ART. XV – *The lineaments of Newland iron furnace, 1747-1903; an historical investigation*

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IN 1988, a survey team made up of members of this Society's Industrial Archaeology Sub-Committee[1] conducted a preliminary survey[2] of Newland Iron Furnace and hamlet, about one mile east-north-east of the town of Ulverston. A close examination of the furnace hearth and boshes (i.e. the circular firebrick lining about 3 metres above the surface of the ground) showed that this industrial monument was in a state of rapid and perhaps irreversible deterioration. More seriously still, that part of the west wall of the furnace stack which lay above the blowing chamber arch was in a state of collapse, about five cubic metres of slate wall and rubble having collapsed into the hearth and blowing chamber.

Since Newland Furnace was one of three major charcoal iron furnaces which had played a key part in the eighteenth and nineteenth century economic development of Furness[3] (the others having been Backbarrow and Duddon), the members of the Sub-Committee felt justified in taking emergency action in respect of the conservation of the unsafe and threatened parts of the former's structure. However, it was not until November 1989 that action became possible, facilitated by Mr T. Clare, then County Archaeologist for Cumbria, who made available a non-recurrent grant of £450. This money rendered possible the hire of scaffolding and staging boards, utilised to protect those working inside the furnace stack and blowing chamber. It has since been augmented by the Society itself.

Initially, the Industrial Archaeology Sub-Committee had obtained the practical help of members of the Cumbria Amenity Trust Mining History Society, as well as some moral and practical assistance from the Cumbria Industrial History Society, and this combined group of bodies provided the necessary workforce to engage in the emergency conservation that was called for. After further monetary assistance had been obtained, from this Society, and from the Shell/B.P. "Better Britain" Fund, as well as from a public appeal, the work of clearance and reconstruction proceeded steadily, reaching an initial and memorable landmark when a new one-tonne oak lintel beam to the blowing chamber arch was lifted into position in November, 1991. Up to that point, some 5-6 cubic metres of dumped household rubbish, slate rubble and garage parts had been removed from the furnace blowing chamber, well over a tonne of ivy had been removed from the furnace stack, and the rebuilding of the side walls of the blowing chamber arch had commenced. The collapsing firebricks of the furnace lining had been shored up by the systematic use of Acrow props and scaffolding, and the advice of the Health and Safety Inspectorate had been obtained. That of the Area Superintendent, North, for English Heritage had been specially sought regarding the construction methods for building renewed masonry.

Historical Methodology and Approaches

In an operation of this character, it is not enough simply to reproduce what may

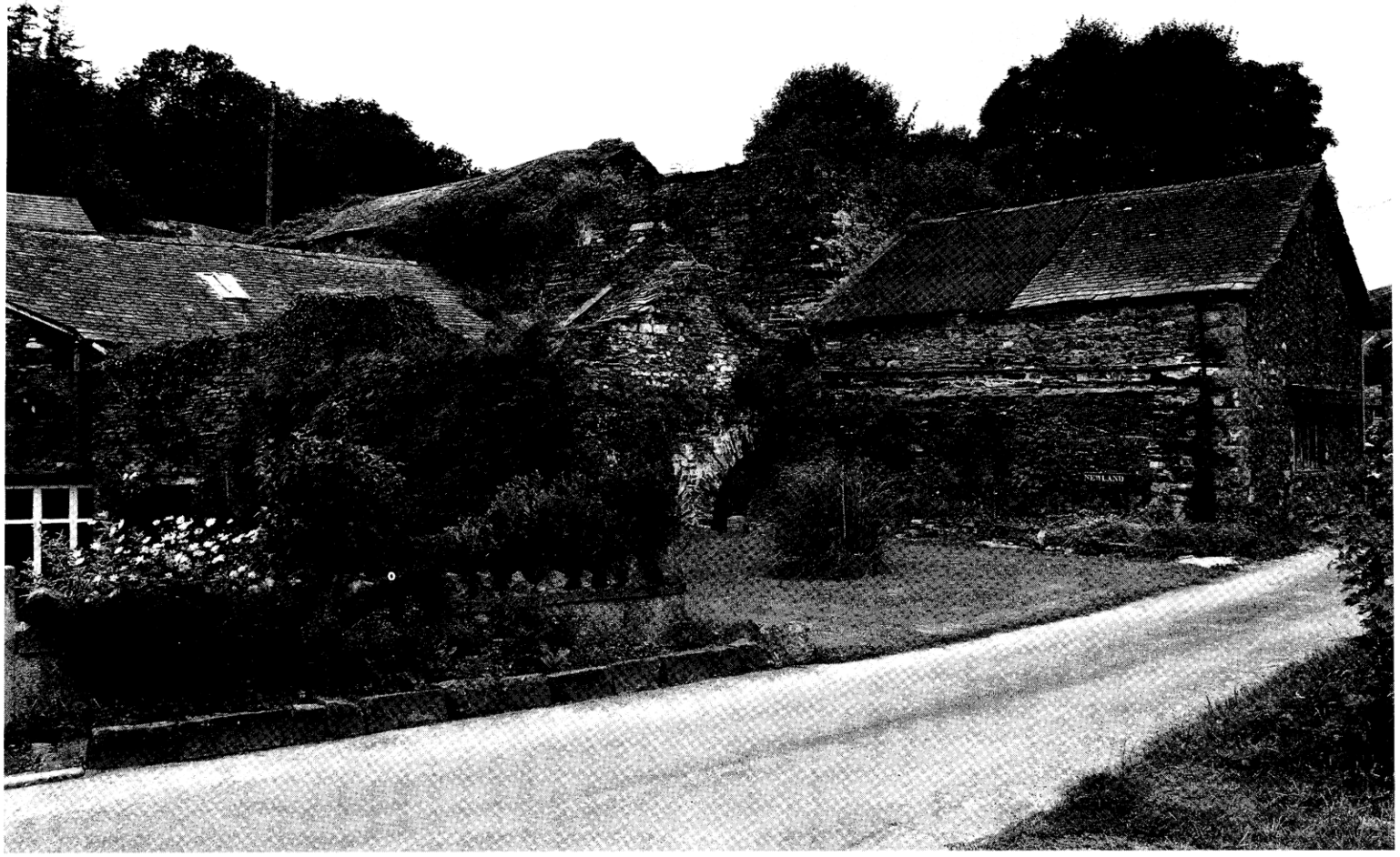

PLATE 1. Newland Furnace 1991. Great quantities of ivy and overgrowth have since been removed. Photographs by courtesy of Mr Michael Trueman.

have been there in a collapsed area. The furnace itself has undergone changes, both before closure and subsequently, and every aspect of the construction and masonry has to be explored. The likely function of all standing structures must be considered, and the historical changes affecting them over (say) two centuries must be taken into account. It is not immediately obvious which parts, if any, of the random slate construction of the main walls of the furnace and associated chambers are as originally erected, given that according to Alfred Fell, the furnace stack was build "about 1770".[4] All that can be said here is that, so far, there have been no signs of any major alteration in the thick slate walls of the furnace stack, as distinct from the firebrick lining of the latter, which was replaced in part or whole after each blast period – and such a period, when the furnace was continuously in use, might last more than two years.

