

SOUTH EAST CORNER AND CHIMNEY STACK

WALTHAM ABBEY SOUTH SITE ROYAL
GUNPOWDER FACTORY

BUILDING No. G431

REPORT No. ESG 2365/97

BRITISH AEROSPACE 
Royal Ordnance

**ENVIRONMENTAL SERVICES GROUP
REPORT NO. 2365/97**

**WALTHAM ABBEY SOUTH SITE
ROYAL GUNPOWDER FACTORY**

**HISTORICAL SURVEY OF
BUILDING NO. G431**

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**Guncotton Factory G431, South Site, Waltham Abbey Royal
Gunpowder Factory, Essex**

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Introduction

Following the recent announcement by the Epping Forest District Council to grant planning permission for a development on the South Site the Essex County Council Planning Department's Archaeological Advisory Group has called for a survey of the Guncotton Factory building G431. The development proposals for the South Site will probably result in the firing and demolition of this building so this report aims to provide an accurate and permanent record of this historically important structure.

The initial survey report of the South Site at Waltham Abbey with component sheets for each building and a computer generated CAD plot has been completed (Chaddock 1996). The report outlines the history of the site, provides a description of each area and outlines appropriate manufacturing techniques to allow fuller comprehension of the archaeological remains. Those buildings of major importance that did not have a 'documentation pack' have been selected for further recording; they include a part of the Guncotton Factory G431, the Boiler House G403, the Box Store M349, the Guncotton Drying Stove M351 with its attendant Fan House 495, the Cordite Mixing House 486 and the gas-proof Air Raid Shelter SS113.

This report provides a more detailed record of the building, complementing the initial survey, and placing the structure in its wider context. A copy of this report, the archive comprising plans and photos will be deposited in the Essex Records Office.

Survey Method

Measured surveys of the buildings were carried out using tapes for both vertical and horizontal measurement throughout. In G403 and G431, where health and safety problems were encountered in gaining access to the full interior height of the roofs, reference was made to surviving architects' drawings in the site archive. Copies of these drawings, converted photographically to metric scales, were used as reference for details, and checked for accuracy wherever possible. Original drawings for M349 and M351 were also referred to and checked, but did not form a significant element of the survey of those buildings.

A Kern GK-O level was used to establish floor levels, etc, in the buildings. Reference to Ordnance Survey datum levels was provided by information from plans of the site supplied by Royal Ordnance (RO).

All plans and sections were drawn in pencil on permatrace. Plans and main sections were drawn at scales of 1:50 or 1:100, depending on the size of the building concerned. Detailed sections were drawn at 1:50, and sections through the passageways in 486 and M351 were recorded at 1:10. A total of 17 drawings were produced, all on A1 or A2 sheets. Following approval by RO and Essex County Council Archaeological Advisory Group (AAG) these were digitised (CAD 12), and A3 copies printed for archiving and the final reports.

A detailed written description of each structure was prepared on proformas prepared in conjunction with the AAG, and is presented in this fashion. Reference was made to the measured surveys for major dimensions: more detailed measurements were made as required with a 5-metre steel tape. The fieldwork notes also contain many sketches of various elements of the buildings. The descriptions were subsequently word-processed, and are presented in hard copy and on disk (Word 6).

The photographic survey was carried out using two Pentax ME 35m SLRs, fitted with 28-70mm zoom lenses. The flash photography was carried out with a professional Metz 60 GT-1 flash, though natural light was used wherever possible. 400ASA film (colour slide and B&W) was used throughout. The photographic registers are presented in hard copy and on disk (Word 6).

The video surveys of 486 and M351 were carried out by a professional cameraman under HAT's direction. Given their similarity, both buildings were recorded in a similar sequence, and structural details, etc, were singled out en route for special attention. Both buildings

were filmed in natural light, with the exception of the NG delivery tunnel in 486, where a portable floodlight was used.

