CAMBRIA ARCHAEOLOGY

REPORT NO. 2001/7
PROJECT RECORD NO. 42560

APRIL 2001

THE CAMBRIAN MILLS, DRE-FACH FELINDRE, CEREDIGION

By

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By
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with a contribution from
Dr. Paul Collins

The National Museums and Galleries of Wales (NMGW) are in the process of carrying out a review of one of their flagship sites, the Museum of the Welsh Woollen Industry (MWWI) housed in the former Cambrian Mills (PRN 22585; NGR SN35515909) at Dre-fach Felindre, Carmarthenshire. This review will form part of a Heritage Lottery bid.

This project is a part of that review. It was designed to provide an up to date survey of the mill buildings, a constructional and technological history of the mill and an assessment of its influence in the village and in the wider community. Alongside the usual suite of archaeological survey and recording techniques are two slightly more unusual elements for an industrial site of this nature; the recording of oral tradition and the in situ *recording of the graffiti throughout the mill buildings. Recording the oral traditions and memories of those who worked in the mills and those who lived in the village will give a valuable insight into the importance of the mill and of the woollen industry in this region which became known as 'the Huddersfield of Wales' during the 19th century. Similarly the recording of the graffiti will allow glimpses of the people that worked in the mills and how they interacted with the buildings and with each other.*

The standing building survey has provided much new information regarding the internal arrangement of the mill and how it has changed over time. It has recorded both the positions of the existing machinery and the evidence, mainly in the form of floor- and wall-scars, of the locations of old machinery now removed. In this way a picture of the interior of the mill buildings has built up, identifying several phases of major change, some of which were technology-led and some forced by a fire in 1919. The survey has also shown that it is difficult to identify with any degree of certainty the positions of the original machinery which has implications for interpretation and presentation within the museum.

INTRODUCTION

PROJECT BACKGROUND

The National Museums and Galleries of Wales (NMGW) are in the process of carrying out a review of one of their flagship sites, the Museum of the Welsh Woollen Industry (MWWI) housed in the former Cambrian Mills (PRN 22585; NGR SN35515909) at Dre-fach Felindre, Carmarthenshire. This review will form part of a Heritage Lottery bid. This project is part of that review and consisted of a detail structural survey undertaken by Cambria Archaeology during October and November 2000.

This archaeological study forms part of much wider review of the operations of the MWWI. At the outset, the intentions of the project were to outline the development history of the site and to identify the technology and operations of the manufacturing process to aid future interpretation of the site and its history. It was recognised at an early stage that the mill had an influence that extended into the life of the surrounding communities and further afield through its connections with the markets in South Wales and London.

THE REPORT

This report details the structural history and technological development of the mills and how that is manifest in the layout and fabric of the present mill buildings. It also includes a brief history of the Lewis family's founding and subsequent ownership of the Cambrian Mills. Detailed, scaled-drawings of the exterior elevations, the internal elevations and the floor plans of the mill buildings are included in an series of appendices.

METHODOLOGY

The wide-ranging nature of the project meant that the study had to be multi-faceted and flexible. This was achieved through a programme of standing building survey; process recording; documentary research; collection of oral tradition and local knowledge; recording the graffiti throughout the mill buildings.

STANDING BUILDING SURVEY

The exterior and interiors of the mill buildings were surveyed using a combination of Electronic Distance Measurer and hand recording. The internal survey resulted in four floor plans at ground and first floor level (FP1-4), and forty eight elevations (E1-48) showing the arrangements and layout of the machinery and the internal fixtures and fittings of all the rooms and galleries. Once collected the survey data were manipulated and output through AutoCad and MapInfo computer applications to produce colour-coded floor plans. The internal elevations were surveyed by hand. The elevation drawings which accompany this report are based on the survey originals. This survey has shown that the internal arrangement of the mill has changed several times, with the scars from old machinery still visible in the floors and walls. Some of the changes seem to relate to changing technology, but some are certainly from the internal re-ordering following a fire on the 11th of July 1919.

The external elevations (EE1-4) were produced in the same way as the internal ground surveys. The fabric of the surviving mill buildings was not examined in detail, but significant features, such as blocked openings, joints and machine scars were recorded. See below for a description of the buildings.

PROCESS RECORDING

The processes of manufacturing that occurred within the mill buildings are crucial to any understanding of the mill's history. Advice on the nature of the manufacturing process and any evidence that may have survived for the operation from the early years of the mill was provided by Dr. Paul Collins, Ironbridge Institute, Ironbridge, Shropshire, who was commissioned to inspect the interior of the mill.

DOCUMENTARY RESEARCH

A programme of map and documentary searches were carried out at various local and national repositories for relevant information. A detailed history of the Cambrian Mill had been compiled in March 2000 using the collections of papers held by the Museum Library and the National Library of Wales, Aberystwyth, (Robinson 2000) and the searches for this project did not re-examine those sources. It did, however, reassess the early map evidence and re-examine some of the published histories of the woollen industry as a whole and the Dre-fach Felindre area in particular.

The earliest map evidence for any buildings on the site is the Ordnance Survey 25" map of 1888 (Carms. Sheet XIII.8). The tithe map of Llangeler parish, published in 1839, shows an empty plot (No. 1341) on the east bank of the Nant Bargod where the mill now stands.

There appear to be four main building phases -

Phase 1 - pre-1888
Phase 2 - 1902
Phase 3 - 1906-1913 (1909?)
Phase 4 - post-1919 (after a fire) - possibly 1921

The southern, and earliest of the two surviving mill buildings (Mill 1) was erected during Phase 2 (1902), partly on the site of an earlier mill. This earlier, Phase 1 mill is shown on the 1888 map when it was supplied by the present leat, which has persisted throughout the lifetime of the mill. The wheelpit is shown in its present location, and the tailrace exited from the northwest corner of the building to empty into the Nant Bargod in its present form. The second gallery (Mill 2) was added in *c.*1909. A major rebuilding and re-ordering of the mill took place in 1919-1920 following a fire which destroyed the upper levels of Mill 1. The weaving shed, which now houses the museum shop and workshops, and *Ty Pen Pownd* were constructed sometime around 1915.