Thanks to the existence of a contemporary photograph (Plate 2), taken not many years after the closure of the furnace in January 1891, we know how the Newland furnace complex appeared[5] in many of its details. By comparing this photograph with a relatively recent one, taken from roughly the same standpoint to the east of the complex, we can deduce the more material changes in the fabric, brought about by partial dismantling in 1903, when even the inscribed lintels of the furnace were "sold for a few shillings' worth of scrap iron".[6] It can now be deduced that there has been very little change in the outward lineaments of the furnace buildings since that date. The main fabric of this important industrial monument remains, it being

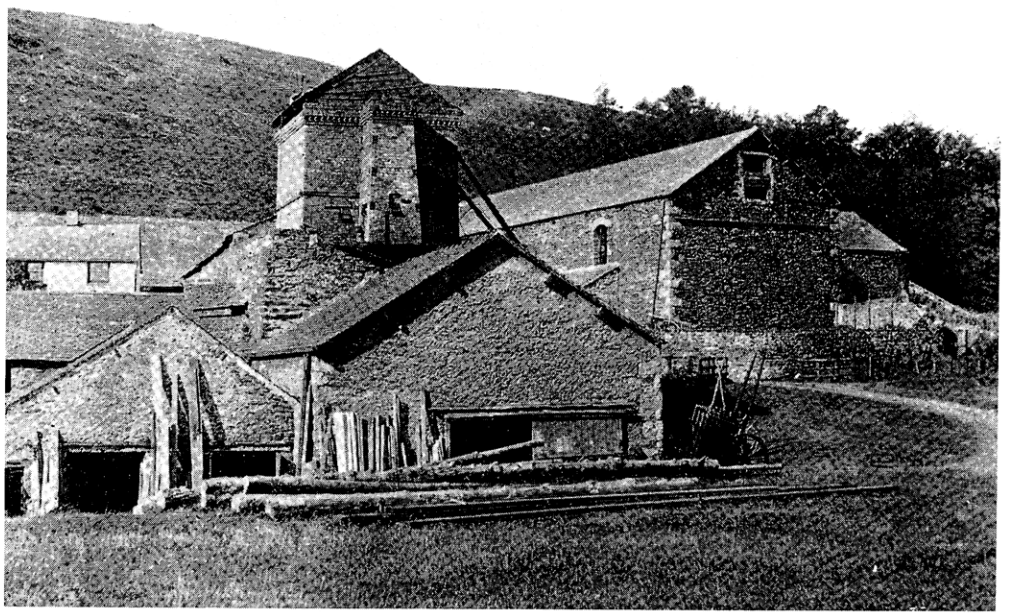

PLATE 2. Newland Furnace *c.* 1897. Photograph by Holmes of Ulverston and first published in *The North Lonsdale Magazine* in October 1897.

understood that the group of structures is not so well preserved as those of the analogous group round the Newland offshoot furnace at Bonawe, Argyllshire;[7] nor is it capable of restoration to the same degree of detailed excellence as the Bonawe complex. It is evidently this consideration which has led to an official unwillingness to schedule the Newlands site since this possibility was considered in 1983;[8] there is, for example, little likelihood that Newland could be made into a popular paying exhibition area of the Bonawe kind.

Yet Newland, like Bonawe, has to be seen as an industrial village and community, and the important feature of both localities is that they are settlements unique in their own milieux. To have allowed the centre-piece of Newland hamlet, the furnace, to collapse into rubble would have shown a singular irresponsibility in the historical, archaeological and educational senses. The initial or preliminary work of rebuilding and restoration, meanwhile, has proved to be highly instructive in itself.

What follows is an account of the fabric of the furnace and its associated buildings, as that fabric was at the time of closure in January 1891, and as it is at the present day. This comparative account is necessarily related to the more general history of the Newland hamlet and enterprise.

The operative furnace in 1891 and earlier

The Newland furnace, then operated by the noted Furness firm of Harrison, Ainslie and Co., was closed on 19 January 1891, because of a general depression in the iron trade, and by virtue of the growing stocks of unsold iron accumulated by the firm. The stocks of iron held at the furnace had amounted to 91 tons in January 1886, but were 1170 tons two years later. The stockpile had fallen to 363 tons by January 1890, but had climbed back to 1071 by January 1891. Even after the closure of the furnace, considerable tonnages were held in Newland, and during 1892 a total of 187 tons 15 cwt. of "white pig" was delivered at Newland from Backbarrow furnace (also owned by Harrison, Ainslie and Co.).[9]

The furnace had been in operation intermittently through a series of six "blasts" (or periods of continuous working) from 1877 until the date of closure in 1891. These blast periods varied in length from four months to an astonishing twenty-eight months (September 1882 to January 1885), and after the furnace was blown out at the end of such a period, repairs to the firebrick lining and blowing or other gear would take place. Such particulars have some importance to the industrial archaeologist, who has to determine how much of the remaining firebrick lining is in fact older than the last blast of 1889-91 (and indications are that some of it may be older – see below).

Even in 1891, there was much about Newland furnace that directly resembled rural blast furnace practice of the preceding two centuries, in Furness and elsewhere. Its weekly output (or make) was appreciably though not vastly larger, at rather over 20 tons,[10] than the make at Backbarrow furnace in 1763-80.[11] During most of the period under review, the Newland furnace had used charcoal as fuel, but its owners had experimented for a period with "coal" (i.e. furnace coke), and even with peat, and they had also introduced a number of refinements which brought the enterprise more completely into the nineteenth century; a rudimentary system for re-heating

furnace gases (for the purposes of heat economy), an extension of the upper furnace stack which had the effect of increasing air draught through the furnace itself, iron or perhaps steel air pumping cylinders in the blowing mechanism (the former type perhaps being installed from the commencement of the century), and even a water-powered charging hoist – presumably operated from the original bank-top charging floor or level to the top of the stack extension.[12]

Researchers into the general condition of Newland furnace have what is in many ways a most useful analogy in the equipment of Backbarrow furnace, finally run in tandem with that at Newland by the same firm of proprietors. Backbarrow, even today, has the brick extension to the upper stack, and, at the time of its closure, had a charging hoist which operated over the nearby roadway[13] from the fuel and ore storage barns by the railway line there. Unfortunately, the proprietors at Newland treated all such equipment as wholly disposable, and few metallic items have remained on the site. But, as we here note, they utilised a water-powered hoist.

By far the most impressive feature of the Newland furnace complex in 1891 was a high breast waterwheel 39 feet in diameter, set in an appropriately large wheelpit on the north side of the blowing chamber wall, and situated at 90 degrees to the main water-channel or leat. The twenty-five inch 1888 O.S. map for the locality shows a side-channel (or launder) set to direct water to the wheel at roughly 45 degrees towards its eastern side, probably via a "sliding hatch" which directed water into the buckets. The approximate fall of the water from leat level was 29 feet, and the width of the wheel was 2ft. 9ins.,[14] indicating a substantial potential, the efficiency of such wheels being about 55 per cent. In other words, the unit was intended to drive fairly heavy machinery, and to operate not only the blowing cylinders but also the hoist for lifting charges into the top of the furnace, each of 6 to 7 cwt.[15] There was clearly a very deep wheelpit, (now entirely infilled), and the outline of a canopy on the adjoining wall does not fit these dimensions. The water apparently escaped through a flue or underground channel on the north side of the wheel pit, the entrance to which is still visible, but the line of egress has not yet been traced.

