3.1 Retort House

The east wall of the retort house is local Silurian random rubble built tight against the demesne wall. The north wall of the retort house, also of random rubble in courses, survives to full height in places but is broken elsewhere. A breach in this wall may represent a collapsed semi-circular flue entering the chimney (fig. 14). Surviving stonework gives the impression that no arch was formed at the flue – the stones simply being laid horizontally against the curve. The chimney position is indicated by two ragged edges on the outside of this wall (fig. 38). At waist-height the chimney measured 1.85m east-west externally. Collapsed masonry hid the northern edge preventing a north-south measurement.

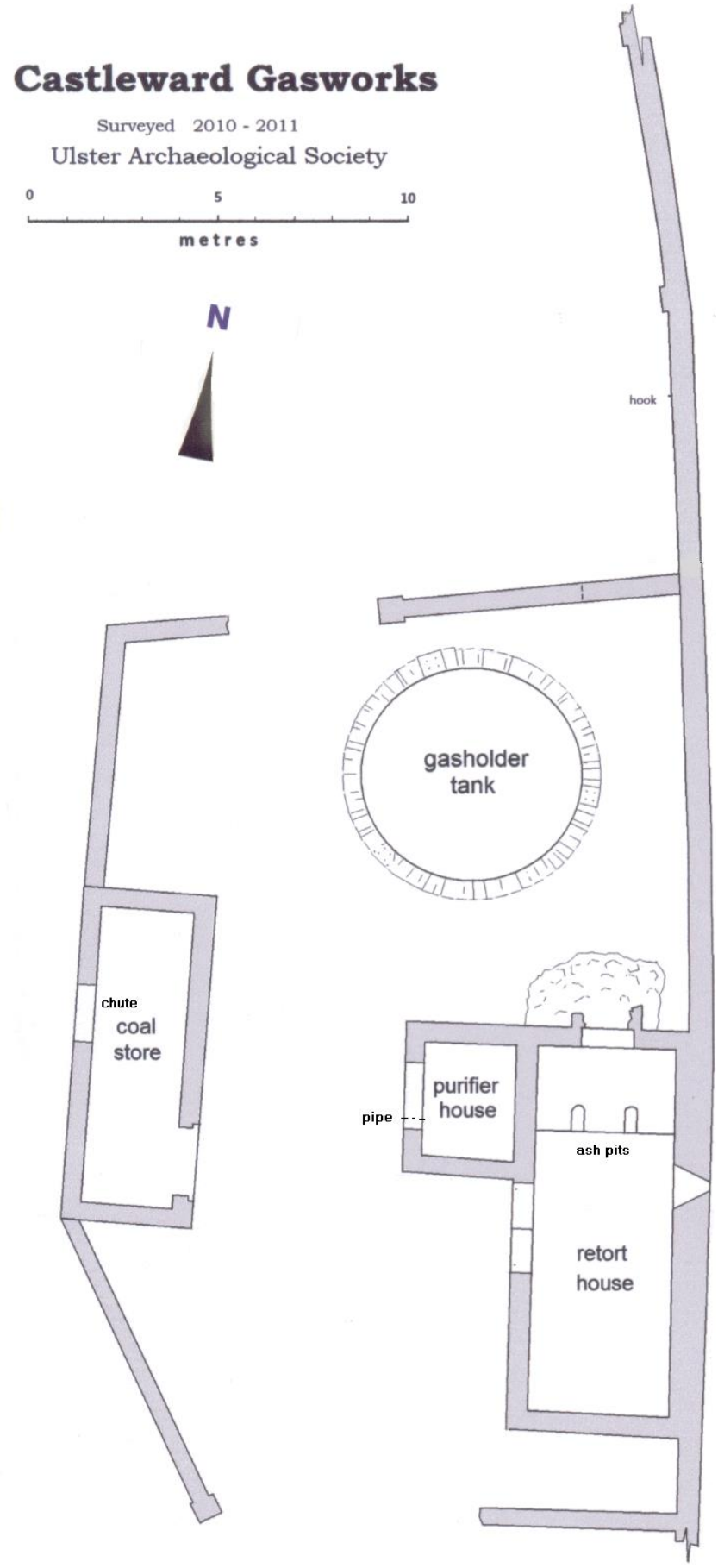


Fig. 8: Plan of Gasworks.

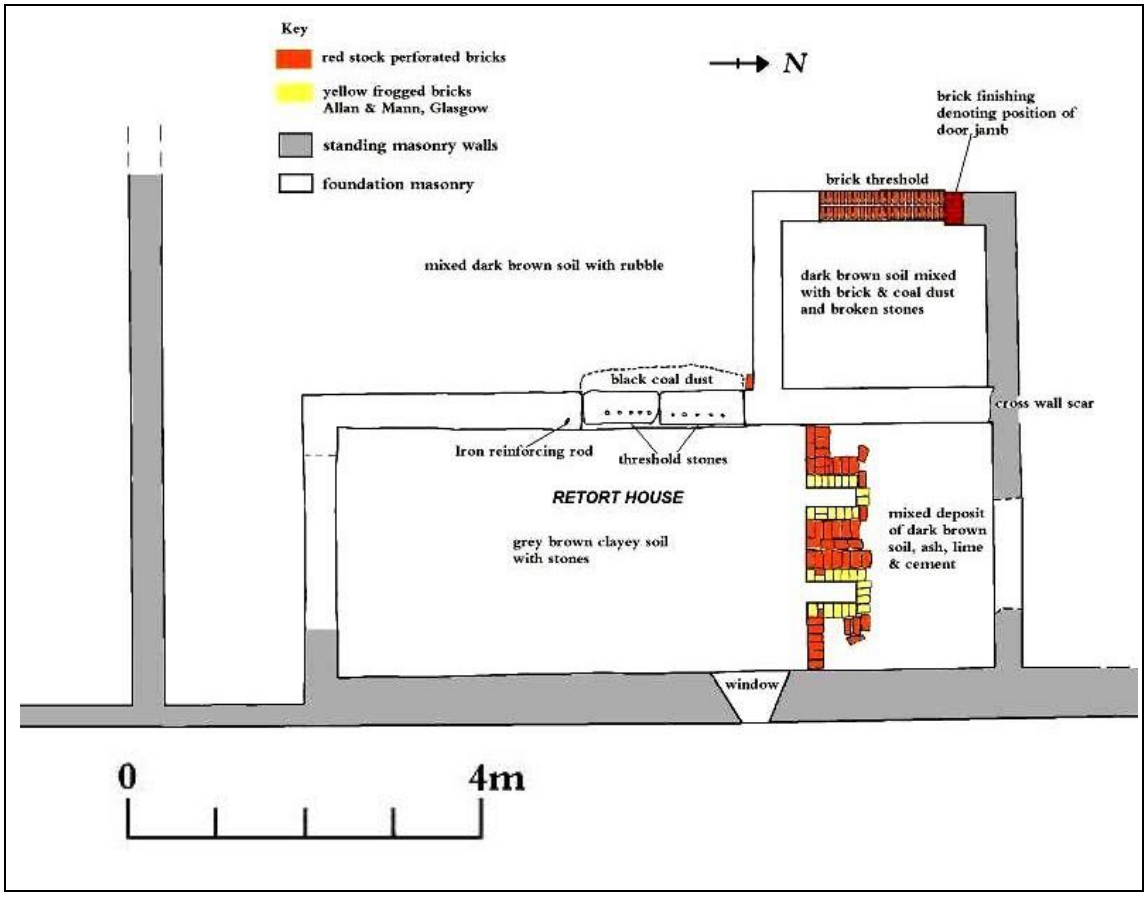
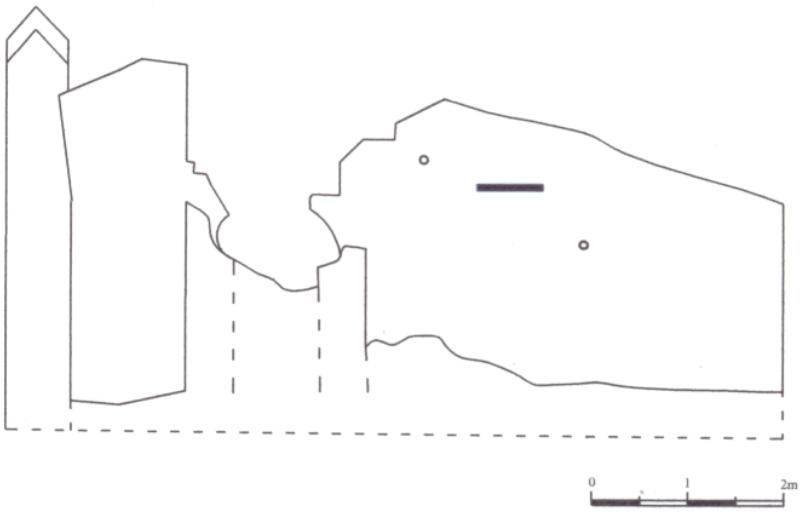
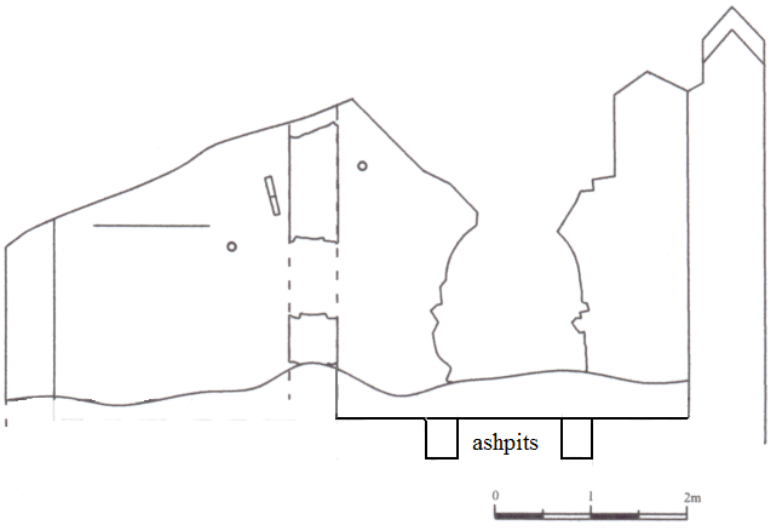