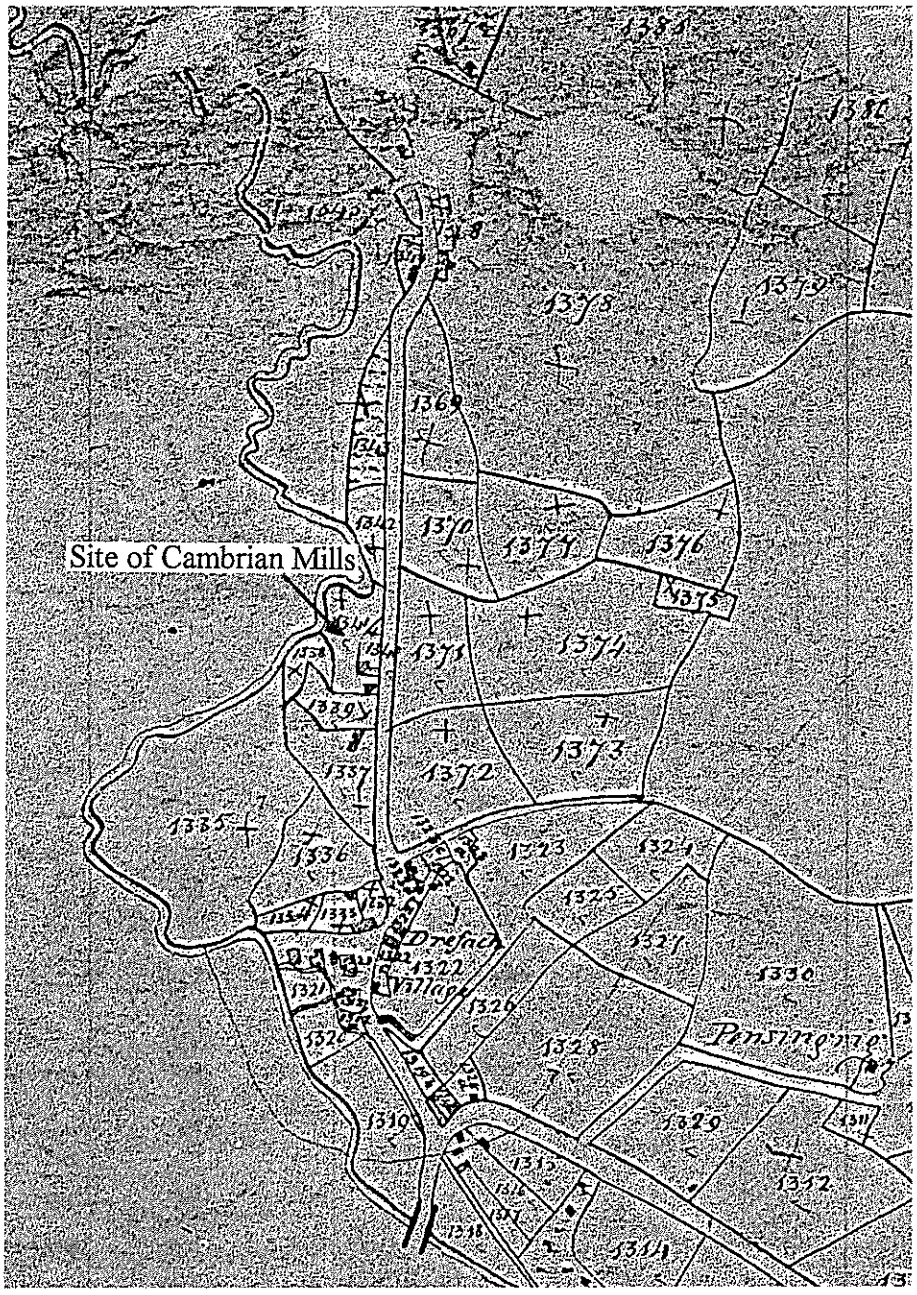

Figure 1: Llangeler parish tithe map (1839)

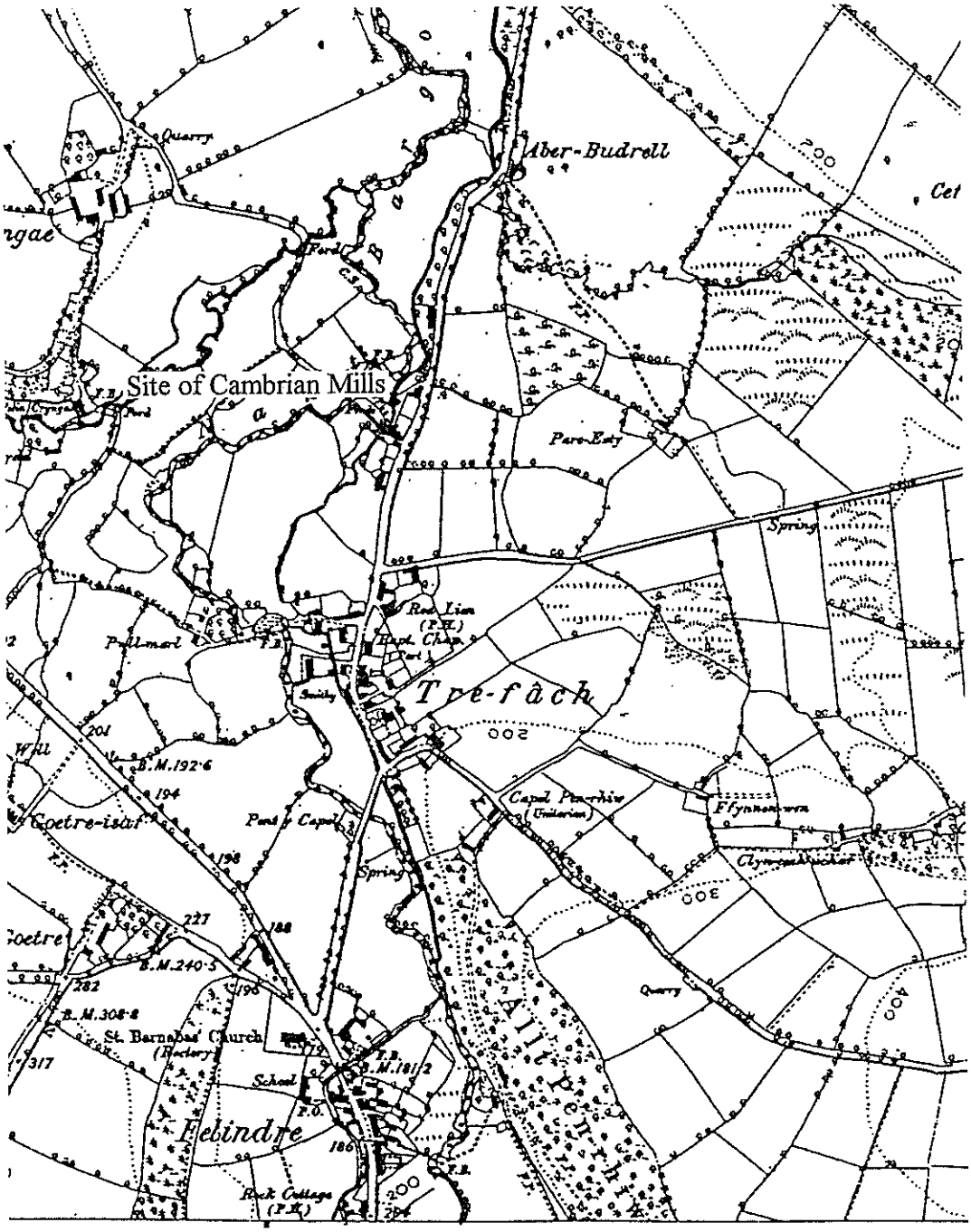

Figure 2: Enlarged extract of 1st edition 1:10560 map, (1888)