The use of water-power at Newland furnace was long ante-dated by that utilised by Newland water corn mill, about 60 metres to the south, which seems to have been operative at the time of the Dissolution of the Monasteries,[16] and the original Newland ironmasters (*c.*1735) made the most effective use of an existing and proven supply, constructing or enlarging a reservoir and dam 200 yards to the north of the hamlet. However, their utilisation of the topography of the foot of this small valley can only command admiration; the gradient of the leat and the sharper gradient of the bank to the west of the furnace are most skilfully employed to reap the advantage of gravity in each case – it being understood that the very large waterwheel and wheelpit represented heavy capital investment. The work of charging the furnace with iron ore, charcoal, peat or coke, and limestone flux, from store barns on the upper part of the bank to the north-west, was done on a more or less level surface throughout, until the brick stack extension was constructed. In its final months the furnace consumed 56 tons of charcoal a week – such a quantity meant that Newland and Backbarrow furnaces could not work simultaneously – with 35 tons of ore and 3 tons of limestone flux in the same period. This total weekly mixed charge was estimated to produce 28 tons of pig-iron from the furnace.[17] The work of loading and mixing it was not negligible, and was performed by a maximum of six men in

and around the furnace, including a founder (or head furnaceman), and one or two fillers,[18] who, with labourers, had the job of mixing and transporting up to two tons of charge material an hour over a distance of some thirty metres across the "bridge" or gangway, originally level with the top of the slate-built furnace stack. That is to say, the work was steady and repetitive rather than brutally heavy, but it had to proceed without a break for a twelve-hour period. Nor was charging the only work; the piling of sacks of charcoal, the distribution of ore in the barn for loading and mixing, and the stacking of iron pigs for stock or sale added a no doubt necessary variety.

The mention of "coal" (coke) fuel may be found intriguing; the Newland proprietors evidently experimented with this form of fuel in the 1870s, as revealed by a writer in the *North Lonsdale Magazine* (1895).[19] This report remarks that "considerable alterations" were made to the furnace in 1874, and that "coal was substituted for charcoal". The latter policy was not pursued for many years, because the enterprise was utilising charcoal fuel just before closure in 1889.[20] No real traces of coke have been found in the area of the present furnace site, apart from the very obvious ones left by a local dealer near the original charcoal barn, and what interests the present investigators is the reference to "considerable alterations" following 1874. This gives a chronological bench-mark as to the origin of firebricks used or re-used in the vicinity of the furnace stack proper, and, as is indicated below, there is further archaeological evidence to support the dating of these artefacts.

The significance of the blowing chamber

To return to the subject of the transmission of power at the furnace; the very large waterwheel was utilised primarily to operate a simple blast engine situated in the original blowing chamber, which is set to the immediate west of the furnace stack proper, and which is separated from that stack by a flat, tapering "arch" with splayed side-walls. It is in this arch area that conservation is taking place; and it is also in this area that the oldest parts of the furnace masonry are encountered. By way of an illustrative comment, the collapse of the arch was precipitated by the rotting of a heavy oak lintel beam which lay across the upper part of the arch mouth, and the beam was originally set by the eighteenth century builders, probably in *c.*1770.[21] The intact masonry near the beam, and in the west or "tuiron" wall is original, and shows no sign of major disturbance or rebuilding. The main stonework built near the butt-ends of the original beam, both of which remained in place until November, 1991, is evidently original. The same may be said of the stonework in the north wall of the blowing chamber, which is immediately adjacent. It is massive, and there would be no point in rebuilding it.

This north wall is of much interest in that it contains the slot for the waterwheel axle and main driving shaft for the blowing gear, together with some heavy stone blocks immediately against the interior wall, on which part of that gear evidently rested. What we had here, in the way of going gear, for at least a century before the furnace closed down, was a single or double blowing cylinder of the kind apparently utilised at Backbarrow from 1818 and supplied by William Dowing of Gospel Oak in that year.[22] The 1889 report on Newland furnace referred to a cylinder in the

PLATE 3. Initial support system for the blowing chamber arch at Newland Furnace, early 1991. The butt-end of the original lintel beam can be seen *in situ* on the right hand upper corner, as can the broken remains of the beam itself (lower left). The rubble and debris had been cleared at this stage.

singular, double acting, of 3 feet diameter, with a 3 feet stroke at twelve strokes a minute.[23] Any other measurements, speculative or other, connected with this device, probably have little relevance to the general dimensions of the blowing chamber, which was originally designed to accommodate twin wooden-framed leather bellows. Both Alfred Fell and John Lucas of Warton[24] give somewhat varying dimensions of bellows used in local furnaces, so that Leighton's, as described by Lucas, were seven and a half yards in length, whereas other specimens in Furness were 18 and a half feet in length. Both authorities agreed that the bodies of the bellows were four and a half feet in width, and Fell added that the latter were two and a quarter feet in width at the end nearest the furnace hearth.

These dimensions have some direct bearing on the layout of the Newland blowing chamber and arch. The chamber was cut into the rock of the adjacent hillside to accommodate blowing bellows of this kind, and the measurement from the hearth entrance (into which the twin nozzles of the bellows were inserted in a clay or firebrick packing) to the likely line of the main driving shaft, as indicated by the

present axle hole, is 23 and a half feet (704 cm), a dimension which allows space for the operation of the cams which alternately lifted the upper levers of the bellows. At the tuyere or "tuiron" end, i.e. the narrowest part of the blowing chamber entrance by the hearth itself, the width between the side-walls is just over 4ft. 6ins. (137 cm), a dimension which would have accommodated closely the tapered ends and nozzles of the bellows. It is considerations of this kind which lead us to conclude that the present masonry of the blowing chamber, like that of the slate walls of the furnace stack itself, is that of the eighteenth century furnace.

Until the urgent rescue work of rebuilding the collapsed blowing chamber arch has been completed, it would be quite inappropriate to investigate the floor of the chamber, which was cleared of a large volume of rubbish and debris in the winter of 1989-90. Elsewhere, two heavy beams run from the north to the south wall, in such a position that it would appear likely that they were part of the blowing gear framework. Although the eastern 4 feet (122 cm) of the main blowing chamber, as far as the west wall of the furnace stack, is open to the sky, these beams have been sheltered from the weather, and they show no sign of the acute rotting which affected the original and now collapsed lintel beam; decay so comprehensive that a qualified botanist had difficulty in discerning the type of grain of the timber used. It has to be concluded, with due caution, that these beams are not "original", and that they may have been used in conjunction with the iron or steel blowing cylinder and gear, but that they may also have supported an office or store in the upper part of the chamber. The roof of the latter is provided by a former loading or charging store or bay (now a furniture warehouse), and the fundamental layout is of interest in that it is the reverse of that obtaining at Bonawe; in the latter case, the blowing chamber is on the west side, and the charging bay and platform (and appropriate steep hillside) is to the east. The opposition-principle is also exemplified at Duddon furnace, where the blowing gear was on the opposite side from the charging platform.

Some early works had the blowing chamber divided by a transverse wall, with two slots through which protruded levers carrying counterweights to raise the bellows at each stroke, although there is no sign of these at Newland. The beams (see above) may have been inserted when the wall was removed to make way for the cylinder blowing apparatus, and may have provided lifting points for the cylinder blowers – which may also explain why one has snapped and has been repaired.