Fig. 9: Plan of Gas House, March 2011. (Drawing by Malachy Conway)

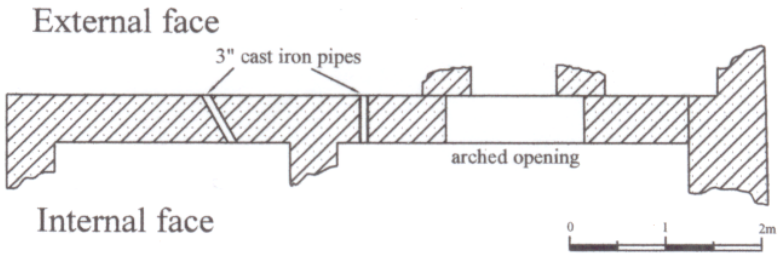
Fig. 10: Elevation of south wall of Retort House, interior. (by Malachy Conway)



Castle Ward Gas-House - gable end (north)
External Elevation



Castle Ward Gas-House - gable end (north)
Internal Elevation



Castle Ward Gas-House - gable end (north)
Plan view

Fig. 11: Castleward gashouse: north end wall. (after Michael Catney)

Fig. 12: North wall of Gashouse, interior. (RIMG0007).

Fig. 13: East wall of Retort House. (RIMG0008).

The west wall has been demolished, but the broken edge can be seen where it engaged with the north wall. However, when the site was cleared the lowest courses were uncovered, revealing an internal rectangular space of 7.06 x 3.70m Two granite slabs (1.26 x 0.52m, 1.15 x 0.52m) lay along the line of the west wall

of the retort house. Each had a hole drilled into the upper surface as though to act as a pivot. A number of shallower holes may be the result of previous use. The slabs were interpreted as the threshold. A deeply splayed window looks seaward through a narrow slit defended by three modern metal bars (fig. 13). It is 1.20m in height, has an external opening of 28 cm. and internal 1.23m. The lintel is rough slate and the sill is levelled cement. The splay is mostly trimmed with red brick, inside and outside, but otherwise is the local stone.

In the north wall about 2.5m above ground level and about 0.2m from the west wall a 3" cast iron pipe goes straight through to the outside (fig. 14).

Fig. 14: Exposed ash pits and north wall of gashouse, 2011. (DSCF0856).

At the northeast corner a fragment of zinc-coated corrugated iron sheeting, 0.4m long, overhangs the outside of the north wall and lies at an angle of about 20^{o} to the horizontal (fig. 26).

Removal of building rubble exposed two ash pits at the north end of the retort house, proving the position of the retorts next to the chimney (figs. 8, 9, 14 & 33). They were 0.3m wide, 0.4m deep, and lined with firebrick in a setting of perforated red brick (20 holes, arranged 7, 6, 7). Excavation continued down through the floor level to enable construction of the soak-away for the bicycle wash. During this operation no hard floor level (such as tiling) was encountered.

3.3.2 Purifier House

The purifier house was clearly co-eval with the retort house, its north wall being the continuation of the north wall of the latter (figs. 12 & 38). The west wall of the retort house provided the east wall of the purifier house. Removal of building

rubble revealed a white layer, which was left in-situ. The footings of the west and south walls of the purifier house were exposed, showing a threshold in the west wall. It was two brick lengths in breadth, composed of red bricks laid on edge and making a total length of 1.8m Incorporated into this brickwork and just below the surface was an iron pipe of 3-inch diameter.

Fig. 15: Purifier house looking east (March 2011): the tape box rests on the threshold directly above the exiting pipe. (DSCF054).

In the north wall about 1.5m above ground level and about 0.6m from the east wall a 3" horizontal iron pipe goes through to the outside at an angle of about 60^0 to the face of the wall (figs. 11 & 44). A horizontal strip of iron is attached to the outside of the wall between the two pipe outlets (figs. 11 & 38).

A slot in the inside of the north wall runs horizontally in line with the eaves, but the line is not to be seen on the outside.

3.3.3 Coal Store

A small structure of coursed random rubble sits on the west of the yard and faces the retort house. It survives well, to eaves height. The doorway is trimmed with yellow brick (9½" x $4^3/_8$" x $3^1/_8$" : 13 x 11 x 8 cms) and has reveals of red brick ($8^7/_8$" x $4^3/_8$" x 3" : 22.5 x 11 x 7.5 cms). The ground immediately west of the structure, and outside the yard, is about 1.5m higher than the levelled yard and a chute enters from the outside. Both sides of the chute are trimmed with red brick and the steep slope between may be cement (fig. 32). We therefore identified this windowless structure as the coal store. But, this may have been a lime store; coal being put at the south end of the retort house.

Fig. 16: Coal Store viewed from the east. (RIMG0015)

On each side of the doorway a flat iron bar projects from between yellow bricks (16 bricks from the ground, 4 from eaves) and is pierced by a round hole (figs. 39 & 40). These bars angle slightly outwards. Opposite the doorway an iron staple projects from the back wall (fig. 41). The unbroken concrete floor was removed and re-laid in 2011 to incorporate drainage for the bicycle wash. The roof sloped towards the yard.

3.3.4 Gasholder Tank

To the north of the gashouse the location of the tank for the gasholder is clearly defined by its coping - a circle of hewn stone presenting a smooth circular face to the tank, which is 5.76m (18' 11") in diameter (fig. 17).

Three embedded sandstone blocks are equidistant from one another and each has four holding-down bolts and a mason's mark on the upper surface (figs. 18 & 19). Two of the blocks are square, but that in the SW is less regular. The rest of the circle is an alternation of concrete with voussoir-shaped stones, apparently of coarse yellow sandstone, brighter in colour than the three finer-grained blocks. The tank has been filled with spoil (reportedly a safety precaution about 1980) and has not been excavated during the project, so the depth remains undetermined.

However, embedded 12cms. below the inside rim and on the seaward side, is a plate of grey metal, 16cm. in diameter and perforated with about one hundred holes. This is presumably an overflow outlet for water contained in the tank, but no outlet drain was discerned next to the beach.

Fig. 17: Coping of gasholder tank. (RIMG0110)

Fig.18 Sandstone block with bolts (RIMG0079)

Fig.19 Mason's mark (RIMG0076)

3.3.5 Yard Wall

The group of gasworks structures was contained by a wall 45cms. thick, of stone rubble and lime mortar. It abuts the demesne wall at NE and SE and the two rear corners of the coal store. At a height of 1.85m there is a creasing course of slate. Above this a single pitch deflects rainfall to the outside, and the total height reaches 2.15m.

Fig. 20: North gate, east pier. (RIMG0103)

Fig. 21: North yard wall, interior. (RIMG0030)

There was a gateway in the north and another in the south, apparently positioned so that a cart could easily enter at one and exit at the other moving straight through the yard. The original width of the gateways could not be measured because a portion of the south wall had been demolished including the eastern gate pier and also a part of the north wall with the western gate pier. The surviving

gate piers are 60-64 cms. square with a cap 70 cms. square (fig. 20). The piers are the only parts to be finished with a smooth coating of Portland cement and ruled to simulate courses one foot in depth.