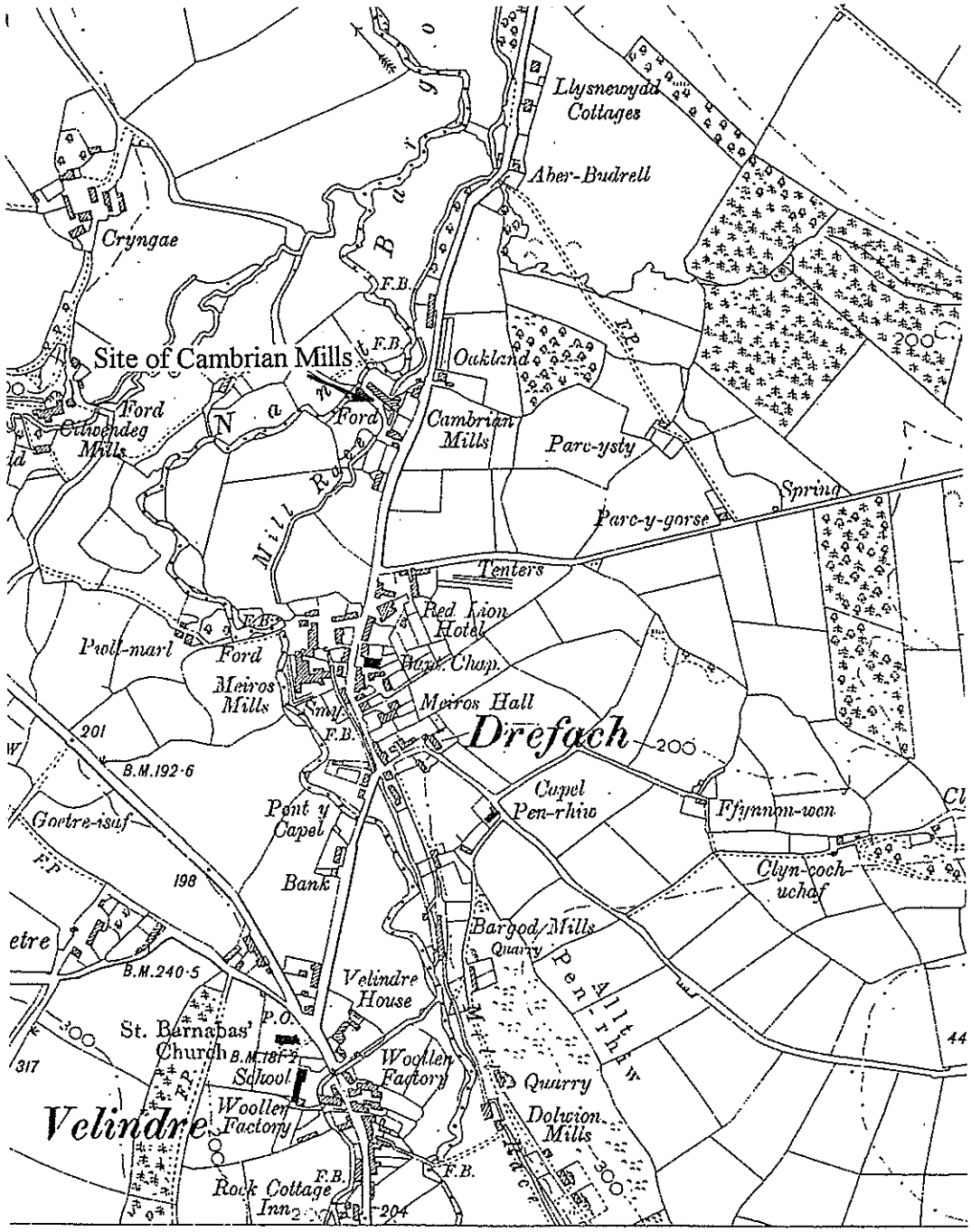

Figure 3: Enlarged extract of 2nd edition 1:10560 map, (1906)

ORAL TRADITION AND LOCAL KNOWLEDGE

Even though any history of the mill will tend to emphasize to the technology and systems of the manufacturing processes it is important to recognise that the key to the success of the mill was its staff. Without staff, the mill could not operate. The MWWI is fortunate that some of the staff that worked in the mill still live in the village and some still work in the commercial mill that operates within the museum. Therefore, it was decided to collect the oral testimony of those that were willing to try to establish as full a picture as possible of the working life of the mill and how it affected the lives of those in the surrounding communities. However, it is recognised that there is a wealth of information still to be collected and efforts should be made to collect it as soon as possible. Once collected, transcribed and collated this information will form a valuable archive of 'folk memories' which may prove useful for future interpretation and display within the museum.

RECORDING THE GRAFFITI

During the internal survey work a large amount of graffiti was noted throughout the mill buildings. The graffiti varies in both content - from constructional details to technical information about the running of the mill to personal notes and details - and form - including pencil, chalk, pen and inscribed or scratched on surfaces. The graffiti was often juxtaposed in an apparently random fashion with some areas being particularly complex. It is proposed that, in order to attempt to understand the patterns and meanings within the graffiti, a record of the locations and content should be made as soon as possible. The method of recording should based on that used for recording prehistoric cave paintings, rock art and medieval wall paintings.

Each area of graffiti should be traced using sheets of clear acetate film and photographed using colour slide and digital formats and their locations plotted onto the plans and elevations from the internal survey. Tracing directly from the *in situ* graffito means that the content will be recorded as seen, and even those areas that were incomprehensible would be accurately recorded for examination and possible subsequent interpretation. The different forms of the graffito should be recorded using a system of colour coding for pencil (blue), chalk (red), pen (black), marker pen (green), inscribed (mauve) and scratched (dark blue).

The graffiti can be divided into four main categories: constructional; technical (associated with the running of the mill); personal; and miscellaneous. These categories can be sub-divided into clearly defined groups.

Constructional

Carpenters' marks on the roof timbers.
Dated structural timbers.

Technical

Tally lists.

Stock control information.
Sketches of machinery, pulleys and gearing.
Operational information.
Warning and information notices.

Personal

Names and addresses.
Initials and dates.
Details of relationships.

Miscellaneous

Drawings.
General shapes, patterns and lines.

It is hoped that the recording and analysis of the distribution of the graffiti will aid an understanding of the spatial dynamics within the building and allow some analysis of how the staff interacted with each other and their surroundings.

THE CAMBRIAN MILLS

AN OUTLINE HISTORY

A fairly detailed history of Cambrian Mills was produced by Deborah Robinson in March 2000 and it is not intended to reproduce that here, rather this discussion will be a summary of that work and the results of this project. The chronology of the development of the Cambrian Mills is well known and there is no reason to dispute the dating for the main construction phases of 1902 (Mill 1) and 1909 (Mill 2), with the weaving shed added sometime later, *c.*1915. *Ty Pen Pownd* may also have been constructed around the same time as the weaving shed.