The site arrangement at Newland, which was not without ingenuity, left space near the bases of two if not three furnace stack walls for a casting floor, a store and a foundry or forge. When the furnace was closed down in 1891, these out-buildings were all roofed. (It should be borne in mind that there was a separate forge building to the north of the hamlet). The southernmost of these, now roofless, was the casting floor, suitably facing the southern or taphole arch of the furnace; the eastern or foundry (or forge) area is now a garage; and a space to the south-east, now a lawn, was a joiner's shop. Some interest attaches to this foundry area; as we shall see, one Edward Bivins (1877-8) was paid "1/6 for melting up all the sows", and Mr Jonathan Wignall suggests the hypothesis that there was a small or cupola furnace near the main source of power, the water wheel, from which molten iron could be obtained by the ladle full in the Isaac Wilkinson tradition at Backbarrow. Such considerations could be helpful when the deeper floor of the blowing chamber is

investigated, although the present garage is not available for such an operation. A similar "cluster" arrangement is seen in the layout of Backbarrow furnace site portrayed for the year 1850,[25] it being noted that the Backbarrow furnace lay at the foot of a steep slope, taking its water through a leat at the base of the slope while employing the bank for charging purposes. Newland furnace is unique in having a number of its adjoining chambers still roofed in the mid-nineteenth century fashion.

The evidence of the Newland furnace lining

While the completeness of the layout of the Newland furnace buildings is a strong point in their favour as a comprehensive industrial monument, there is little doubt that the masonry in the immediate vicinity of the hearth and furnace shaft, and some of that walling farther afield, has alike been subjected to considerable disturbance and rebuilding during the last two to three decades of the life of the enterprise. Not only this; refractory blocks which were originally designed for the furnace lining are to be found in the upper courses of the furnace stack proper, in the side-walls of the casting building, and even in the garden wall of the cottage to the south-west of the furnace "bridge", formerly an ore store.

About fifty of these blocks had in any case become detached from the lower firebrick courses around the furnace hearth, as a consequence of the collapse of the blowing chamber arch and of the movements of tree roots in the stack as a whole, and it has been possible to study such printed makers' names as are legible on the surface of the firebricks.

It has become evident, then, that such refractory bricks and blocks were obtained from two areas, West Cumberland and Stourbridge, and the first-mentioned trade source is of particular interest, in that the bricks were evidently bought from particular manufacturers whose names are known, and whose activities are now being traced. At the same time, there is also a known trade connection between Newland and the West Midlands: the Newland owners' Order Book for 1879-80[26] shows them delivering pig-iron to firms in Wolverhampton and Walsall. It should here be explained that Newland iron was especially prized for the manufacture of edge-tools (like shears and sickles);[27] meanwhile, it is easy to see why the company developed so many trading connections. The present investigators were looking for unusual items of evidence in the late 1870s and early 1880s, because it was hereabouts that the furnace seems to have been stopped for a notably long period, and, indeed, it was out of action from February 1881 for a period of 19 months, suggesting extensive repair and reconstruction.[28] However, it was before this time that the furnace was adapted for coke or peat-smelting, and other references in the company ledgers indicate the nature of the company strategy, which was to sell "Lorn pig" from stocks[29] kept in the Highlands at Bonawe, otherwise Lorn Furnace, which closed in 1876.[30] Backbarrow was enabled to keep up local production when its sister furnaces were not operative. The close relationship of these two furnaces must be stressed, now that Backbarrow is being thoroughly investigated as a scheduled monument, and more is said on this subject below. The two furnaces did not only sell pig iron, but sent blast furnace ore and annealing ore to the West Midlands, just as former trade connections are reflected in such sites as that of the

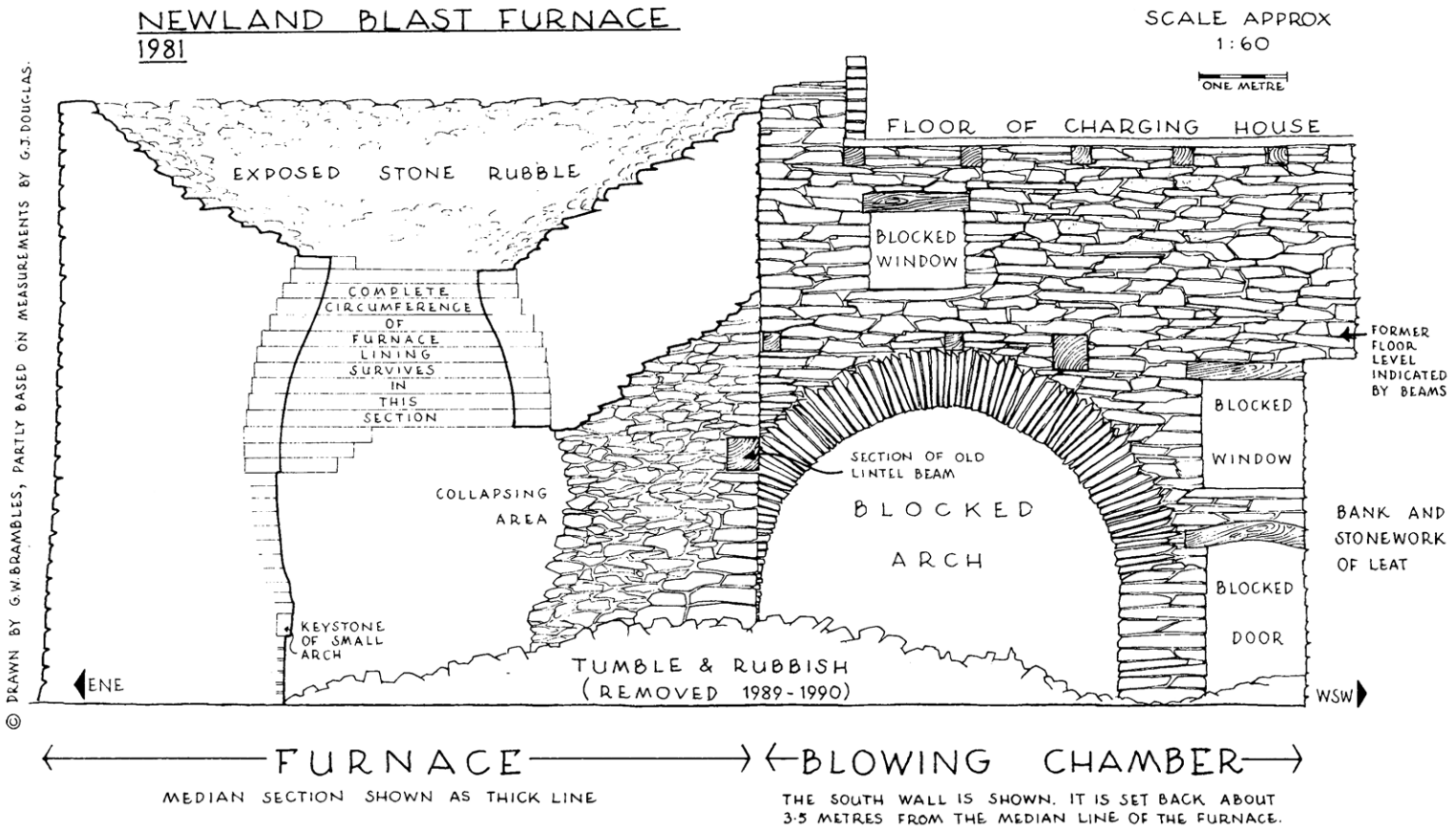

FIG. 1. Newland Blast Furnace 1981.

sickle mill at Broughton Beck, and the former "ruddle" grinding mill, once Harrison, Ainslie's, at Lindal-in-Furness; Mr Wignall also reports that in 1894 and 1898 Backbarrow pig was sent to Woolwich Arsenal for bayonet and sword manufacture.