3.3.6 Open Roof

The north yard wall retains the clear indication of a sloping roof leaning to the demesne wall. This can be seen on both sides of the yard wall, so would have predated it. The roof was 2.56m wide and may have been cantilevered to the demesne wall as there is no sign of a support on the west side. The roof seems to have run north to a buttress 14.11m from the yard wall.

3.3.7 Demesne Wall

Generally the demesne wall is built of local stone rubble and lime mortar. The top is single pitch deflecting outwards. However, for a length of about 70m, including the gasworks and Coal Quay gate, the wall is crenellated (fig. 25). All crenelles and merlons are double pitched (figs. 23 & 24).

The crenellations between the gasworks and the Coal Quay gate are composed entirely of local stone rubble and lime mortar, as are those south of the gate.

Extra height is given above the gate by a crow-stepped gable with a splayed slit on either side of a mock machicolation which projects towards the quay (fig. 22). The gateway has a semicircular arch on the outside with shaped quoins and voussoirs of imported stone, probably grey carboniferous limestone. The heavy supports for the machicolation are of the same material. On the inside is a shallow elliptical arch with narrow voussoirs of shaped sandstone.

Fig. 22: Quay Gate, viewed from quay. (RIMG0088)

The crenellations alongside the gasworks are a combination of stone, brick, and roofing slate held together with mortar. The section of wall beside the gasholder

carries nine merlons. The five closer to the retort house are double-stepped, the four northerly are single-stepped.

The creasing course of the merlons is 2.4m above ground level; the same as the summit height of the wall as it continues northward. An additional 0.35m is given to the merlons by the coping, which is brick, sheeted on top with blue roofing slates.

The creasing course of the crenelles is 1.94m above ground level. They are also roofed with blue slate and each ridge is finished with a single red sandstone, neatly shaped. This gives a ridge height 0.46m above the creasing course. The merlons are faced with stone: the most northerly with red sandstone on the east side.

Fig. 23: Merlon near gasholder. (RIMG0092)

Fig. 24: Double-step merlon. (DSCF1424)

A 6” diameter pipe is embedded in the north side of the most northerly merlon, but almost immediately is stepped down to a 3” bore. The second merlon has a 3” diameter iron pipe entering both its eastern and western faces and another on the north side 34 cms. higher (fig. 23). Ivy has choked the pipes so communication between the various ends was not proved.

Next to the four single-step merlons comes the five double-step. Their lower steps are similar in treatment to the first four, but for each the upper step is effected with three yellow bricks placed as stretchers, one above another (fig. 24). A tall triangle has been carved into the stretcher face and rises through the full height of all three bricks forming a small niche. The niche is repeated on both outer and inner faces. Ornamental battlements are a common feature on the buildings in and around the farmyard, but none exhibit these dwarf niches.

Fig. 25: Demesne wall, farmyard and tower house beyond. (RIMG0095)

The section of wall coinciding with the length of the retort house is heightened and the creasing course sits 2.96m above the interior ground level (fig. 13). This section carries nine double-stepped merlons. The first and last rise above the height of the others and mark the eastern corners of the retort house. The east face of this row generally presents corners of squared sandstone, both red and yellow, showing horizontal tooling. The copings of the lower steps are also finished in sandstone. The upper steps are faced with sandstone (except one, which is composed of red brick) each having a dwarf niche similar in proportion and size to those fashioned in brick near the gasholder. The copings of the crenelles are finished, sometimes with a single shaped sandstone, sometimes with a setting of bricks, but all have a small opening formed by a dwarf transverse ridge at the centre, next to the creasing course. On the inside all merlons are red brick and all sloping surfaces are finished with roofing slates. The east wall of the retort house combines with the demesne wall to give greater width, but the merlons are no wider than on other sections. The roofing slates continue to the inside edge of the retort house wall where they make an unbroken line for the length of the house.

A single block of yellow sandstone with sculpted decoration (weathered, but perhaps foliate) on two faces is built into the northern of the tall merlons on its NE corner (fig. 26). Its singular appearance suggests a previous use in another building.

Fig. 26: Merlon at NE corner of gashouse. (RIMG0097)

South of the retort house the demesne wall resumes its lower height. There are two more double-stepped crenelles, the details of which were obscured by ivy. This point marks the end of the gasworks yard.

The demense wall appears to have been repaired over a 7.74m stretch. A vertical repair join is visible on the seaward side about 9m north of the north yard wall and another further along. It is not known whether this was rebuilding a deliberate breach or repairing accidental damage.

4 Discussion

4.1 General Historical Context

4.1.1 A Brief History of Coal Gas

William Murdoch (the father of gas lighting) illuminated his Cornish home with coal gas in 1792 (Clow: 427). Subsequently coal gas was installed in factories to prolong the working day and permit shift working. It was first used for street lighting by the *London and Westminster Gas Light and Coke Company* in 1812 and many cities followed the example. Belfast acquired street lighting in 1823 and later many provincial towns (Bardon: 81).

With improvements made by Samuel Clegg and others coal gas became a proven technology, more economic than candles or whale-oil in lighting large buildings.

By mid-century equipment manufacturers were supplying plant designed for country estates, which were usually beyond the reach of town gas (Thomas: 2). Towards the end of the century and into the twentieth the uses to which gas could be put increased rapidly as cooking and heating appliances were developed. By then electricity was a contender. Acetylene gas for domestic use appeared at the turn of the century. It did not require the high labour input of coal gas nor the need to purify the product. In mansion houses coal-gas plant already in place seems to have continued in use into the twentieth century until replaced by acetylene or rendered wholly obsolete by the spread of electricity mains supply.

However, with the economics of scale, town gas continued well past the middle of the twentieth century. The British Gas Boards began switching to imported natural gas in 1962 (Doherty: 39). Between 1965 and 1968 all town gas in Northern Ireland switched to oil-based production and Dublin also moved to oil by 1968 (O'Sullivan: 174).

4.1.2 Plant and Usage of an Estate Gasworks

Horizontal retorts, six feet or more long, were partly filled with coal and then made airtight by sealing cast iron doors. Typically a setting would hold two retorts supported above a furnace in a chamber of firebrick. The retort house at Mount Stewart had two such settings, allowing maintenance to be carried out on one setting while the other continued production, or both could be used to meet an occasion of high demand (Hamond, 1997: 3). Over the course of perhaps six hours the coal would be reduced to coke as volatile constituents were driven off and up the ascension pipes and into the hydraulic main (Clegg: 60). This was a trough of water which acted as a trap against re-entry of air or gas.

The gas then passed through a condenser, cooling as it went, and precipitating tar and ammonia, which collected as liquid at the base and was led away to a tar tank. A condenser took the form of two concentric tubes; water in the inner tube cooled the gas circulating in the outer. Typically, two or more of these would be arranged in series.

Hydrogen sulphide and hydrogen cyanide also needed to be removed to provide a safe product. This was effected by passing the gas through moist lime held in enclosed tanks known as purifiers. When the lime became saturated it might be removed and exposed so that hydrogen sulphide was released into the air. The rejuvenated lime could be used again, but ultimately had to be discarded, possibly being spread on the land as a fertilizer (Thomas: 8).

A mixture of methane, carbon monoxide, and hydrogen was delivered by underground pipe to the gasholder. The gasholder was a metal cylinder, open at the bottom, that floated in a tank of water. When empty it sank low in the tank. As gas was made, it rose, the gas filling the cylinder and pushing out the water which continued to act as a seal between the gas within and the air without. Another pipe (with open end above water level) would convey the gas to the point of use. As

the gas was consumed, the gasholder would sink gradually, the weight of the holder providing pressure on the gas.

An exhauster located on a suitable part of the pipework within the gasworks would ensure that the coal gas would always be sucked from the retorts and pushed towards the gas holder. However this was often not present on the gasworks of a private house (Thomas: 5).

The coke left in the retorts could be fed into the furnace to heat the next batch of coal, with the surplus taken elsewhere for fuel.

4.1.3 Edmundson & Company

Joshua Edmundson & Co. is listed in Shaw's *New City Pictorial Directory*, 1850, under 35 and 36 Capel Street, Dublin, as "ironmongers, gas fitters, brass founders, and lamp makers". They began installing gasworks in mansion houses in 1855. A brochure printed in 1889 lists 152 of their coal gas projects completed between 1855 and 1889. TC Trench of Naas bought the first, for 60 lights, soon followed by Powerscourt for 300 lights (the largest in the early years). We learn that Castleward was fitted for 70 lights in 1858.