DAVID LEWIS AND THE EARLY YEARS OF CAMBRIAN MILLS

David Lewis, the founder, was born into a textile manufacturing family in 1847. In 1881 both David Lewis and his father are listed as woollen manufacturers employing seven and twelve people respectively (Robinson 2000, 7). His brothers also went on to own or manage woollen mills in the Dre-fach Felindre area. Ten years later, 1891, Lewis had moved with his family to Pantglas Mill at nearby Cwnhiraeth from where he supplied large quantities of cloth to South Wales, his principal market at the time.

When Lewis built the first Mill (Mill 1) of the new Cambrian Mill in 1902 he moved his entire operation from Pantglas, including the staff and machinery. The Pantglas mill was much smaller than Cambrian Mill indicating that Lewis would have had to have bought new machinery when he moved to augment and probably replace his existing equipment. During David Lewis' ownership the mill expanded rapidly reaching its present size by about 1915. A fire which destroyed the upper storey of Mill 1 in 1919 would have led to major re-building of the mill and a re-ordering of the interior. New machinery would have been introduced at this time. The internal survey work has revealed several points of interest regarding the introduction of new machines and the re-structuring of the mill interior. David Lewis passed control of the mill to his son John in 1921, following the rebuilding.

JOHN LEWIS AND THE LATER HISTORY OF CAMBRIAN MILLS

John Lewis continued to manufacture cloth until the 1950s, but the economic depression of the 1930s and his failure to keep abreast of both technological change and changes in the legislation concerning working conditions - particularly post-WWII changes - meant that on his retirement the mill was almost unsaleble. However, a buyer was found and a programme of investment initiated. Several new contacts, including Mary Quant and Hodges the menswear manufacturers (Robinson 2000, 16), briefly revived the fortunes of the mill, until its sale in the mid 1960s. Shortly after its sale the mill became of interest to the National Museum of Wales and its life as a purely commercial manufacturing enterprise was effectively over.

FLANNEL PRODUCTION AND THE CAMBRIAN MILLS

by

Dr. Paul Collins, Ironbridge Institute, Ironbridge

THE PRINCIPAL PROCESSES OF FLANNEL PRODUCTION

The following section is a bried outline of the processes involved with the production of flannel. If the wool has not been washed to remove its natural oils following shearing, this will precede:

1. ***Willeying*** - Passing twice through a machine known variously as a Devil, Teaser, Willow or Wool Mill to open out and disentangle the fibres. If wools of different colours are to be used, these are blended at this stage. On the second pass through the machine, which consists of a cylinder and rollers, both covered with rows of metal spikes, between which the wool passes, oil is sprinkled onto the wool to replace that lost during washing.

2. ***Carding*** - A refined willeying process that further opens and combs the wool fibres. It consists of three sets of cylinders and rollers each covered with thousands of fine wire teeth. These are known as the Scribbler, Intermediate and the Carder. The end product is a fine web of wool that is divided into one-inch wide strips and fed through oscillating rollers, which forms them into round slivers. These are wound onto bobbins.

3. ***Spinning*** - The carded wool is spun on a spinning mule, which slightly stretches it and introduces a twist into it. Welsh flannel yarn was noted for its high degree of twist.

Before weaving can commence the spun yarn is wound either to form the warp or the weft of the finished cloth.

4. ***Warping*** - The warp is the series of parallel threads that lie on the loom. This is formed from individual threads of yarn wound around a warp engine of drum.

5. ***Winding*** - The weft yarn is combined from many small bobbins into one larger cone or 'cheese' of continuous yarn.

6. ***Weaving*** - Combining the yarn from the warp with that of the weft in a loom.

The final stages in the production of flannel are collectively known as Finishing.

7. ***Washing*** - A self-explanatory process, but important for shrinking the cloth.

8. ***Fulling*** - Opening out the woven threads to 'full' out the cloth and to lose the pattern of the weave.

9. ***Napping*** - Abraiding one surface of the cloth to raise a nap.

10. ***Pressing*** - Pressing the cloth after napping.

11. ***Stentering*** - Drying the cloth of frames in the open air.

THE ORGANISATION OF FLANNEL PRODUCTION IN A MILL COMPLEX

Textile production is a vertically integrated one, with the raw materials entering and being processed on the ground floor, and the finished product emerging at the top. This is particularly the case for the production of yarn, although less so with regard to weaving. Therefore, of the eleven processes outlined above, willeying and carding would have taken place on the ground floor of the mills, and would have been arranged sequentially. Spinning - evinced by the half-set of surviving mules in Room K - would have taken place on the first floor. Organisation of the three 'W's - warping, winding and weaving - varied from mill to mill, although it was quite common fro warping to be done on the ground floor and winding to be done on the first floor. The weaving itself would have taken place on the ground floor or in a separate ground floor building, which seems to be the case at Cambrian Mills, where a separate weaving shed was added during Phase 3 of its development (1906-1913). Washing, fulling, napping and pressing are all processes that use heavy machinery, and therefore are most likely to have been housed on the ground floor, possibly in a separate building. Washing and fulling also require supplies of water, which again strongly influences their location. Stentering, by its very nature, took place outdoors, and the area at the back of the mills known to have been used for this makes this site particularly interesting.

A POSSIBLE EVOLUTIONARY TIME-LINE FOR CAMBRIAN MILLS

Mechanisation came late to the southern Welsh textile industry. First came the carding engine, from 1820 onwards, followed by the power loom around 1870. Up to this time much weaving was done at a domestic level, on farms or in one-person or one family small factories, which also produced their own yarn. Medium-sized or large factories came with the wider availability of mechanisation of the various processes in cloth production, in the latter part of the 19th century and early part of the 20th century.

The Welsh textile industry tended to specialise in tweeds and flannel. Production of the latter received a massive boost during the Great War, with the placing of large Government contracts for the cloth. A number of factories were expanded and re-equipped to accommodate this production. When these contracts ended in 1919, industry suffered a slump, which was compounded by two strikes in the South Wales coalfield - the major market for the flannel outside the Government contracts.

From this pattern it is possible to speculate about the development of Cambrian Mills. Initially the operation may have been for the production of yarn to supply weavers working on an outworking basis nearby, plus a small weaving operation housed on the ground floor of Mill 1. As business expanded, and greater weaving capacity was required, a separate weaving shed was constructed, freeing ground floor space for more machinery

involved in preparing the wool. Mill 2 can be seen as a mirror of Mill 1 - with preparation machinery on the ground floor and spinning mules on the first floor - and was probably added effectively to double the productive capacity of the operation. A likely contender for providing the stimulus for this expansion is Government contracts for flannel during the Great War. The fact that the mules in Mill 2 bear the date '1913' does not rule this out. They might have been 'in stock' at the makers or have been 'nearly new'. Given this scenario, the fire on 11 July 1919 was quite providential, occasioning a reworking of the site that other factors were already dictating.