A number of bricks in the vicinity of the Newland furnace hearth were found to be stamped with the name *Lucock*, an especially evocative name in the history of brick and tile manufacture in the region; Robert Lucock, originally an appointee of Sir James Graham of Netherby, was at one period "the greatest tile burner in Cumberland", and he commenced his first operation at Langrigg, near Bromfield in 1824.[31] Together with his brother Joseph he built a major enterprise embracing at least five brickyards and tileries,[32] including a major site at Broughton Moor in the mid-century, and another, also associated with Joseph Lucock, at Aspatria (1855). The significance of these data for the Newland investigation is principally a chronological one. What seems to have happened in this instance – and the history of the subject is as yet obscure – is that the Aspatria enterprise involved a coal mine, and, accordingly, brought a source of fireclay to the brickmaker, who would have found the manufacture of firebricks profitable as the West Cumberland iron and steel industry burgeoned. In about 1872, then, the Lucocks pass out of observation, but it is likely that some of their stock of firebricks had come to Newland in the 1850s or 1860s. Such Lucock specimens as have remained are of different dimensions, but may of course have been of the same chronological order and period. Yet another chronological layer of firebricks (or refractory blocks) is represented by Newland specimens stamped *Rd Graves Gillhead.* These are much larger than the bricks, and are tapered to allow for the circularity of the furnace lining, being as much as 50 cm in depth and 38 cm at the widest end. As for the origin of the blocks, Richard Graves was given as "colliery proprietor and firebrick manufacturer" in Gillhead, Flimby, West Cumberland in *c.*1878,[33] and we have so far had to conclude that these blocks, the last to be used in Newland furnace, represented the later "generation" that is still to be seen in the furnace lining today. That they had to be transported from West Cumberland is unsurprising; Furness has had no coal industry, and, accordingly, no source of ganister or fireclay (which appears in the coal measures). It would not have been too difficult for Harrison, Ainslie and Company vessels, bound from Bonawe in Argyllshire to Furness, to call in at Maryport to take such refractories on board in the middle and late seventies, although rail transport would have been even more straightforward.[34]

It remains only to give a somewhat more human dimension to the closing years of Newland Furnace. The latter, with Backbarrow, was kept in operation for specialised purposes only, but Newland hamlet and its trade associations were evidently evocative even to the owners, who understood the depth of tradition in the old Furness charcoal iron industry. The Newland enterprise was in any case a very small part of the Harrison, Ainslie commitment, which, as we have seen, owned Backbarrow Furnace and, in addition, it leased that at Duddon. However, Mr Wignall reports that the survival of these old charcoal furnaces may owe something to an agreement between Harrison, Ainslie and Co. and Barrow Haematite Steel Co. (1866), giving the latter sole rights to the output from the former's Lindal Moor Mines with the exception of sufficient ore for their own furnaces existing and one being built (Warsash in Hampshire). This agreement lasted until 1872. Even so, the

Harrison, Ainslie profits from furnace operations varied between one-sixth and one-fifth of those from iron mines in the period 1857-1864. Backbarrow Furnace was "twice as profitable as Newland" during this period,[35] and one cannot but think that the direct and personal association of some of the firm's principals with Newland hamlet made them more disposed to keep the local furnace in blast. During the period 1850 to 1874, Furness industry was in any case thriving,[36] and provided that the small charcoal iron industry did not create obvious losses – and it made profits in every year from 1857 to 1864, and almost certainly prospered more notably in the following ten years – then it could be safely left alone, even when its technology appeared more and more out-dated.

In the event, and helped by the Haematite Steel Co.'s hasty development of the great mine operation at Stank, the Ainslies found a use for their Lindal ore in a new and advanced iron enterprise in South Ulverston, the North Lonsdale Iron and Steel Co. (1874), on the site of the present Glaxo pharmaceutical plant.[37] They were major shareholders (with the iron ore master Myles Kennedy) in this venture, and such developments meant that the interests of the Ainslie family became more diffused but also less and less localised. In 1861, for example, William George Ainslie was living in Ford House, Ulverston, but eight years later he became permanently located in London to supervise "the principal financial affairs" of the firm,[38] leaving Aymer Ainslie in charge at Ulverston. In fact, the latter took a leading part in the direction of the North Lonsdale Iron and Steel Co., but even he moved to Hall Garth, Carnforth, by 1876, by which time his brother was living at East Sheen, Surrey.[39] Interestingly enough, Aymer Ainslie was resident at Newland House, ("Newland Furnace") in the hamlet, much later (1887), and there is abundant evidence that the family partners took an interest in the furnace itself. Hence, Aymer Ainslie officiated at the blowing-in ceremony of Newland Furnace on 16 October 1880, just as "Miss Ainslie" took the honorary role in this ceremony on 24 October 1889.[40]

The hamlet itself had been the residence of Thomas Roper, a well-known manager to the ironworks and company in 1851,[41] and Roper himself not only took a growing part in the administration of the company, but had a significant role in the development of the new port of Barrow-in-Furness.[42] Richard Roper continued to live in the hamlet and to manage the furnace for a number of years,[43] and it is interesting that a man of that name had been a founder (senior furnaceman in charge of casting) at Leighton near Arnside in the eighteenth century.[44]

It is evident, moreover, that those who actually made the iron had their own dynasties in the Furness area, and it is in this respect that Newland connections are suggestive. The furnace keepers, or head furnacemen, in the hamlet in the first half of the nineteenth century, were William Briggs, father and son, and a Newland family named Barker, blacksmiths, were also probably associated with the furnace.[45] But perhaps the most interesting connection of all is that of the Bevins or Bivins family. Of them, Alfred Fell wrote in *c.*1905 that the descendants of "one George Bevins", whose family had been brought over from Ireland in the early eighteenth century "have been continuously employed at the (local) furnaces and forges for upwards of two hundred years . . . the family is well known, and one member of it was employed a year or two ago at Backbarrow Furnace".[46] Fell did not mention that the Bevins (or Bivins) family had a direct interest in Newland, especially in its

closing years. In 1887-8 one of the founders was Edward Bivins, "paid 27s. per week and House free and 1s. extra for melting up all the sows". In the following blast period (Oct. 1879) "Bevins" had apparently been demoted to the job of filler at 24s. 6d., a job which he was still performing in 1887-8.

Edward Bivens was jointly founder with William Williamson during the last blast of all, from 17 October 1889 to 18 January 1891, assisted by fillers William Wilkinson, William Williamson, John Williamson and John Tyson. If ancient rulers have their monuments in stone, so these men have their memorial in the now empty furnace, with so much of its fabric bearing the marks of their handiwork. The pig-bed that daily glowed with molten metal, tapped by them, is now a quiet garden. Some of the walls closest to the hearth were clearly rebuilt by these men during periods out of blast. A family can remain semi-hidden, its identity as uncertain as the spelling of its family name (now firmly fixed among present-day descendants as Bevins), and the least we can do is to honour those who contributed their labour to the industrial upsurge that gave us our present world.