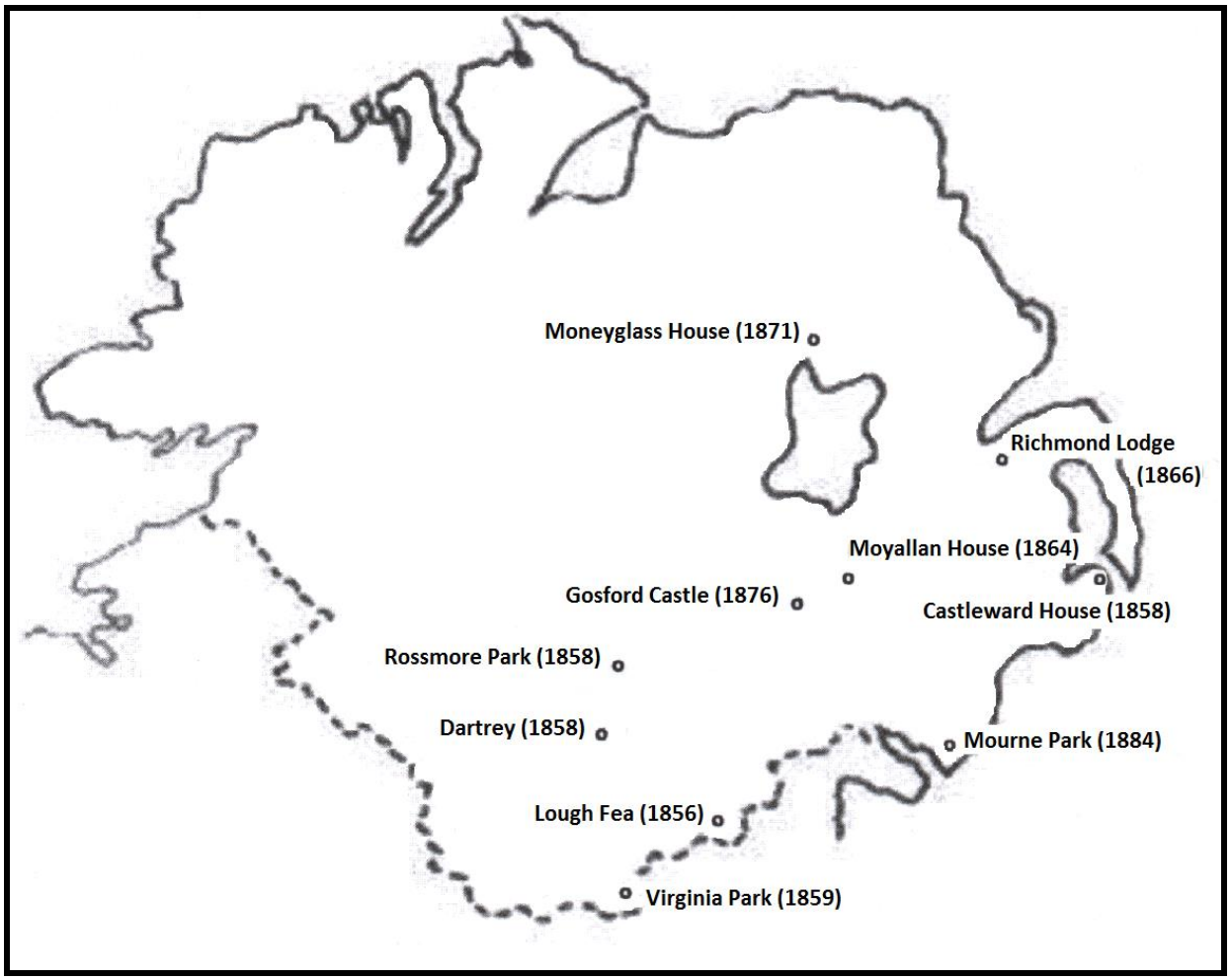


Fig. 27: Mansions in Ulster provided with Edmundson coal-gas apparatus showing year of installation. (based on PRONI: D1071H/B/E/24/2)

In the first ten years 1855-64 Edmundson's completed twenty-six projects, all in Ireland. An installation was made in Cheshire during 1865. From then until 1884 the firm supplied nobility and gentry across Britain and Ireland. During the 1880s the number of projects declined sharply with only eight in the ten years 1880-89. The last was in 1884 for the Earl of Kilmorey.

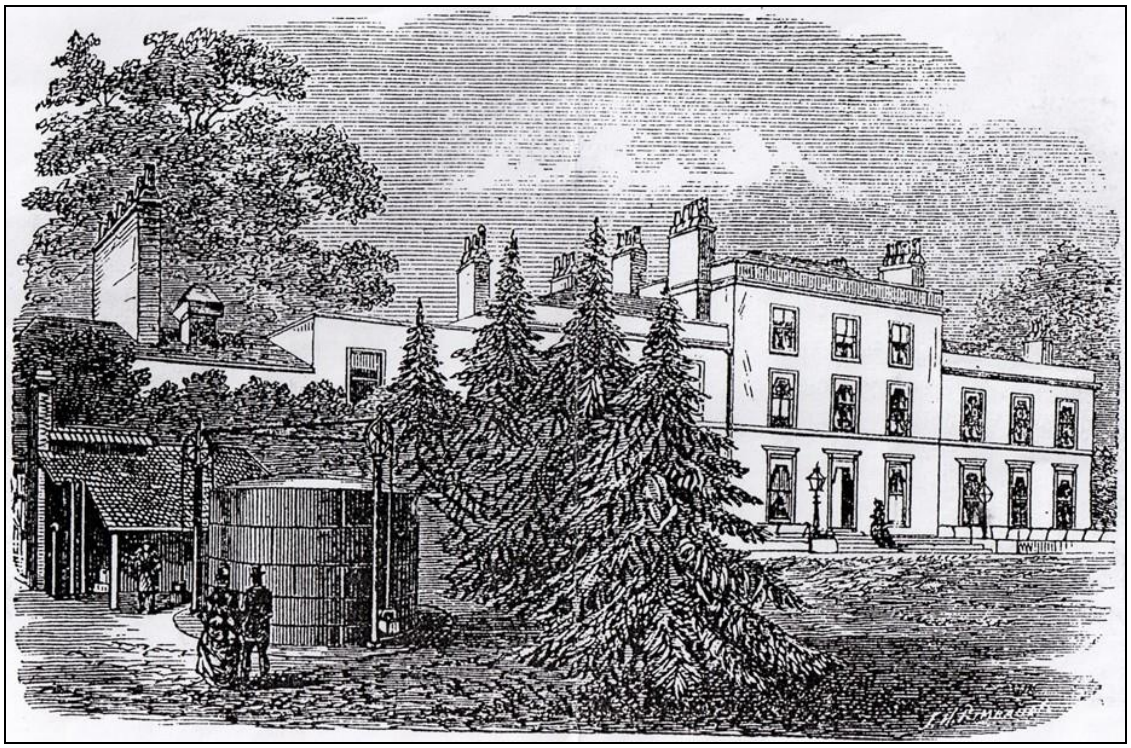


Fig. 28: Illustration from an Edmundson advertisement which appeared in *Walford's Country Gentry*, 1874.

Fig. 29 John Richardson Wigham (1829-1906): a great innovator. After the death of his brother-in-law Joshua Edmundson in 1848, Wigham managed the firm.

http://www.picturehistory.com/product/id/24096

In 1879 Edmundson's had begun supplying mansion houses with their "patent atmospheric gas apparatus" using "gasoline gas". Then in 1882 they began supplying "incandescent electric lights", which quickly became the preferred choice. Ninety-one projects for electricity are listed for the period 1882-89 including five on ships of the Dublin Steam Packet Company.

4.2 Other Gasworks

A more complete estate gasworks survives at Mount Stewart (Hamond, 1997: iv). It is also on the shore of Strangford Lough and was probably built in 1858 judging from entries in the estate cash book (PRONI D654/H/1/7). Traces of another can be seen in the west yard of Downhill Castle on the north coast of Co. Derry. The Argory, another grand house in National Trust care, still has its acetylene gas plant of 1906 (Marlow: 32), as does Castle Myra 2.5 km. west of Castleward. The gasworks that served the town of Carrickfergus from 1855 to 1967 has been preserved as a museum, now called "Flame" (Hamond, 1988: 27).

4.3 History of Ownership

The land came into possession of the Ward family in 1570 when purchased from the Earl of Kildare by Bernard Ward. The marriage of Judge Michael Ward (1685-1759) to co-heiress Anne Hamilton added in estates in Bangor. The Judge's son, another Bernard Ward, and his wife Anne built the present Castle Ward House, famously with one side Classical and the other Gothic. He was created Viscount Bangor in 1781 shortly before he died leaving a will that was to divide the estate, with future lords Bangor continuing to live in Castleward while the junior branch occupied Bangor Castle. Edward Southwell Ward (1790-1857) inherited in 1827 as 3rd Viscount. His son Edward Ward 4th Viscount (1827-1881) died unmarried and was succeeded by his brother Henry 5th Viscount (1828-1911). During part of this time the estate was managed by their step-father Major Savage-Nugent (1809-1889). When the 6th Viscount Bangor died in 1950 his son offered the estate in payment for death duties, and the government of Northern Ireland offered it to the National Trust with endowments.