A DESCRIPTION OF THE BUILDINGS

The core of the Cambrian Mill site is represented by two E-W lying mill buildings on the east bank of the Nant Bargod, Mill 1 to the south and Mill 2 to the north. Between them is a narrow yard, now covered, which connects with a wider, open yard at its east end. To the south of Mill 1 is a detached building, '*Ty Pen Pownd*'. A waterwheel pit and launder lies between the two latter buildings. To the west of *Ty Pen Pownd* lies the weaving shed, and a further building, now occupied by offices, lies to the south, alongside the entrance to the site.

Unless stated otherwise, all buildings are in squared, local slate rubble with brick quoins and dressings; roofs are slated gables.

MILL 1 (plates 1, 2 and 5)

The present Mill 1 was erected over the Phase 1 building, in 1902, as an 'L'-shaped structure comprising an E-W block, with a N-S wing in the eastern third which appears to have assimilated - or was dictated by - the Phase 1 mill. There is possibly some surviving stonework from the Phase 1 building in the wall across the outside of the external courtyard between Mills 1 and 2. A section of a random rubble mortared stone wall which survives to a height of *c*.0.5m above the stone arch of the tail race (EE 1) may be from the original building.

Overall measurements of Mill 1 are 37.40m E-W and 19.80m N-S. As originally built, Mill 1 was of three storeys, and is shown as such in contemporary photographs. After the extensive fire of 1919 it was rebuilt (Phase 4) as a two-storeyed structure, retaining only about 40% of the earlier fabric, mainly in the east N-S wing (where charred timbers also remain, see below) and the lower stage of the north wall. Not much of the present building - except, perhaps, for the section of stone wall mentioned above, part of the wheelpit and race itself - now appears to incorporate any fabric from the Phase 1 building but photographs of the Phase 2 Mill 1, taken in 1919, appear to show a vertical joint in the south wall between the E-W block and the N-S wing, and a gable above the latter which would provide a fourth storey attic. The ground floor windows on the southwest elevation show some differences which may indicate the survival of some of the original pre-fire fabric. The lower six courses of the brick surrounds on the six central ground floor windows of the southwest wall are dark red/purple, whereas the upper courses and the

other window surrounds are of red brick (EE 2). It is possible that the lower six courses are the original pre-fire brick surrounds.

As originally built, or soon after construction, the Phase 2 (1902) Mill 1 featured a gas-plant house lying against the southern half of the east wall, its lean-to roof lying at first floor window-sill level. The scar from the gas-plant roof is still visible on the southeast elevation. The upper windows in the wall had been partially blocked and their sills raised to the height of the gas-plant roof. The gas-plant seems to have worked in association with the later *Ty Pen Pownd* (see below), and may not have been rebuilt after the fire. A scar in the stonework from a small wheel, *c.*0.5m diameter, at the southwest end of the southeast wall indicates a belt-drive, which roughly lines up with a vertical slit in the wall of *Ty Pen Pownd.* Two small blocked openings and a blocked doorway provide evidence of how the gas-plant was connected to Mill 1 (EE 3).

The 1906 map also shows an E-W building against the west end of Mill 1, almost as wide as the mill and about 11m long. This was presumably only of one- or two storeys and is concealed in the 1919 photograph. It may be the dwelling house recorded as lying within the mill in the Llysnewydd estate documents at the NLW, and is apparently shown in a photograph of 1919 when it was 'domestic' in appearance. It too appears not to have been rebuilt after the fire and was replaced by the smaller boilerhouse which now lies against the west end of the mill. The gabled roof line of the earlier building is visible as a slight scar above the roof of the present boilerhouse. Externally the alterations to the boilerhouse include the blocking of a window (EE 4). Subsequent alteration, though only superficial, has been extensive and includes new machinery throughout the mill.

Ground floor

Room A (weaving mill) (E 1, 2, 3 and 4)

Room A is 'L'-shaped, occupying the eastern part of the building which includes the N-S wing, comprising 11 bays E-W and 4 bays N-S. Most of the fabric appears to be from Phase 2 (1902), apart from the south wall which was entirely rebuilt - with different openings including larger windows - after the 1919 fire. The openings in the east wall are all from Phase 2 (1902) - unlike the first floor openings where the wall was rebuilt - as are those in the north and west walls of the N-S wing. The west wall is shared with Room B, but is blind. The engineering-tile floor may be a primary feature, from Phase 2 (1902), but the first floor joists are from Phase 4 (post-1919).

The room is now entered through an entry in the north wall, from Phase 2 (1902), a loading door in the north wall of the N-S wing and an entry in the east wall of the wing, both also from Phase 2 (1902), and a loading door in the south wall from Phase 4 (post-1919). The first floor Room D is reached by an internal softwood staircase against the north wall of the N-S wing, which in its present form appears to be later 20th century.

The interior is now divided between an area in the N-S wing in which are located 2 coning machines, a twisting machine and a warping machine, all of which have independent electric power units. In their present locations, at least, these appear to be secondary and may be fairly late, but the warping machine drive-shaft connects with the exterior through a secondary hole in the east wall. The main body of the room, to the west, contains 4 'Dobcross' looms, date of manufacture 1961, by Hutchingson and Hollingworth, which are similarly independently powered. The south-east corner is now partitioned off as a commercial sales area, within which a timber waterwheel has been recently installed as a display feature, but like the remainder of the room, impressions of former machinery mountings can be seen in the floor, many of which have been filled with cement. These are less apparent in the area of the looms.

Room B (washing room) (E 5, 6,7 and 8)

Room B occupies the western third of Mill 1, comprising 5 bays E-W. It is slightly narrower than Room A, from which it is set at a slight angle, with an offset in the north wall; however, there is neither stylistic nor documentary evidence for any long break in construction. The north wall, with its narrower window openings, is from Phase 2 (1902), and features an entry. The south wall was, as in Room A, entirely rebuilt with larger windows in Phase 4 (post-1919), and features both an entry and a taking-in door. The west wall is shared with Room C but the entry here cannot be dated. The original floor is unknown, and now lies beneath a concrete finish which, however, appears to be no later than the earliest machinery now present. The first floor joists are from Phase 4 (post-1919).

The interior is now occupied by various machines associated with finishing, including two fulling boxes a drop-hammer scourer, a scouring machine, a spin-drier and a hydro-extractor, all of which appear to be of mid 20th century date and are still in use by the present firm of woollen manufacturers. Not all, however, were always independently powered and the fulling-boxes and spin-dryer appear to have been associated with the surviving ceiling-mounted, E.-W. Drive-shafting in the form of 'A'-hangers (some with their original glass bearing oil-reservoirs), and a bearing-box in the west wall. Some of this shafting, at least, may relate to an earlier machinery layout pre-dating the concrete floor. The first floor Room G is reached by an internal pitchpine staircase against the east wall, probably from soon after 1919, and also by a trapdoor and hoist in the southeast corner. The staircase features a wealth of personal graffiti.

Room C (boilerhouse) (E 9, 10, 11 and 12 - plate 2)

The boilerhouse is a narrow lean-to building against the west wall of Room B, apparently built new in Phase 4 after the fire of 1919 to serve the present washing room (B) and drying room (G). It is entirely in red brick, of a single storey with a lean-to roof at Mill 1 first floor door-sill level. There are blocked windows in the north and west walls, and a blocked door in the south wall, all blocking in brick, and is now entered only from Room

B and lit only by one window in the north wall. It still contains an upright iron boiler, water-tank and chimney.