The Newland furnace complex has unfortunately undergone some major alterations since the closure of the furnace in 1891, and there is reason to believe that some demolition took place between 1891 and 1897. The indirect evidence for this can be sought in known and perhaps coincidental alterations at Backbarrow, which almost certainly involved the transfer of gear from the Newland site. Hence, a new blower and a large new waterwheel were erected at Backbarrow in 1896, and a hot blast system was operative there at the same time. In the following year, moreover, an improved water-powered hoist was set up at Backbarrow,[47] and it would seem only logical that Harrison, Ainslie and Co. should use existing equipment which was available a few miles away. Meanwhile, it should be stressed that the Newland and Backbarrow furnaces were, in the nineteenth century, run in tandem by their firm of owners, and that their histories are interlocked. Since a focus of interest has been directed to Backbarrow, this is an important consideration, and a justification for the volunteers who have devoted so much time to the conservation of the former. Hence, the *Barrow Times* of 15 November 1879 observed that the two furnaces were usually worked alternately "owing to the difficulty experienced for some years past in meeting with an adequate supply of charcoal".

There remains a most interesting technical problem relating to the use of fuel and the conservation of heat in the furnace blast system. The *Barrow Times* item went on to remark that "the Newland Co. had tried various experiments in order to provide a substitute, such as compressed turf, etc.". However, the *Ulverston Mirror* made it clear that such experiments were not new to the district, and its issue of 17 September 1870, remarked of the Backbarrow furnace that 'Harrison, Ainslie and Co. . . . who have for some time employed peatmoss in the smelting of iron ore, which, however, they had to procure from a distance . . . very recently rented 70 acres of peatmoss, situate near Roudsea, from the Duke of Devonshire. This moss, when incorporated with the crushed iron ore, forms a species of brick, and if placed in the furnace burns in a very effectual manner, the iron smelting free from either sulphur or phosphorus, which have both a deteriorating effect on the quality of the iron produced". The same newspaper made clear that this experiment was of some duration, and its issue of 17 July 1875 declared that a 50 h.p. waterwheel used at Backbarrow "was formerly used in the drying and charring of peat", but added that

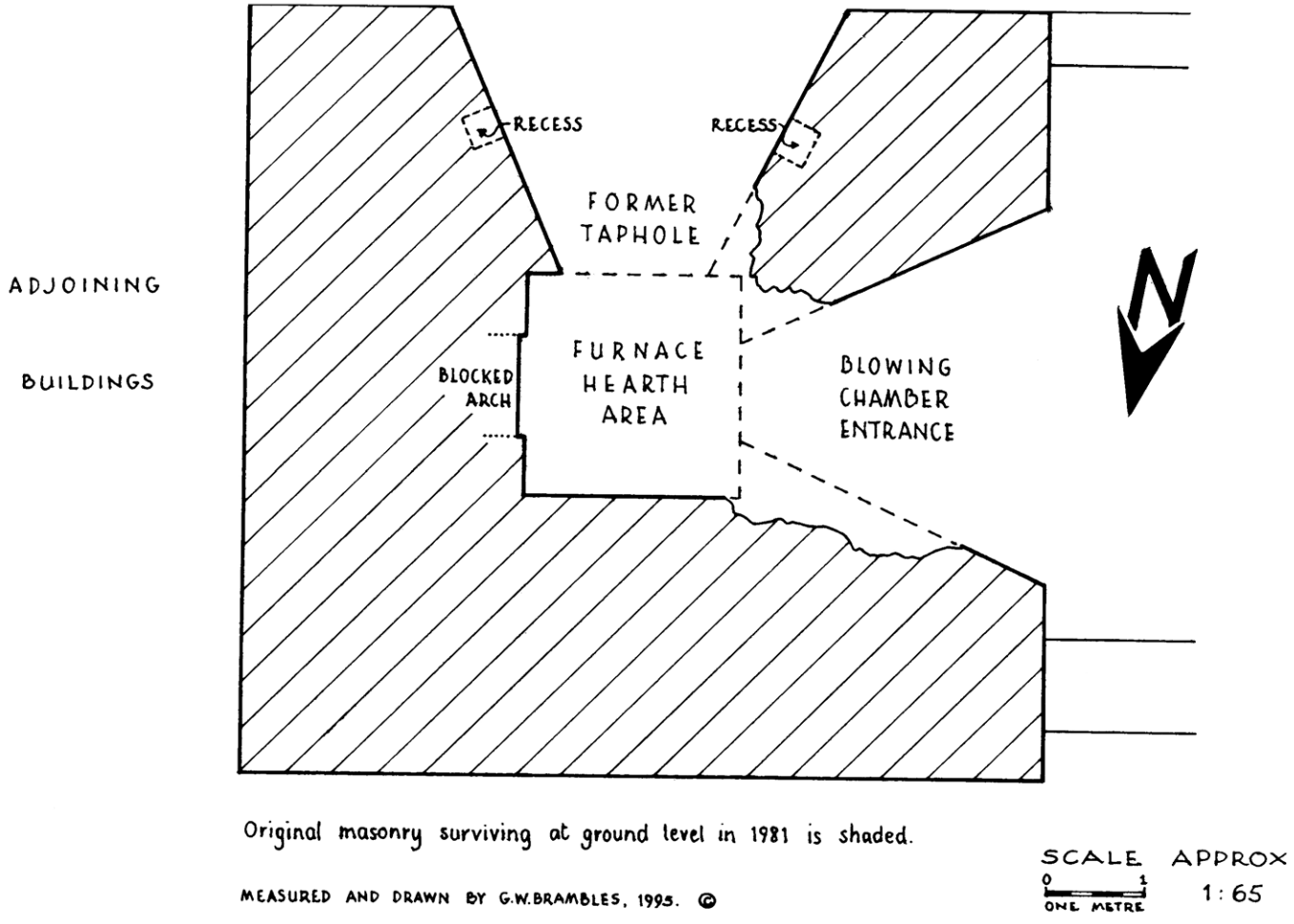

FIG. 2. Ground Plan of Furnace.

"since the firm ceased that branch of business, it has remained idle".

So, there we have an important development; there was insufficient charcoal in the district for the two furnaces, but an enhanced form of use for peat was tried and evidently abandoned between 1870 and 1875. A new technical approach seems to have been attempted almost immediately afterwards, and a clue to this technology appears in the Mannex *Directory for Furness and West Cumberland* for 1882,[48] writing of Newland, remarked that "from its commencement until 1874, charcoal was the fuel used in the manufacture of the iron, but in that year considerable alterations and improvements were made, and coke and coal substituted for charcoal".[49] The "coal" reference caused much puzzlement to the present investigators, for ordinary pit coal contains too many impurities and volatiles to be useable in iron smelting, and it must be cooked first; moreover, there were few signs of coal (or coke) on the present site. It appears, however, that in 1874 the Newland operators, and possibly those at Backbarrow, decided to instal coke smelting with a hot blast system whereby the normally hot waste gases from the furnace mouth could be directed into the pre-heating of a special stove or stoves, and then the original cold blast was heated via these devices on its way into the furnace. This conservation of heat principle was based on a famous technological advance pioneered by J. B. Neilson in 1829 in Glasgow, and it was therefore hardly new in 1874.