4.4 Estate Financial Accounts

4.4.1 Gasworks in Estate Accounts

Some of Viscount Bangor's estate accounts survive and contain purchases for the gasworks. Unfortunately there are gaps, but relevant entries are given below (PRONI: D2092/10/10-35).

April – September 1866

none

October 1872 – September 1877

27 Apr. 1874	Edmundson's and Co^{s} acct.	£27-15-7
16 Jan. 1877	Edmundson's Acct.	£7-13-6

April 1878 – March 1881

26 Jan. 1879	Edmundson's account	£6-9-0

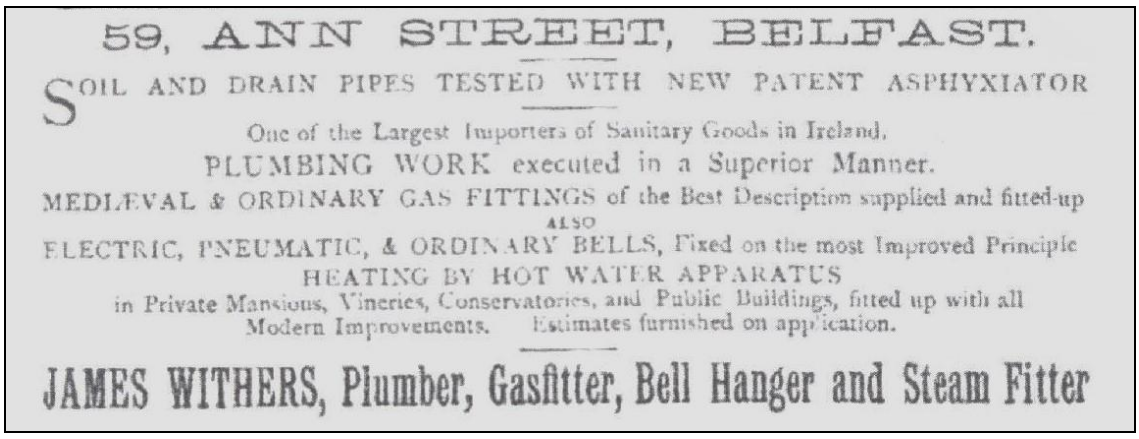
September 1881 – March 1883

16 Aug. 1882	20 tons 11 cwt. Gas Coal at 38/	£39-0-10

April 1886 – March 1894

30 Oct. 1886	J Edmundson & Co. a/c Two Retorts	£16-1-9
24 Ap. 1889	J Edmundson & Co. Retort for GasWorks	£8-5-0

5 Oct. 1889	J Edmundson & Co.Gas Retort+mouthpiece	£9-10-0
14 Feb. 1890	Edw[d] Keogh for putting Gas works in order	£0-15-0
13 Feb. 1890	Jas. Withers' a/c for work at Gas pipes +c.	£19-0-0
11 Dec. 1980	WD Henderson + Son, Tiles for Gas Works	£5– 8 -2
13 Feb. 1891	J Edmundson & Co. 2 Retorts for GasWorks	£17-11-0
18 June1891	Cash rec[d] for old Gas Retort	£0-7-6
11 May 1893	J Edmundson for 2 Cast iron D Gas Retorts	£17-11-0


59, ANN STREET, BELFAST.

SOIL AND DRAIN PIPES TESTED WITH NEW PATENT ASPHYXIATOR

One of the Largest Importers of Sanitary Goods in Ireland.

PLUMBING WORK executed in a Superior Manner.

MEDIÆVAL & ORDINARY GAS FITTINGS of the Best Description supplied and fitted-up

ALSO

ELECTRIC, PNEUMATIC, & ORDINARY BELLS, Fixed on the most Improved Principle

HEATING BY HOT WATER APPARATUS

in Private Mansions, Vineries, Conservatories, and Public Buildings, fitted up with all Modern Improvements. Estimates furnished on application.

JAMES WITHERS, Plumber, Gasfitter, Bell Hanger and Steam Fitter

Fig. 30 Advertisement in *Belfast Street Directory* for 1887, page xxxii.

James Withers ran his business from Ann Street, Belfast, (fig. 30) and had a residential address in Lawrence Street, with a listing as plumber, gasfitter, and bellhanger (*Ulster Directory*). Henderson was an insurance agent and also a merchant in fireclay goods. He too was based in Belfast.

An entry in the Demense account (p. 36) for 11th May 1893 records payment of £17-11s. for two cast-iron D-section gas retorts (see above). Another entry in the Castle Ward House accounts is dated 11th May 1893 (p. 20) and records £6-15s.-11d. paid to William Neill for plumbing work. The synchronism of these two payments suggests a possible connection. The plumbing may have been pipework for gas.

4.4.2 Coal

Every year the accounts have entries for the purchase of coal, but only one explicitly states its intended use in the gasworks viz:

20 Tons 11 cwt. Gas Coal at 38/- £39-0-10.

That was on 16th August 1882. For the same day is the entry:

69 Tons 9 cwt. House Coal at 13/- £45-2-10.

Not till the end of the 1880s is it usual to specify coal type, tonnage, and price per ton. By this time it is usual to buy most of the annual need in summer from Jas. Kelly & Son [sic.]. It is then shipped to Castleward. Thus on 13th July 1889 was received:

83 ton 3 cwt. Orrell @ 15/- per ton for the House Account
70 ton Wigan @ 13/- per ton for the Garden Account
84 ton Wigan @ 13/- per ton for the Steward's Account
24 ton cannel @ 22/- per ton for the Demesne Account.

Fig. 31: Coal Quay. (RIMG0087)

This last (Demesne Account) seems to be intended simply for the gasworks. Next year saw higher prices when, on 30th July Orrell was 17/6, Wigan 15/6, and cannel 34/- per ton. Only 15 ton of cannel was landed on this occasion, which clearly proved insufficient as another 5 tons was bought 13th February 1891 at 31/- from Wm. M. Barkley. On 4th August 1891 Orrell and Wigan retained their price, but cannel was now 40/-. Nineteen tons was bought this time augmented by another twelve tons, ten days later, from Moore Brothers at 29/6.

Fig. 32: Interior of Coal Store: chute (3.3.3). (DSCF0840)

For the blacksmith's forge in Ballyculter coal was bought separately, in small quantities ie:

12 Feb. 1894 Wm. M. Barkley + Son 5 Ton of Smiths Coal £4-5-0.

Coke is mentioned only twice in the accounts and without giving the quantity:

24 Ap. 1886 Cash rec^{d} for Coke supplied to Ballyculter Church £6-12-0
24 Jan. 1894 Cash rec^{d} for Coke sold per D. Cochrane £0-2-6.

Wigan and Orrell were both mined in the Lancashire coalfield and both were classed as cannel. Orrell was particularly noted for its bright flame. For gas-manufacturing purposes all hard coals, homogeneous in appearance, and yielding gas of 20 candle-power, and upwards, are classed as cannels. But cannel, in its different kinds, would yield from 10,000 to 15,000 cubic feet of gas per ton of a quality of 20 to 40 candles (Hornby: 7-8). Presumably the "Cannel" bought for Castleward was towards the high end of this scale to justify the higher price.

4.4.3 Other Entries in the Accounts

On 16th January 1877, the same day as a payment to Edmundson's (4.4.1), an amount of £8 8s. 6d. was paid to Lanyon's account. This is likely to be the architect John Lanyon as it is assumed Sir Charles Lanyon had retired by this time. Unfortunately, the reason for payment is not given.

An entry under 20th May 1878 itemised "Sheet iron for C.Ward 2s. 6d." Again, there is no quantity recorded nor intended use – it may have been anywhere on the estate.

Under the heading "Castleward Improvements", during the year ending March 1883, two payments totalling £264-1-8 were made to "James Withers a/c". In the same period many payments were made to G. Stockdale totalling £735-17-6 and to P. Ferguson totalling £360-14-6. George Stockdale was a builder based in Church Street, Downpatrick, and Peter Ferguson a painter in Irish Street (*Ulster Directory*). The object of the improvements is not specified.

On 12th July 1887 £5 8s 3d was paid to Thomas Fraser's account for bricks and clay.

William Frizelle is described as a plumber when paid 18s. on 14th February 1888. But, in the *Ulster Directory* he is simply listed as "gasfitter" in Saul Street, Downpatrick.