First floor

Room D (new gallery) (E 13 and 14)

Room D represents a recent division of the eastern part of Mill 1, which appears to be mid-late 20th century but may follow the line of an immediate post-1919 division (Phase 4); it now separates the 6 bays of the N-S wing from the rest of the building.

The east wall, unlike that in the ground floor Room A, was entirely rebuilt after the 1919 fire (Phase 4) with wider window openings which feature a different brick type in the surrounds. The north wall, and the external west wall, however, are from Phase 2 (1902), the former featuring a contemporary loading door in the reveals of which can be observed fire-damaged timbers. The west wall is also from Phase 2 (1902), with two contemporary windows either side of a blocked entry. The latter appears to be from Phase 3 (1909) but probably on the site of a Phase 2 (1902) window, and formerly led onto a walkway to Room K; it was blocked with breezeblocks in the late 20th century. The floor, and the attic joists, are from Phase 4 (post-1919). The ground floor Room A is reached by the staircase described above, partitioned off by a very recent lobby; the staircase continues to the attic Room H, again lying against the north wall of the N-S wing and in its present form also appears to be later 20th century.

The room is empty, ready for use as a gallery. The walls have been rendered, the joists are featureless and there is now no physical evidence of the room's former uses.

Room E (sewing room) (E 15, 16 and 17)

Room E represents the body of the eastern part of Mill 1, comprising 9 bays E-W, used by the present firm of woollen manufacturers. It is divided into two by a mid-late 20th century partition; what was the southern part is divided off to form Room F (see below) by a similar partition. The south wall - which mainly forms the south wall of Room F - is Phase 4 (post-1919) being part of the rebuild of this entire wall after the fire. The Phase 2 (1902) north wall was also partly rebuilt after the fire, from about halfway up the window openings; while the openings, however, remained the same pre-1919 width, one was converted from a pre-1919 doorway. The west wall, shared with Room G, is an upwards continuation of that between ground floor Rooms A and B, and continues into the attic space dividing H from I; it is rendered, and cannot be closely dated, but may be pre-1919. The floor, and the attic joists, are Phase 4 (post-1919).

The eastern half of the room is mainly occupied by trestles, the western half by a folding-and-rolling machine and a rotary press used by the present firm of woollen manufacturers. However, these are relatively recent introductions and in the floorboards can be seen the

impressions for at least six mules (three on each side) which themselves were introduced in Phase 4, after 1919. There is a small, hinged trapdoor to Room A in the floor.

Room F (tailoring room)

Room F represents a recent division of the southern part of Rooms D and E, by a timber, glass and hardboard screen, to form a tailoring area for the present firm of woollen manufacturers. Its east wall, however, continues that of Room E and like it was entirely rebuilt after the 1919 fire (Phase 4) with wider window openings which feature a different brick type in the surrounds, and the Phase 4 (post-1919) south wall features a loading door set directly below a similar door in attic room H. The floor, and the attic joists, are Phase 4 (post-1919).

The room is now empty of machinery and contains only office equipment, a number of trestles and small portable sewing machines. However, there is a bearing-box in the east wall, associated with the scar in the render below, associated from an unknown process but apparently caused by wear from a belt-drive, and also a scar and cut-out in the adjacent attic floor-joist, from the belt-wheel. In addition, the internal face of the south wall, between the two windows immediately east of the loading door, is cut back to form a curved, concave recess with a head at half window-height, of unknown derivation. Within the floor are a number of impressions of former machinery, all seeming to continue the line of the mule-impressions in Room E.

The window reveals feature a wealth of personal graffiti.

Room G (drying room) (E 18, 19, 20 and 21 - plate 6)

Room G lies directly above the ground floor Room B, and like it, it comprises 5 bays E-W set at a slight angle, with an offset in the north wall, from Room E. The south wall, like the remainder of the south wall, was entirely rebuilt with larger windows after 1919 (Phase 4). The Phase 2 (1902) north wall was also partly rebuilt after the fire, from about halfway up as in Room 5. There is now one entry, at the east end of the wall, which may be pre-1919 in its original form, leading onto a walkway to Mill 2, but further west in the north face of the wall can be seen the impressions of two pre-1919 entries, one of which was converted into a narrow window after 1919. The other, wider window was entirely new in Phase 4 (post-1919). The west wall, which at this stage at least appears to be Phase 4, features a taking-in door set obliquely below a similar door in attic Room I. The floor, and the attic joists, are Phase 4 (post-1919); the stairway from Room B has been described above and continues to Room I.

The interior is now dominated by the large tentering machine which, with its timber partition, has occupied most of the northern half, since the mid-late 20th century and is still in use by the present firm of woollen manufacturers. It is associated with a large water tank. The southeastern quarter is partitioned off as a display area by a late 20th century screen; within this area is the trap to Room B, and a pulley is still mounted on the attic

floor joist above. However, it appears that there was formerly more machinery. There is a bearing-box in the east wall which still houses an E-W drive-shaft, one of whose 'A'-hangers exhibits a large, timber belt guard. The shaft runs halfway through the room up to - but not connected to - a second shaft which is also mounted in 'A'-hangers and ends, awkwardly, within the embrasure of the taking-in door. There are no impressions in the floor from any earlier machinery arrangements.

Attic

The attic space over Mill 1 is entirely a product of the Phase 4 (post-1919) period, when the former third storey was removed and the two present gables - the west gable and that at the north end of the N-S block - were built. The southern end of the N-S block is hipped.

Room H (east attic) (E 22 and 23)

The east attic is 'L'-shaped, lying over the eastern part of Mill 1 including the N-S wing. The Phase 4 (post-1919) north gable wall is pierced by a window. The attic is divided from attic I by an upwards continuation of the wall between Rooms A and B, and between Rooms E and G, which may be pre-1919. The N-S wing comprises 7 bays N-S of simple 'A'-frame trusses with princess-posts; the main body of the attic comprises 11 bays of similar trusses, the hip at the southwest corner representing 3 bays from each. The trusses, and most of the other timbers, may be original, immediate Phase 4 (post-1919) work. The floor is all Phase 4 and at the north end is open to the stair from Room D.

Towards the west end, the southern roof slope is interrupted by a taking-in door bay, with a gable roof, lying over the taking-in door in Room F. It features a large, immediate Phase 4 (post-1919) hoist, with the winch still working.

Room I (west attic) (E 24 and 25)

The west attic lies over the western third of Mill 1. The Phase 4 (post-1919) west gable wall is pierced by a loading door, obliquely above the loading door in Room G, and a window; externally, the summit is embellished by a dummy chimney. The attic space comprises 7 bays N-S of simple 'A'-frame trusses with false queen-struts from the floor-joists; the main body of the attic comprises 5 bays of trusses like those in attic H which may also be original, immediate post-1919 work (Phase 4). The floor is all Phase 4 and at the east end is open to the stair from Room G. A cut-out has been let in the floor on the north side, between the second and third bay from the east wall, for the top of the tentering machine in Room G.