However, the significant photograph of Newland furnace as it was in the mid-1890s appears in *The North Lonsdale Magazine* for October 1897, and it seems that there had been a real attempt to improve the efficiency of the furnace by extending the upper shaft or throat by means of a brick tower (a similar piece of construction was added at Backbarrow *c.*1897, and may still be seen), and the Newland structure incorporated a side-chimney resembling a pilaster, evidently a stove. It is here that the reference to "coal" becomes meaningful; pit coal was used for giving additional heat to the stove (which would normally contain a "honeycomb" of flues and fire or other bricks), and was not brought into contact with the smelted iron; the authority for this technology is Johnson, a U.S. technician (1919), who remarks that coal-heating was used before the hot blast itself was re-utilised, and adds that "in the early days, these stoves were set on the top of the furnace, or . . . at the level of the top and just to one side . . . so that the burning gas from the open furnace top could be drawn into them. This had the disadvantage that the cold blast had to be taken to the top of the furnace and the hot blast brought back to the bottom with the loss of heat consequent upon that journey . . .".[50]

It is not difficult to perceive the motivation behind this attempt to project eighteenth century charcoal smelting into the mainstream of nineteenth century technology; the partners' North Lonsdale Iron and Steel Company, with its fine new blast furnaces, lay less than a mile away, and was establishing its plant in 1874-7,[51] when the original Newland experiment took place. Today, the only archaeological evidence consists of many scores of bricks in the "tumble" of debris caused by the stripping down of the tower, and, intriguingly, in an arched brick compartment of about a cubic metre near the gated entrance to the site – this lies far from the furnace top, but may conceal some flue system as yet unidentified. However, it is very likely that re-lining of the furnace with new firebricks took place around 1874, and many of these refractories must be of that date or period. The coke and peat-smelting was evidently not a success, and the furnace used charcoal in

its final blasts.

The *North Lonsdale Magazine* photograph of the Newland furnace shows plainly that the site became a timber-yard after closure, and it is known that a Mr James Athersmith, joiner, occupied part of the site after Harrison, Ainslie and Co., surrendered the lease of Newland from the Duke of Buccleuch in 1903, and that Mr Thomas Thompson was a sub-tenant. The latter subsequently occupied a cottage as well as part of the old furnace building, in order to carry on his business as contractor, wheelwright, joiner and funeral director.[52] W. F. A. Wadham, agent to the Duke's estate, wrote to the Duke of Buccleuch in these significant terms: "I think it is hardly necessary for me to enlarge on the state of repair of these premises, as I have, in all my letters, based a recommendation to sell this property on the deplorable condition of repair into which it has fallen, largely as a result of the Harrison, Ainslie and Co., tenancy . . .".[53] The current rescue operation has come very late in the day.

This survey has concentrated on the furnace itself; the original Newland industrial village remains as an historical monument, together with the respective fabric of a corn mill, a blacking mill, charcoal and ore stores, the master's house and a former farmstead. Indeed, the whole of the Newland valley contains a complex structure of water-powered industries, and the furnace has to be seen within this context. Without the partially preserved furnace, however, the broader whole would be much diminished.[54]

Notes and References

[1] The then team consisted of J. C. Braithwaite, J. H. A. Gavin, J. D. Marshall and J. Wignall. We should like to thank Mr H. Stevenson, the Newland proprietor, for his help and encouragement throughout.

[2] Two reports were issued; a general survey, *Newland Furnace and Hamlet* (1988), and a detailed technical report on the state of the furnace interior, J. C. Braithwaite, *Newland Industrial Complex, Ulverston, Cumbria; the Charcoal Iron Furnace* (21 September 1988, revised 7 February 1989), with photographic illustrations of the furnace lining and environs. An earlier report had been made on behalf of the Department of the Environment, giving a detailed breakdown of the state of the furnace and associated buildings; this was compiled by Mr J. A. Griffiths and dated 11 July 1983, and submitted to Miss J. L. Weston, DofE reference AA 10081/2. This report revealed that a thoroughgoing reconditioning of all masonry would cost an estimated £37,724 at 1983 prices; whilst a present-day estimate would roughly double this figure, it must be borne in mind that labour costs (as in the above case) make an approximately two-thirds element of any estimate. These charges are being largely obviated by volunteer labour at present. Meanwhile, Mr Griffiths's report is used as a guide to procedures in dealing with the worst areas. The University of Strathclyde made a measured survey of the furnace area in 1981, *per* Mr G. T. Douglas, and our draughtsman colleague, Mr G. Brambles of C.I.H.S., was enabled to compare the present state of the furnace with Mr Douglas's detailed plans. We should like to thank Mr Brambles especially for his meticulous workmanship.

[3] A. Fell, *The Early Iron Industry of Furness* (Ulverston, 1908); J. D. Marshall, *Furness and the Industrial Revolution* (Barrow, 1958), esp. Chaps. 2 and 11. The three furnaces here mentioned all lasted through much of the nineteenth century; the rest perished in the eighteenth.

[4] A. Fell, *op. cit.*, 218. Fell's qualifying word, "probably", should be noted.

[5] This photograph, several times reproduced, appeared in *The North Lonsdale Magazine* for October, 1897 and in Mackereth's *Furness Year Book for 1898*, facing page 112. It was originally taken by Holmes of Ulverston.

[6] A. Fell, *op. cit.*, 218. But see also note 47 below.

[7] G. P. Stell and G. D. Hay, *Bonawe Iron Furnace* (Historic Buildings and Monuments; Scottish Development Department, Edinburgh, 1984).

[8] *Vide*, for example, letter from Miss J. L. Weston (DofE) to Mr H. Stevenson, AA10081/2, September 1983; nevertheless, it is clear that the Department did take very seriously indeed the scheduling of Newland Furnace on its then merits.

[9] For the trade depression in iron and steel, see, for example J. Y. Lancaster and D. R. Wattleworth, *The Iron and Steel Industry of West Cumberland* (Workington, 1977), 132-3; Furness newspaper press, *passim*. For the building up of iron stocks, see Newland and Backbarrow ledgers under the class BDB at the Cumbria Record Sub-Office, Duke St., Barrow-in-Furness – in this case MS Pig Iron Book BDB/2/9, entries from 1886.

[10] Newland and Backbarrow ledgers, Barrow R.O., Blasts and Production Book, BDB 2/7/1 and 2. However, the average "make" in 1889 (Newland furnace only) was 28 tons, which is nearly double the Backbarrow output of over a century before; survey reports on Newland and Backbarrow furnaces included with papers for the Barrow Corporation Bill, 1889, Barrow R.O. Z2166 (this source is given below as B.C. Bill 1889).

[11] Output data for Backbarrow in B. G. Awty, "Backbarrow and Penny Bridge furnace accounts", *Trans. Hist. Soc. Lancs. and Ches.* 116 (1964), 31, 33.

[12] B.C. Bill 1889 – the charge was "lifted into furnace each time by water power". Regarding the use of peat, *Barrow Times* 15 September 1879 for evidence that Newland had utilised "compressed turf". (Information by courtesy of Mr J. Wignall).

Since the present article was completed, a remarkable discovery has come to light, the diary of a Swedish metallurgist who visited the Newland and apparently the Backbarrow furnaces in 1828 and again in 1831. This information has come to us by courtesy of Mr Nils G. Ekman of Karmansbo, Kolsva, Sweden, who has kindly offered to translate the technical and other information. For the present, it is clear that the dimensions of the furnace were very close to those measured in our own researches, and that the blowing capacity of the cylindrical blowers was weak. Iron of excellent quality was produced for refining purposes, and this product was used for wire drawing in Birmingham and also for steel manufacture in Sheffield. (The steel in this case would be made by the slow and costly cementation process; the Bessemer process came some thirty years later). It is already clear that the edge-tool market was only a part of the Newland and Backbarrow "reach".