4.5 Bricks

The firebricks lining the ashpits displayed clearly readable maker's marks in the frogs: ALLAN & MANN / PATENT / GLASGOW. A loose brick bears this legend on one side and the other frog is blank. Some bricks *in situ* present lettered and others blank frogs. Allan and Mann made common brick from 1837 to 1887 (Douglas: 15) and Hugh Allan's diary (1867-70) reveals that their Rutherglen Pottery was largely occupied in fireclay production by 1867 (Hume: 3). Clay was transported from Rochsolloch and Govan pits for the purpose. The firm's city office was at 48 Enoch Square, Glasgow, and sales outlets were established at Port Eglinton and Greenock. Unfortunately the present state of knowledge does not permit a commencement date for the use of our frog mark.

Fig. 33: Eastern ashpit. (DSCF0858)

In the west wall of the purifier house and next to the entrance, two yellow bricks are close to, and at, ground level. For each, part of a frog is exposed. On the higher brick (9¼" x 4½" x 3" : 23.5 x 11.5 x 7.5 cms.) can be read the first four letters, "ALLA". The other has a blank frog.

Fig. 34: Buckley brick in merlon. (RIMG0109)

The coal store is trimmed with yellow brick. The brick at the top of the SE corner has parted from sufficient mortar to allow a reading of several letters of the frogmark: "... KLEY". A single yellow brick has been built into the most northerly merlon on the demesne wall leaving its frogmark fully exposed (fig. 34).

The colour and general appearance of this brick is the same as those incorporated in the coal store. The frogmark reads: N & S BUCKLEY / FLINTSHIRE. The North and South Buckley Colliery Brick & Tile Co. Ltd. was formed in 1881 and dissolved in 1891, but production continued under the newly formed South Buckley Rock Brick Co. Ltd. (Hodnett).

4.6 Gasholder

An Edmundson advertisement of 1875 (fig. 28) illustrates an installed gasworks. The picture emphasises that the works can be screened from view and that a gentleman and lady, finely attired, may stroll by safely. The gasholder is in the nearly-full position. It has been formed of plates riveted together. Three guiding columns stand on the tank coping and are steadied at the top by a triangle of tie-rods. A pulley wheel is mounted on each column to carry a chain loaded with a counter-weight, which maintains tension on the holder. This arrangement would fit the remains at Castleward. In the advertisement a retort house is depicted with a ventilated roof and a chimney of modest height.

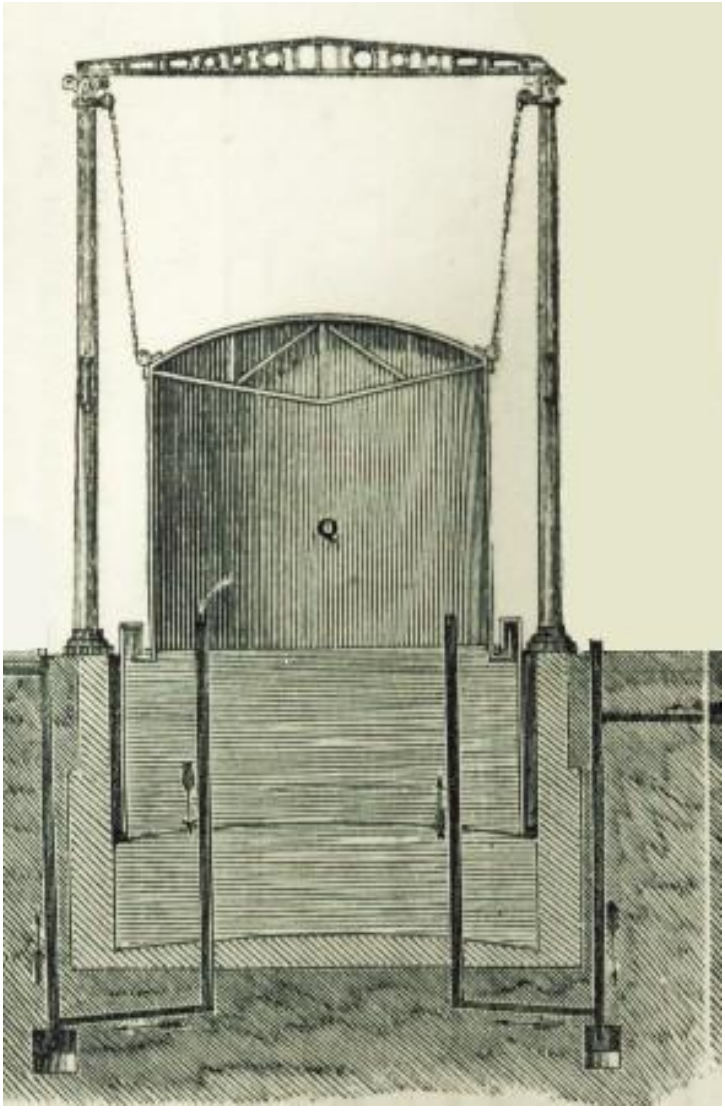


Fig. 35: Cross-section showing workings of a gasholder and tank. Detail from Muspratt, p. 135 (figure 94).

The widely separated coping stones on the Castleward gasholder tank may have been originally intended to form a tighter circle for a gasholder of smaller capacity – possibly the gasholder at the stables.

4.7 Retorts

The length of the bed at Castle Ward would admit retorts 6' or 7' long. The account book entry shows that Castle Ward was still using cast-iron retorts in the 1890s. About mid-century there had been a general trend away from iron to fireclay retorts because the rapid decomposition of the former at high temperatures constrained usage to a maximum of 800^0 C (Lewes: 51). Gas yield rose at higher temperatures. A ton of coal carbonised at 1400^0C might give 13,000 cu. ft., while at 800^0C would typically yield 10,000 cu. ft. The working life of an iron retort was taken as twelve months, while a fireclay retort would be expected to last thirty months. The short life of iron retorts was a real disadvantage because it meant taking down and rebuilding a setting for each replacement – a job for a bricklayer and a labourer. In considering a setting of five retorts, Clegg would allow a week for it to cool, two weeks work, then enough time to dry completely before lighting a fire (Clegg: 70).

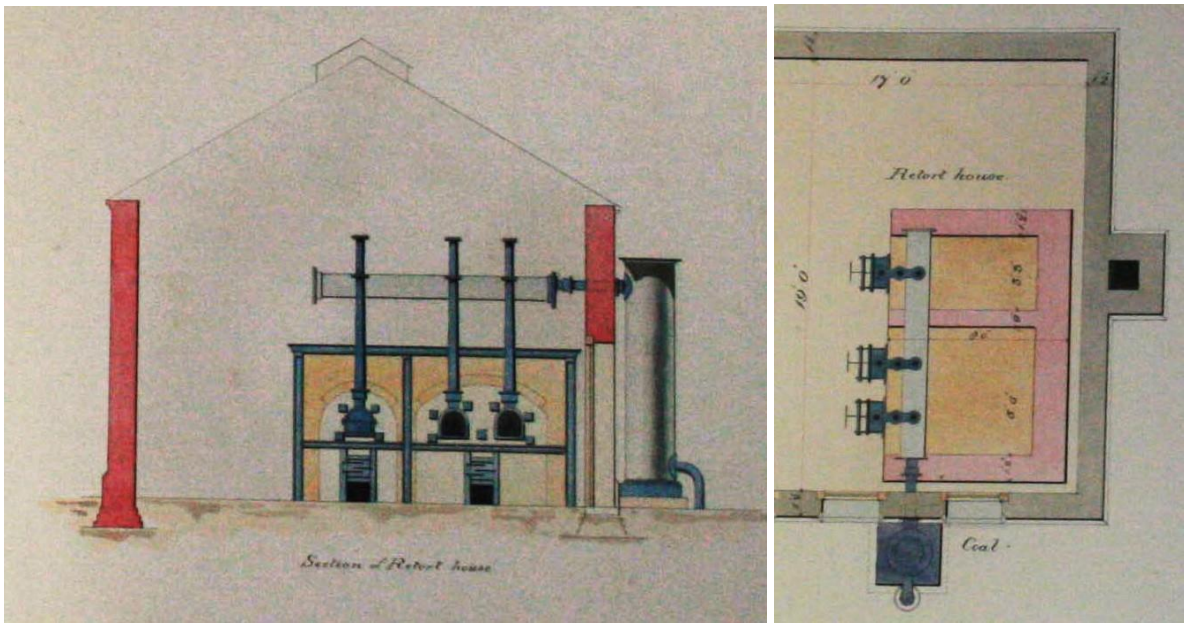


Fig. 36: Details from drawing for Gas Works at Holkham by Porter & Co., 1865, representing three retorts in two settings: front elevation and plan. (Copyright: Viscount Coke and the Trustees of the Holkham Estate)

The Arrangement of retorts shown in the drawing for Holkham, Norfolk (fig. 36) allows a certain flexibility in operations. One setting may continue in production whilst the other is down for maintenance. As retorts for Castle Ward were ordered either singly or two at a time, this may reflect a maintenance pattern of two such asymmetric settings.