THE WHEELPIT (plate 7)

A wheelpit lies against the eastern quarter of the south wall of Mill 1, partly between it and *Ty Pen Pownd.* In its present form it is rectangular in area, measuring 11.5m E-W by

2m N-S, of which the western 7m forms the pit proper with a depth of approximately 1.75m. A waterwheel is still mounted within the pit. It is worked from a closed water system, in which water is pumped from the tailrace around to supply the wheel at backshot/high-breastshot level from the launder which occupies the eastern 4.5m of the pit area.

The wheel was originally supplied, during Phase 1, by a leat which entered the site from the southeast, and turned to run due north - where it was culverted beneath *Ty Pen Pownd* - towards the east end of the pit/launder, at 90°. The same arrangements are depicted on the 1906 map, and are also suggested on the 1888 map showing the earlier mill building. However, it is not yet known how much of the launder area is original. The tailrace exits at 90° from the west end of the pit, through an arched culvert in the south wall of Mill 1 which it runs beneath. The culvert shows two levels of brick voussoirs suggesting that it has at least been lowered - although this is curious given that backwatering was a frequent problem within tailraces. The 1888 map depicts the tailrace as open, running along what was the east wall of the earlier mill building. Both levels of voussoirs are therefore from Phase 2 at the earliest (post-1888). The tailrace exits through the north wall of the open yard (see below). A gas-plant is shown on the 1906 map but it is apparent that waterpower continued, at least for some functions, beyond this date and an overshot wheel, supplied by a timber launder - which appears to be at a slightly higher level than the present launder - is shown an a photograph from 1919.

MILL 2 (plates 3, 8 and 13)

The northern of the two mill buildings (Mill 2) appears to have been erected during Phase 3, i.e. after 1906 - possibly 1909 - but before 1913, the date of the earliest graffito inside, and also the date of manufacture of the mules within. It was built on a virgin site, shown as an empty plot in 1906. Overall measurements are 31.70m E-W and 10.20m N-S. Mill 2 was only superficially affected by the fire of 1919, damage being confined to the window glass - some of which cracked - and probably the roof. However, graffiti suggests that the latter was replaced, or at least repaired, in the 1940s. Again, there has been much alteration in machinery arrangements.

The construction of Mill 2 appears to have been contemporary with - and probably occasioned - the culverting of the near end of the tailrace beneath a small, walled enclosure between the east wall of the mill and the N-S block of Mill 1. This enclosure is not shown on the 1906 map, on which the tailrace here is shown as open. The enclosure is now an open yard but in the past has been roofed, as a lean-to at Mill 1 first floor window-sill level, which may reflect its initial arrangements; the physical evidence confirms that machinery has been situated within the enclosure.

***Ground floor* - Room J (Gallery 2)** (E 26, 27, 28 and 29 - plate 9)

The ground floor of Mill 2 consists of a single room, J, comprising 12 bays E-W. The fabric is almost without exception all from Phase 3 (1906-1913) and the engineering-tile

floor, like the first floor joists, appears to be a primary feature. The room is now entered through an entry at the east end of the north wall and a loading door at the west end of the south wall. Both are original, but the entry from the covered yard to the south, at the east end of the south wall, was inserted after the fire of 1919 (Phase 4) when the yard was covered; the opening is open to the rafters. The remainder of the bays are all lit by an original window in each side wall, most of which retain their original ribbed or patterned glazing. There are also two original windows in each end wall. The first floor Room K is reached by an internal softwood staircase against the west wall, which is largely original; the banister features a graffito dated 1913.

The interior is now an exhibition area (Gallery 2), with a variety of machines of differing age and function including a fulling box and a 'Jacquard' loom. None of them are original and most have been imported from other mills. Lying against the east wall are a hot-press and a cold-press, which may be original - the firebox beneath the hot-press appears to be contemporary with the flooring. Elements of the original machinery layout survive. There are two bearing boxes in the east wall, the southern of which still receives the end of a long - but not continuous - E-W line of drive-shafting running through the greater length (9 bays) of the building, probably from Phase 3 (c.1913). It still features two belt wheels, a drive-cogwheel and nine 'A'-hangers (some with original drip-trays). A second, free line of drive shafting runs down the centre of the greater half of the west half of the room. In addition, the floor features a plethora of impressions from former machinery. Some of these resolve themselves into N-S lines of impressions either side of the central passage, very similar to the impressions made by mules. Many have been infilled with cement, one area of which bears the date 1956.

***First floor* - Room K (Gallery 3)** (E 30, 31 and 32 - plate 10)

The first floor of Mill 2 also consists of a single room, K, also of 12 bays E-W. The fabric, including the openings, is all from Phase 3 (1906-1913) as is the boarded floor and attic joists; however, the east wall was entirely rebuilt in the late 20th century, using the original materials. The room is entered via the original staircase from the ground floor Room J, with a door frame bearing the graffito 'New door, 1947'. A similar original staircase against the same (east) wall continues up to attic L. There are entries in the east and south walls, both of which appear to be original and were initially associated with walkways to Room D and Room G respectively. There is also a taking-in door, with an *in situ* hoist located in attic L, at the west and of the south wall. There is otherwise a side window in each bay, two windows in the east end wall and three in the west wall. Most retain their original ribbed or patterned glazing, that on the south side showing considerable fire-damage from 1919. The attic floor above is supported on a row of simple iron columns running E-W just north of centre; these are probably from Phase 3 (1906-1913) but may have been altered in the 1940s when graffiti in attic room L suggests that the building may have been at least partly reroofed.

The interior is now an exhibition area (Gallery 3), with a variety of machines of differing age and function. However, the four mules occupying the north side of the room - which

are dated 1913 - are original Phase 3 fittings. They are associated with *in situ* drive-shafting which occupies the east half with a bearing box in the east wall, is mounted on 'A'-hangers and retains an associated belt idler wheel, and two drive-wheels. Wear-impressions in the attic joists suggest that the latter are all original and *in situ*. The drive-wheels are associated with the tandem-drive between the 2 mules, which is also original and more-or-less complete.

In the floorboards on the south side of the room can be seen the impressions for four similar mules which would suggest that there were originally eight mules on this floor (i.e. four on each side). However, there is no evidence for further drive-shafting and there is no corresponding bearing-box in the southern half of the east wall. In addition, a continuous linear E-W impression in the floor appears to indicate the line of a partition for a narrow corridor along the south side of the room, south of the mules, while the scars left by adhesive tape, marking out walking-spaces, also survive. This side of the room is now occupied by introduced machinery for public display, while the top of the 'Jacquard' loom has been let through a cut-out in the floor on the north side. There is also an original trapdoor towards the east of the central floor-space, and a trapdoor to attic L at the east end of the north side of the room.