History of the Site

The Royal Gunpowder Factory at Waltham Abbey was a centre of gunpowder production, and latterly chemical-based explosives manufacture, for more than 300 years. There is documentary evidence that gunpowder was being produced at North Site by mid 1660's. The mills were acquired by the government in 1787, and expanded greatly as a result of the demand for powder generated by the Napoleonic wars. After a period of retrenchment for the 1820's, the RGPF returned to prominence in the second half of the 19th century, playing a leading role in technical innovation, meeting demand for cannon powders for guns of ever increasing size, and manufacturing moulded powders in large quantities (RCHME 1993). From the 1890s into the early twentieth century the site was a leader in the development of manufacturing technologies for the new chemical propellants and explosives that were extensively utilised in the First and Second World Wars.

History of G431

The Guncotton Factory was built on the newly purchased South Site in 1887 as an expanded production facility of an existing but much smaller guncotton factory on the North Site beside Highbridge Street. Fortuitously in the late 1890s the demand for Guncotton increased dramatically when a successful smokeless powder (Cordite Mk 1) was developed with Guncotton a major ingredient. As Waltham Abbey remained the main Ordnance manufacturer of Cordite, even up to the 1914-18 war, the Guncotton Factory saw much improvement and alteration. In the later part of the 20th Century the building saw a new use as a central stores building. Another part still remained in active factory use where lead salts were prepared for use as ballistic modifiers in the propellants research branch on site.

The history of Chemical Explosives in the late 19th Century.

Guncotton is manufactured by the action of mixed nitric and sulphuric acids on cellulose. The product is a cellulose nitrate but has become known as Nitro Cellulose (NC). Guncotton is the name given in the armed services to nitrocellulose containing 13% or more of nitrogen. Although Guncotton had been known from 1833, a series of fatal accidents, notably in 1847 at the Faversham Works in Kent where 20 individuals lost their lives, led to reduced interest in the new explosive.

During the mid 19th Century Baron von Lenk continued experiments in Austria (RCHME 1993, p180) and concentrated on the problem of producing a strongly nitrated cotton. His method was to take skeins of cotton and clean them before drying thoroughly. The dried skeins were then immersed in the strongest acids available for forty eight hours before removal into a stream of water, where they remained for several weeks to wash all traces of acids. Finally they were washed in a solution of potash.

Guncotton Manufacture at Waltham Abbey RGPF

Abel continued experiments at Waltham Abbey North Site and in 1864 he patented the pulping and pressing of Guncotton. This improved method used short cotton fibres, for which cotton waste was an ideal raw material. Teasing of cotton waste removed foreign objects and opened up the fibres to allow good penetration by the acids. The pulping after nitration and initial washing resulted in efficient removal of trace acids which had hitherto caused decomposition within the nitrocellulose. The resulting pulp could be moulded with hydraulic presses to form cylinders or discs.

Manufacture of Guncotton as a practical explosive was further helped by the discovery in 1859 that wet Guncotton, a relatively stable and safe substance, could be detonated by a dry Guncotton primer and detonator. In 1873 the boiling of Guncotton after nitration was found to help stabilisation and was widely adopted. Development work continued on the North Site at Royal Gun Powder Factory (RGPF) where the Highbridge Street Guncotton factory was active.

In 1885 construction started on the Quinton Hill Guncotton Factory. There was plenty of room to stretch the factory out westwards along the south side of Cobbins Brook from the existing farm buildings. The farm and its stables were utilised as stores and offices. In its early days, from 1887 to 1905, the factory was laid out to manufacture Guncotton by Abel's Method. This is clearly laid out in Younghusband's "Description for the Manufacture of Abel's Pulped and Compressed Guncotton at Waltham Abbey" (1873 referring to the Highbridge Street factory).

Although Abel's method was taken up enthusiastically by many private manufacturers, there was a major development in 1905 when the nitration process was changed to the Thomson and Thomson displacement method from Abel's dipping method (the Thomsons were brought to Waltham Abbey from Ardeer, Scotland, on the advice of McRoberts who was the manager at Ardeer). Large earthenware pans containing mixed acids, were filled with the cotton and then weighed down with perforated earthenware plates. Fumes were guided off by means of a fume hood and nitration took about two and a half hours. On completion of nitration, the acids were run off by means of an earthenware cock at the base of the pan and the cotton was washed through with water. From the nitrating pans, the cotton was taken to the boiling vats where trace acids were removed, then to the pulping room where it was pulped in the beaters between rotating knife blades. It was then run over a grit trap and blanket run to remove any foreign matter before being run into the potchers where it received a final wash before being added to the greater mass of pulped nitrocellulose in a tank capable of holding four tons. From this tank the pulp was pumped into hydraulic powered mould presses where it was compressed into cylindrical blocks which could be stored and transported reasonably safely if the water content was kept between 15% and 30%.