Fig. 37: Cast-iron retorts used as gate piers, Derrymore.

Six iron D-section retorts survive in the Bessbrook area where they have been re-used as gate piers, the open mouth sunk into the ground and the closed end uppermost (fig. 37). The internal breadth and depth of one was measured through a hole – it was 19¾“ x 12” (50 x 31 cms). The external measurements were 23½“ x 15¾“ (60 x 40 cms). The curved roof was twice the thickness of the floor. Accretions and defoliation of layers of rust may account for a variation of 2” in the breadths and depths within the group. The “length” above ground level was 5’ 3” (1.6m). Engineers defined retorts by the internal measurements.

John Grubb Richardson (1815-1890) was owner, then chairman, of Bessbrook Spinning Company (Adams : *passim*) and was also a customer of J Edmundson & Company (Edmundson: 14). (Both Richardson and the chief executive of Edmundson’s, John Richardson Wigham (1829 –1906), were members of the Society of Friends.) So, the surviving Bessbrook retorts may be products of the Edmundson foundry.

4.8 Condensers

The remnants of pipe through walls allow us to draw conclusions on the arrangement of plant. We can postulate condensers on the outside north wall of the purifier house. Gas produced in the retorts would reach them via the pipe through the wall of the retort house. The strip of iron attached to the gashouse wall probably secured the condensers in an upright position. After most of the tar had been precipitated, the gas would progress to the purifier through the angled pipe. From the purifier the gas would travel through the pipe under the threshold and continue underground to feed into the gasholder.

Fig. 38: North wall of gashouse, exterior. (RIMG0021)

Fig. 39: Interior north wall of purifier house: through-pipe and iron bracket. (RIMG0113)

4.9 Aspiring to the Picturesque

Heightening and crenellating the demesne wall was clearly intended to disguise this little patch of industrialisation. We do not know the height of the chimney, but the size of the base could allow as much as 18 metres (*The Gas World Year Book*).

The upper reaches of the chimney might well have been gothicised to complete the romantic ensemble seen by the Strangford voyager.

4.10 Coal to Light Quantified

The payments for cannel coal in the financial accounts give an annual usage of about 24 tons, although, as the sample size is small this figure may be unrepresentative.

The most economical charge in each retort was 1½ cwt. of coal (Clegg: 60) or 150 lbs. (Muspratt: 136). Clegg's retorts were 7' long with a diameter of 1' 2"; Muspratt assumed 6.5' long and 1' diameter. After 6 hours the retorts were drawn. Twenty-four tons of coal would give 320 retort charges. Total distillation would take 1920 retort hours, or all three producing for 640 hours, neglecting time for emptying and recharging. Clearly this could be a part-time employment for one man.

If it is assumed one ton of cannel yielded 14,000 cu.ft. of gas (Hornby: 8) there would have been an annual output of 336,000 cu.ft. An argand lamp was expected to burn 4 cu.ft. per hour (Clow: 438). Therefore keeping all seventy lamps in Castle Ward House burning would expend 280 cu.ft. each hour.

It is possible to construct a hypothetical pattern for the lighting of Castle Ward:

70 lamps lit for	4	months @	6	hours/day	201,600	cu.ft.
70 lamps lit for	2	months @	4	hours/day	67,200	cu.ft.
70 lamps lit for	2	months @	2	hours/day	33,600	cu.ft.
				Total	302,400	cu.ft.

There is little need for artificial light in summer and so maintenance can best be done then. In practice there is always a loss through leakage and the long line from works to house necessitated many lengths of cast-iron pipe and many joints.

Some Scottish cannels had exceptionally high luminosity but poor coke yield, and so commercial gasworks operators would "dilute" it with other coal types (Cotterill: 22). It has been noted that surplus coke is rarely mentioned in the Castle Ward accounts (4.4.2).

The gas mantle, which became commercially available in the 1890s, was an important innovation because it allowed heat energy to convert to light energy. The brightness of the incandescent light and the ease with which it could be directed downwards encouraged its rapid adoption giving it a dominant position as the new century opened (Gledhill: 16). It would have been interesting (had account books survived) to follow the effect this made on the coal-buying habits of the estate.

A price list for WC Holmes, gas engineers, of Huddersfield and London, offers a complete gasworks for 70 lights at £100 (Thomas: 2). This includes: one retort; a gasholder with a diameter of 12½' and depth 8' having capacity of 1,000 cu. ft.; condensers, purifiers and all requites.

Gas engineers calculated cubic capacity of a gasholder using the formula: diameter squared x 0.7854 x height (Hornby: 150). The diameter of the holder at Castleward can be taken as eighteen feet. The height is equal to the depth of the tank, which is unknown because presently filled with spoil, but ten feet is a reasonable guess. Placing these values in the formula gives:

$$18^2 \times 0.7854 \times 10 = 2545 \text{ cu. ft.}$$

This is much larger than the Holmes example and raises the question: was the Holmes expectation of usage much lower than Edmundson's, or had Castle Ward increased the number of fittings since 1858?

4.11 Dating the Gasworks

Two consecutive OS surveys confine the construction of the gasworks to the interval 1859-1901.

The Edmundson brochure of 1889 lists the gasworks of 1858. It may be expected that if they were contracted for a major new work it would also be listed. (Some customers are mentioned a second time when capacity is increased.) So it may be assumed no such contract was made with Edmundson's. The continued purchase of retorts into the 1890s shows no switch in brand loyalty. Rather than contracting a foundry for a ready-made gasworks, the estate might have engaged a competent gas engineer to supervise the construction, moving from the stables whatever is useful and buying in whatever plant is needed. At Mountstewart Mr. Saunderson supervised construction in 1858 for a fee of £30 (PRONI: D654/HI/7). William Saunderson was the gas engineer for Newtownards gas company.

Yellow brick used in the coal store shows it cannot have been built before 1881 (4.5). Though Allan & Mann may have ceased production of fire brick in 1887, this does not force the conclusion that the retort house was built by that date.

The "Castleward Improvements" of 1882-83 (4.4.3) employed men with the skills necessary to build a gasworks, and fall within the period when both identified brickworks were in production.

Bricks and clay bought in summer 1887 (4.4.3) are just the materials required for a gasholder tank. Puddled clay was laid under the floor and behind the walls to make watertight a tank of porous brick. But, there were other uses!

A purchase of tiles for the gasworks was made in December 1890 (4.4.1). If they were floor tiles for the gas house, they were not found in 2011 when the floor was excavated for the soak-away. It is perhaps more likely that the tiles mentioned were the fire-tiles on which retorts would rest (Clegg: 67). Fire-tiles spanned the width of the bench and protected the retorts by dispersing the heat rising from the furnace.

Available evidence is insufficient to allow any particular year to be selected with certainty, but the improvements that went forward in the summer of 1882 could well have been the building of the gasworks on a new site with increased capacity. Distance from the house would dissipate the smells. The lower level would

increase pressure in the pipes permitting a supply to farmyard and stables as well as the house. Additional light fittings would lead to redecoration and the need of a painter. August 1882 sees the only use of the term "Gas Coal" in the accounts (4.2.2). This, in readiness for the first charging of the new gasworks?

5. Recommendations

5.1 Chimney

A limited excavation under the rubble of the chimney could establish its exact footprint. The rubble could then be used to build a low wall carrying the line of the chimney above ground level. This would tidy the area and enhance the display function of the site.

5.2 Information Boards

All-weather information boards should be prepared and mounted on site displaying:

1. Function and operation of a gasworks;
2. Identified features of Castle Ward gasworks site;
3. Other gasworks that may be visited.

5.3 Retorts

The surviving retorts in Bessbrook can only be expected to suffer accelerating deterioration. The National Trust, Northern Ireland Environment Agency: Built Heritage, or the Bessbrook Development Company (or a partnership of them) might explore the possibility of selecting examples to acquire, conserve, and exhibit in a suitable environment.

Fig. 40: The gashouse in 2012. (DSCF1443)

Castle Ward Gasworks: iron fittings

Fig. 41: Coal store door (north). (RIMG0126)

Fig. 42: Coal store door (south). (RIMG0125)

Fig. 44: Purifier house. (RIMG0120)

Fig. 43: Coal store (W wall, int.) (RIMG0137)

Fig. 45: Purifier house. (RIMG0118)

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APPENDIX A

PHOTOGRAPH RECORD FORM 1

Site: Castle Ward Gasworks
Date: 24th April 2010

Make and Model of Camera: Ricoh Caplio G600 Wide
Cameraman: Duncan Berryman

The compass bearing indicates the direction from which the subject has been viewed.