Room L (attic) (E 33 and 34 - plate 11)

The attic space is very similar to that in Mill 1, with identical roof-trusses. However, one carries the graffito 'New roof, 194(4)' suggesting that it has been partly, if not entirely rebuilt. Each end gable wall is lit by two windows, from Phase 3 (1906-1913), and the board flooring is contemporary; however, the east wall was entirely rebuilt in the late 20th century, using the original materials, when modern galvanized roof trusses were inserted in each end bay to prevent them falling outwards. The west gable carries a dummy chimney stack like in Mill 1. The western bay is occupied by a winch, for the hoist which leads into the attic from the taking-in door in first floor Room K, and which appears to be original, from Phase 3 (1906-1913). The third bay from the west end features a cut-out in the floor, on the south side, for the top of a machine in Room K; this is a recent introduction and does not relate to any original arrangement.

THE COVERED YARD

The narrow yard between Mills 1 and 2, which appears previously to have been occupied by an external walkway between the first floor rooms G and K, was covered over after the fire of 1919 (Phase 4), at the same time that the boilerhouse (Room C) was constructed in the early-mid 20th century, to become a two-storeyed, roofed space.

***Ground floor* - Room M (Gallery 1)** (E 35, 36, 37 and 38 - plate 12)

The conversion necessitated very little alteration at ground floor level where the space was covered, and the west end was closed off with a wall, with an entry, in similar brickwork to the contemporary, adjoining boilerhouse. The east end appears originally to have

remained open but is now closed by a late 20th century stud wall. The space is now used for display (Gallery 1).

First floor **- Room N** (E 39, 40, 41 and 42)

The first floor only occupies the western half of the area of Room M. It projects 2.5m from the west end of Mill 1 so the south wall here was, like the west wall, a new build in brickwork of Phase 4 (the early-mid 20th century, after 1919); both walls feature original windows. The east wall may be contemporary but is in softwood and glass. The boarded floor is also contemporary but offers little evidence of past usage. The present division down the middle of the room may be later, but pre-dates the panel blocking of the west wall window. The room is entered from Rooms G and K through entries that may be pre-1919 and have been formerly connected by a walkway.

THE OPEN YARD (plate 13)

At the east end of Mill 2 and the covered yard, between them and the N-S wing of Mill 1, is an area which was open to the north and west until Phase 3 (1906-1913) when Mill 2 was constructed; the 1906 map shows it being crossed by the tailrace. The culverting of the tailrace, and the closing-off of the north side with a wall, probably also date to Phase 3 (1906-1913). However, this north wall comprises many phases. The actual culvert through which the tailrace now exits is very crude, and is in slate as is the walling either side - the whole appears to be earlier than Phase 3 (1906-1913), possibly contradicting the map evidence. However, the evidence for later alteration is not well-defined until the later 20th century breezeblock infill of the central section of the wall. The interior of the wall is all rendered and cannot be examined.

The evidence suggests that, as built, a walkway from the first floor of Mill 1 ran over this are into Mill 2. However, it seems that the area was roofed over during Phase 4, soon after the 1919 fire. The walls were all rendered preserving the line of a very shallow lean-to roof up to Mill 1 first floor window-sill level leaving just sufficient room for the walkway. The present concrete floor may be contemporary. The interior space thus created, which was entered from the ground floor of both mills as well as the contemporary covered yard, was used for an unknown - but powered - process. A bearing box in the external face of the east wall of Mill 2 is associated with a 'pillar' in the northwest corner of the enclosure which carries a further bearer at the same level. In addition, the sill of the central window in the same wall shows signs of mechanical damage, whilst some of the patching of the concrete floor appears to be infilling of machine scars.

TY PEN POWND (E 43, 44, 45 and 46 - plate 14)

Ty Pen Pownd is a detached building that was constructed over the leat, at the southeast corner of the wheelpit, at some time between 1906 and 1919, but possibly not corresponding with Phase 3. Unlike the rest of the buildings on site, it is entirely

constructed, in a single phase, from slate rubble, with no use of brickwork suggesting that it may not belong to the same phase as any of the other buildings. It comprises a single storey, the single room being irregular in plan with a west wall at a pronounced angle to the other three walls. This was doubtless to allow vehicular access to the site via the pre-existing drive that runs along this side of the building.

There are entries in the north and south walls, and two windows in both the east and west end walls. The interior faces of the end walls also exhibit a pattern of sockets and corbels which do not appear to relate to the roof timbers which are original and comprise three simple close-coupled trusses with tie-beams. The concrete floor is later but all openings appear to be original, and also include a long, plain, vertical slit in the north wall directly opposite the east end wall of Mill 1.

It is not easy to be certain of the function of this building, which is later than the present Mill 1 but may predate Mill 2. However, it lies very close to the former gas-plant house at the east end of Mill 1 which was certainly present by 1906, being shown on the OS map of that year. The association suggests that *Ty Pen Pownd* may have been connected with the gas-plant, the vertical slit in its north wall possibly having allowed a belt-drive to run between the two buildings.

WEAVING SHED

A long, single-storey E-W weaving shed was built, after 1906, parallel to, and south of Mill 1. Its use of similar brick dressings to those within Mill 2 suggests that it was contemporary i.e. Phase 3, and it was certainly present by 1919 when it appeared in a photograph.

The building was not closely examined during the 2000 project but appears always to have been a weaving shed rather than used for other manufacturing. It now contains storerooms, offices, a shop and future display rooms.

OFFICE

A rectangular, two-storeyed E-W building near the entrance to the site south of *Ty Pen Pownd.* A building with a similar ground plan to that of the present office was shown on the OS map of 1888 (Phase 1). The exterior is presently rendered but it lies beneath a slate gabled roof, with similar extensions on both ends, including a cast-iron 'portico' on the west wall. The present office building apparently replaces an earlier low single storey stone building known as *Ty Dafis Twm* (Robinson 2000, Appendix 4).

The building was not closely examined during the 2000 project. It now houses the Museum cafeteria and offices.

CONCLUSIONS

This project has added to the wealth of existing information about the Cambrian Mills and their subsequent history as the MWWI. New and exciting avenues of research and study have presented themselves throughout the life of the project, many of which are still being explored. It is clear that the mill was an important economic and social institution in the Dre-fach Felindre area which has had a lasting impact on the village and the surrounding communities. Since its construction in 1902 it has been a significant employer and in its early years it would have been the major employer in the vicinity, and as such it has influenced the lives of those that worked there and their families. It still has an important role in the local economy through employment and tourism.

ACKNOWLEDGMENTS

Cambria Archaeology is grateful to the MWWI for funding this work and its support throughout the long process of site recording. Special thanks must go to Sally Moss for her unflagging support, encouragement and enthusiasm for the project, and to her staff, particularly Keith Rees, for their friendly welcome and acceptance of the occasional disruption caused by the site survey. Raymond Jones and the staff of Melin Teifi are similarly thanked for their patience when at times we quite literally got under their feet to record the working mill area. Many people have provided advice and information, particularly Dr. Paul Collins whose site visit was both enjoyable and instructive.

SOURCES

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