Some years later, in 1909, Sir Frederic Nathan delivered a paper "Guncotton and Its Manufacture" (J.Soc.Chem.Ind. No.5, 177-187) to the London Section of the Society of Chemical Industry. The outline of processes then in use at the Royal Gunpowder Factory, Waltham Abbey, which he described allows us to understand the early changes in the layout of the factory.

Considering that the early development of the guncotton manufacturing process was striving towards the production of a high explosive, it must have come as a surprise to many people when Abel and Dewar patented cordite in 1889. This stable, slow burning and smokeless propellant was made primarily from two sensitive high explosives, guncotton and nitroglycerine. Nevertheless the guncotton manufacturing facility was already in existence and the success of cordite as a propellant would mean that the facility would have funds for development and expansion.

Description of Guncotton Factory G431

Building no: G431 Guncotton Factory NGR: TQ 3820 9980

1. General

A large rectangular brick-built structure consisting of three distinct elements: a) the *West Block*, a single-storey structure (24.5 x 16.4m) with a plain gable roof, formerly slated but now felted; b) the *East Block*, a two-storey building (23.7 x 16.4m) with a slated hipped gable roof: (Plate 6). c) the *East Annexe*, a small single-storey structure (6.4m square) with a slated hipped gable roof on the east end of (b). These elements are all of a single build. The

building (now 54.7m long) originally extended further to the west. A flat-roofed brick extension (G431B) to the north of (b) was constructed in the 1950s, and is not included in this survey.

Common Structural Details: The building is constructed in buff brick, laid in English bond. The external walls are all 480mm thick. Around the base of the external walls runs a splayed plinth of blue engineering bricks, three courses deep. All windows in the East and West Blocks have red brick quoins and semicircular arches with gauged voussoirs, and stone sills, unless otherwise described (Plate 7). Doorways are of similar construction. A red brick string course, three bricks deep, links the base of each arch on both floors. A red brick oversail three courses deep runs along the eaves of the two main parts of the building: the line of the oversail on the west end is continued as a band of red bricks, five bricks deep, around the east end and north side (Plate 8). The East Annexe also has a red brick oversail. Windows in the Annexe are set high in the wall, and have segmental brick arches and stone sills. A box-section cast iron gutter runs around all the eaves, with downpipes on all elevations (Plate 9). The upper end of each downpipe is inset into the oversail. Interior walls are painted cream, window frames are white, and doors, guttering, downpipes and ironwork are mid-blue.

South Elevation: Starting from the west end of the West Block (Plate 10), there is a window, an access door (infilled and rendered, with a small rectangular window), a window (replaced by a modern double access door and rendered infill), a window, an access door with fanlight, two windows, and finally an access door with fanlight. Continuing on to the East Block, there is a large rectangular loading door with an 'I' beam lintel, over which are smaller doors centred on a projecting 'I' beam (Plate 11) (according to drawings in the site archive, a window originally occupied the centre of this space). To the east of this is a double access door with fanlight (Plate 12), two windows, and a single access door with fanlight (Plate 6). The East Annexe has an inserted 16-light metal-framed window, 2.12 x 1.58m, with a concrete lintel and tile sill. From brickwork visible in the interior, a small four-light window was originally located here (Plate 13). Adjacent to the south-east corner of the Annexe is a blocked doorway, with a red brick segmental arch and quoins. The base of the doorway is above plinth height. In the wall between the blocked door and window arches is a single airbrick.

In the upper floor (East Block) there is a central loading door with fanlight, flanked on each side by two windows (Plate 6). From the brickwork on the quoins of the loading door and the bottom edge of the fanlight frame, the door has replaced a window (Plate 14). There are no external fixtures or fittings (e.g. projecting beam for hoist) associated with this door. Below the easternmost window a metal grille is inset in the band of red bricks, above the eastern access door.