The fuel used was charcoal, and the rich local haematite was mixed with poorer ore from Staffordshire, at the rate of one basket of Staffs. ironstone to four and a half of local ore. Tapping of the furnace "make" took place every 12 hours. The Swedish visitor was deeply interested in the Newland refining processes, and it is clear that his detailed information should add greatly to the more general account of this work by the late Alfred Fell. Mr Ekman proposes to prepare a paper on this and related subjects.

[13] Data from observation during a scheduling survey, 1980. But note that an improved water-powered hoist was erected at Backbarrow *c.*1897; *Barrow News*, 28 August 1897 (inf. by courtesy of Mr J. Wignall).

[14] B.C. Bill 1889.

[15] *Ibid.*

[16] J. Brownbill (ed.), *The Coucher Book of Furness Abbey,* Vol. II, Abbey Rental, Chetham Soc. New Series, Vol. 78, Part III, (1919), 614, where John Corker pays rent for "Neweland Mill" (1537-8).

[17] B.C. Bill 1889. This does not state how this mean iron output was calculated.

[18] See, e.g., Blasts and Production Book, 16 October 1880 and years following.

[19] *North Lonsdale Magazine and Furness Miscellany*, Vol. 1, No. 5, (February 1895), 79. This was actually a quotation from P. Mannex, *Directory of Furness and West Cumberland* (1882), 249: "From its commencement until 1874, charcoal was the fuel used in the manufacture of the iron, but in that year considerable alterations and improvements were made, and coke and coal substituted for charcoal".

[20] B.C. Bill 1889; charcoal was reported to be the fuel then used.

[21] A. Fell, *op. cit.*, 218.

[22] A. Fell, *op. cit.*, 228.

[23] B.C. Bill, 1889.

[24] A. Fell, *op. cit.*, 227; J. Rawlinson Ford and J. Fuller-Maitland, *John Lucas's History of Warton Parish* (Kendal, 1931), 59.

[25] Cf. a most interesting drawing of "Backbarrow Furnace in the Year 1850" in Fell, *op. cit.*, following page 208.

[26] Order Book (Harrison, Ainslie and Co.), Barrow R.O., May 1879 to September 1892. In fact, "Lorn Pig" went to Walsall, where several buyers ordered it, Wolverhampton, Birmingham, London,

Manchester, Swansea, Liverpool, Leicester and Glasgow.

[27] William White, *Furness Folk and Facts* (Ulverston, 1931), a greatly underrated handbook of local history, gives (page 79) essential details of the Newland trade in edge-tool iron. His reference to trade through Honfleur, for example, is borne out in the Order Book already cited, where (1883) Lorn iron was being stored in Honfleur (Normandy).

[28] Blasts and Production Book, cited.

[29] Pig Iron Book (BDB/2//9 1-2), 1879. More Lorn iron was being held or stocked at Warsash Furnace, Hampshire, another offshoot and distant site maintained by the company – this, presumably, used New Forest charcoal, it being then profitable to send Furness ore to that area by coasting vessel.

[30] G. P. Stell and G. D. Hay, *op. cit.*, 3, 12; "production was deliberately intended to complement the output from the Furness ironworks".

[31] H. Lonsdale, *Worthies of Cumberland; Sir James Graham* (London, 1868), note to page 39.

[32] For references to the Lucock enterprises, see P. Mannex, *Directory of Cumberland* (1847), s.v. Langrigg and W. Curthwaite (both to "Rt Lucock"); *Carlisle Journal,* 2 March 1855 (Aspatria), and 4 May 1855 (Broughton Moor). In addition, the Lucocks had a tilery at Carleton near Carlisle. We are indebted to Mr Graham Brooks for his help with several of these references.

[33] T. F. Bulmer, *History and Directory of Cumberland* (1884), 626. Gillhead Brickworks, on Broughton Moor, was offered for sale by Mrs Lucock (*Whitehaven News*, 18 Jan. 1872, and by the representatives of the late Mr Joseph Lucock. Much later, Backbarrow furnace was lined (1919) with Gillhead bricks; inf. by courtesy of Mr Wignall.

[34] James Park, *Some Ulverston Records* (Ulverston, 1932), 56 (section on Harrison, Ainslie and Co.; the company owned nine schooners and three sloops in 1865).

[35] J. Park, *op. cit.*, 55.

[36] J. D. Marshall, *Furness,* Part Two, *passim.*

[37] The details are in the Register of Joint Stock Cos. Public Record Office, File 7730, lists of shareholders for 18 October 1873, and 28 February 1874.

[38] J. Park, *op. cit.*, 55.

[39] Barrow R.O., Share Register Document for Harrison, Ainslie and Co., April 1876.

[40] Blasts and Production Book for dates stated.

[41] List of Newland inhabitants in Census of 1851, HO 107/2274.

[42] J. D. Marshall, *Furness*, 198, 200.

[43] P. Mannex, *History and Directory of Westmorland and Lonsdale* (1851), 458.

[44] A. Fell, *op. cit.*, 296.

[45] Registers of Ulverston Parish Curch (transcript at Barrow R.O.), baptisms for 1818; 1851 Census, cited. These sources list, *inter alia,* Thomas Peavy, Forge-man of Newland, 15 July 1789, and in the burials, Randall Fallas (Fallows), bur. 7 April 1805, aged 86. Members of the "Bivins" family worked at Penny Bridge and Spark Bridge (Census of 1841).

[46] A. Fell, *op. cit.*, 286.

[47] *Barrow News*, 13 June 1896.

[48] P. Mannex, *Directory for Furness and West Cumberland* (1882), 249.

[49] For the blower and new waterwheel at Backbarrow, see *Barrow News* 13 June 1896; for the hot blast at work there, *ibid.*, 15 December 1896; and further improvements, including the new hoist, *Barrow News* 28 August 1897.

[50] Mr Wignall gives this reference as Johnson, *Blast Furnace Construction in America* (1919), 191.

[51] Cf. J. D. Marshall, *Furness*, 380.

[53] Barrow Record Office, BD/BUC (Z2918), Box 17; Harrison, Ainslie and Co. gave up their lease of Newland on 22 June 1903, and the references to the tenant and sub-tenant are in this box.

[53] Letter in the same collection, (see foregoing note), the date not being given, but evidently coming soon after the transfer of property in 1903. Mr Thomas Thompson (contractor, wheelwright and funeral director), eventually purchased the Newland estate, including the furnace, corn and blacking mills for £1850 in 1921; Box 17, Item 42.

[54] The whole of the hamlet has been denominated a Conservation Area by South Lakeland District Council; the furnace itself has not been scheduled, as was hoped, but is now a Grade II* listed building.

APPENDIX

Stocks, production and blast periods at Newland
by J. Helme

Periods in Blast

Date	Stock (tons)	Blow-in date	Production ceased	Period (months)
July 1879	80	May 1879	April 1880	11
Jan. 1880	117	Oct. 1880	Feb. 1881	4
Jan. 1881	147			
Jan. 1882	582	Sep. 1882	Jan. 1885	28
Jan. 1883	196			
Jan. 1884	561			
Jan. 1885	896			
Jan. 1886	91	Feb. 1886	Jan. 1887	11
Jan. 1887	571	Aug. 1887	Mar. 1888	7
Jan. 1888	1170			
Jan. 1889	687	Oct. 1889	Jan. 1891	15
Jan. 1890	363			
Jan. 1891	1071			

Stock on 1st July 1892, was

Grey sows	75	tons.
Mottled sows	21	tons.
White sows	54.5	tons.
White pigs	137	tons.