Photo No.	Direction	Description
RIMG0001	W	Quay Gate
RIMG0002	SW	General view of Gasworks
RIMG0003	SW	General view of Gasworks
RIMG0004	SW	General view of Retort House
RIMG0005	NW	SE corner of gas house and yard wall meeting demesne wall
RIMG0006	NW	Demesne wall and quay gate from inside gasworks yard
RIMG0007	SW	North wall of gashouse
RIMG0008	W	East wall of gashouse
RIMG0009	S	Chimney breach in north wall of retort house
RIMG0010	S	Chimney breach in north wall of retort house
RIMG0011	S	NE corner of purifier house: iron bar
RIMG0012	S	Retort house: pipe piercing north wall
RIMG0013	SE	Purifier house: pipe piercing north wall at angle
RIMG0014	S	Purifier house: north wall
RIMG0015	E	Coal store
RIMG0016	NE	Coal store : South door jamb
RIMG0017	SE	Coal store : North door jamb
RIMG0018	S	Coal store : interior
RIMG0019	SW	North end of gasworks yard
RIMG0020	NW	Chimney base
RIMG0021	N	North wall of gashouse
RIMG0022	NE	Coal store and coping of gasholder
RIMG0023	W	Kerbstones piled against demesne wall
RIMG0024	NW	Pipes and metal fixing on north wall of retort/ purifier house
RIMG0025	NW	Retort house viewed though chimney breach
RIMG0026	N	Corner between chimney and demesne wall
RIMG0027	NE	Remains of chimney
RIMG0028		Gasholder coping showing holding-down bolts
RIMG0029		Gasholder coping showing holding-down bolts
RIMG0030	SW	Roof line in yard wall, north of gasholder
RIMG0031	N	Gasworks: distant view
RIMG0032	N	Survey party at work
RIMG0033	S	Survey party at work
RIMG0034	N	North entrance: on left gate pier with hinge
RIMG0035	S	Survey party at work in gashouse

RIMG0036	ESE	Coal store
RIMG0064		Kitchen ceiling
RIMG0065		Water pipe? Back wall-cupboard kitchen
RIMG0066		Ditto
RIMG0067		Lead seal pipe on floor courtyard back of kitchen and stable block (NW corner of house)
RIMG0068		Second pipe hole – sealed J57241 49244
RIMG0069		Vent pipe?
RIMG0070		Vent pipe?
RIMG0071		Pipe mark on wall
RIMG0072		Possible pipe track
RIMG0073	E?	Vent pipe
RIMG0074		Vent pipe
RIMG0075		Sandstone block showing fixing bolts for gasholder and mason's mark (S)
RIMG0076		Ditto
RIMG0077		Ditto
RIMG0078		Sandstone block showing fixing bolts for gasholder
RIMG0079		Sandstone block showing fixing bolts for gasholder
RIMG0080	W	SE corner of gashouse and yard wall meeting demesne wall
RIMG0081	W	SE corner of gashouse
RIMG0082	S	South end of yard wall meeting demesne wall
RIMG0083	SW	South end of yard wall meeting demesne wall
RIMG0084	W	Gate to coal quay
RIMG0085	S	Gasworks from quay gate
RIMG0086	S	Gasworks from quay gate
RIMG0087	NW	Coal quay
RIMG0088	E	Quay gate
RIMG0089	NE	Window on east side of retort house
RIMG0090	NE	Decorated stones on outer NE corner of retort house
RIMG0091	E	Merlon incorporating pipe
RIMG0092	NE	Merlon incorporating pipe
RIMG0093	NE	Merlon incorporating pipe
RIMG0094	NE	Merlon incorporating pipe
RIMG0095	SE	Demesne wall: farmyard and castle beyond
RIMG0096	SE	Demesne wall: farmyard and castle beyond
RIMG0097	NW	North wall of retort house engaging demesne wall (carved sandstone and part of galvanised sheet visible)
RIMG0098	N	Yard wall (north) with imprint of sloping roof (detail)
RIMG0099	N	Yard wall (north) with imprint of sloping roof
RIMG0100	NE	Yard wall (north) with imprint of sloping roof (detail)
RIMG0101	NW	Yard wall (north) with imprint of sloping roof (detail)
RIMG0102	NW	North gate: east pier
RIMG0103	NW	North gate: east pier
RIMG0104	NW	North gate: east pier detail
RIMG0105	E	Broken end of yard wall, west side of north gate
RIMG0106	S	North wall of yard showing coping of gasholder tank
RIMG0107	W	Pipe in merlon

RIMG0108	NW	Pipe in merlon
RIMG0109	SW	Buckley brick in merlon
RIMG0110	E	Coping of gasholder
RIMG0111	W	Outlet of gasholder
RIMG0112	E	Gate pier of yard wall, west side of south gate
RIMG0113	W	South wall of yard and demesne wall
RIMG0114	NW	Retort house window
RIMG0115	SW	North wall of retort house, looking through chimney breach
RIMG0116	SW	North wall of retort house, looking through chimney breach
RIMG0117	SE	North wall of gas house: two pipes visible
RIMG0118	S	North wall of gas house: iron bracket
RIMG0119	SE	North wall of gas house: pipe passes through wall obliquely
RIMG0120	S	North wall of gas house: fixed iron plate
RIMG0121	S	North wall of gas house: course of slates
RIMG0122	S	North wall of gas house: course of slates
RIMG0123	N	Coal store: south jamb
RIMG0124	S	Coal store: north jamb
RIMG0125	N	Coal store: south lug
RIMG0126	S	Coal store: north lug
RIMG0127	E	Coal store: south side of chute
RIMG0128	E	Coal store: north side of chute
RIMG0129	S	Coal store: interior
RIMG0130	N	Coal store: interior
RIMG0131	NW	South yard wall meets demesne wall beyond retort house
RIMG0132	SW	SE corner of retort house
RIMG0133	SW	Gas house: general view
RIMG0134	SE	Gas house and coal store: general view
RIMG0135	NE	Coal store: NE corner
RIMG0136	NE	Coal store: NE corner
RIMG0137	E	Coal store: iron staple in west wall, interior
RIMG0138	NW	Gas house: NE corner
RIMG0139	NW	Gas house: NE corner
RIMG0140	NW	Decorated stone in merlon
RIMG0141	NW	Decorated stone in merlon: coal quay behind
RIMG0142	NW	Decorated stone in merlon: sockets
RIMG0143	N	Gas house: fragment of galvanised sheet at NE corner
RIMG0144	NW	Gas house: fragment of galvanised sheet at NE corner
RIMG0145	N	Gas house: chimney breach, potter's kiln beyond
RIMG0146	NW	Chimney area

APPENDIX B

PHOTOGRAPH RECORD FORM 2

Site: Castle Ward Gasworks
Date: 9th March 2011

Make and Model of Camera: FinePix F60fd
Cameraman: George Rutherford

Photo No.	Direction	Description
DSCF0831	S	Gashouse with ashpits exposed
DSCF0832	E above	Eastern ashpit
DSCF0833	E above	Western ashpit
DSCF0834	W	Gashouse with ashpits exposed
DSCF0835	NW	Gashouse
DSCF0836	N	Buttresses on demesne wall
DSCF0837	S	Gasholder tank coping
DSCF0838	W	Gasholder tank coping
DSCF0839	SE	Coal store
DSCF0840	SE	Coal store chute
DSCF0841	S	Coal store interior
DSCF0842	NE	Coal store: south jamb of entrance
DSCF0843	NW	Retrieved objects placed in window of gashouse
DSCF0844	W	Glazed firebrick
DSCF0845	S	Eastern ashpit
DSCF0848	E	Pipe under threshold of purifier house
DSCF0849	E	Purifier house showing footings of south and west walls
DSCF0850	NE	Coal store: south side
DSCF0851	W	Coal store: iron strip mounted on wall
DSCF0852	S	Gashouse with ashpits exposed
DSCF0853	SW	General view of gashouse
DSCF0854	E	Purifier house showing pipe under threshold
DSCF0855	E	Purifier house showing pipe under threshold
DSCF0856	S	Gashouse with ashpits exposed
DSCF0857	S	Ashpits
DSCF0858	E	Eastern ashpit
DSCF0859	E	Western ashpit
DSCF0860	N	Bricks in retort bench (west)
DSCF0861	N	Bricks in retort bench (middle)
DSCF0862	N	Bricks in retort bench (east)
DSCF0863	W	Brian McKee holding glazed firebrick
DSCF0864	W	Brian McKee holding glazed firebrick
DSCF0866	W	Retort house: granite slabs on line of west wall