East Elevation: The lower southern part is occupied by the East Annexe. There is a single ground-floor window, centrally located (Plate 8). From the north-east corner of the building a brick staircase rises southwards at 40° to a projecting concrete landing in front of a centrally located recessed double doorway, with an arched fanlight above a concrete lintel. The south-east corner of the landing is supported by a brick pier set upon the Annexe roof. The treads of the staircase are stone, resurfaced with cement. The iron handrail has square-section stanchions and a flat rail with a rounded top, and is painted blue. Beneath the staircase is a storeroom, evidently formerly used for chemicals. An access door beneath a segmental arch and narrow fanlight is located in the east wall of the staircase, and inside is a blocked doorway leading into the main building.

At first floor level there are two windows, at either side of the doorway. Adjacent to the south-east corner of the building is a brick flue c.600mm (2½ bricks) square, rising from the south-west corner of the Annexe to the eaves of the East Block, where it has been capped with a concrete slab (Plate 15). The red brick string courses previously mentioned are incorporated in the flue.

On the east elevation of the Annexe beneath the oversail a single course of airbricks runs across the north half of the elevation, continuing around to the north elevation. On the southern half a single airbrick is centrally placed (Plate 37). Below this there were originally four small 4-light windows. The southern pair have been bricked up, and replaced by a

rectangular 16-light window with concrete lintel and tile sill, identical to that in the south elevation. Much of the brickwork around this later window has been replaced, including the plinth (Plate 37). Below the two remaining 4-light windows, just above the plinth, are two segmental brick arches similar to those above the windows. Butt joints in the brickwork of the plinth beneath indicate where apertures 720mm wide have been bricked up (Plate 16)

North Elevation: Much of the ground floor part of the north elevation is obscured: on the West Block by storage racking and machinery, and on the East Block by G431B. The locations of windows and doors in the East Block are visible internally, and are given in that part of the description. The West Block elevation is occupied by eight windows: the fifth from the west end has been converted to a door occupying the full height of the arch (Plate 17). The two windows at the east end have been bricked up.

On the first floor (East Block) there is a centrally placed loading door, flanked on each side by two windows (Plate 18). The loading door has a projecting ridged awning, steel framed and boarded, covered with corrugated asbestos. The awning extends 1.9m from the wall. In front of the doorway, below the awning, projects a steel angle frame, forming a 'V' terminating in a loop below. Above this a large hook in the outer end of the awning support beam. From cutouts in the door, now boarded up, it is evident that an 'I' beam projected at one stage above the 'V', and that these elements, not necessarily contemporary, formed parts of a hoist. The door has a fanlight above, and a stone sill (Plate 19). On either side of the door the remains of various iron fittings project from the brickwork. Their function is uncertain.

In the north elevation of the East Annexe are three 4-light windows, located towards the west end of the wall. Above them a single course of airbricks runs beneath the oversail, continuing around the east elevation.

West Elevation: The gable end to the truncated West Block. Wall of blue engineering bricks, mostly covered with PVC cladding. Starting at the north-west corner, at ground floor level there is an access door with a concrete lintel and four metal-framed 30-pane rectangular windows with concrete lintels and tile sills. Traces of a blocked segmental-arched doorway are visible near the south-west corner. Detail of the brickwork at the south-west corner shows that the engineering bricks are a later addition, intended to strengthen and protect the former internal wall beyond which part of the building was demolished.

The west elevation of the East Block (first floor) is devoid of windows or other features (Plate 20).

Internal Description: The interior of G431 is divided into five principal rooms on the ground floor, and a single room on the first. The names used for these rooms are taken from a plan of the building in the site archive, and are as follows, from the east:

Cotton Waste Room, Teasing Room, Cylinder & Fan Room, Drying Room, Cooling Room
Above the first two rooms is the Cotton Store. No name is given for the East Annexe.

Cotton Waste Room: 13.75 x 15.35m, ceiling height 5.75m. In the north wall is a central doorway, flanked by two windows. The west window is blocked. The west wall is pierced by three segmental arched openings 2.7m wide, symmetrically located (Plate 21). The central arch is bricked up; the south arch has been damaged. Across the face of the central arch a steel staircase rises northwards to the upper floor. In the centre of the room are six cast iron columns, each 230mm (9") diameter, supporting the floor above (Plates 22 and 23). The columns are set at 3.9m centres, in two north-south rows 4.5m apart. There are two modern electric service lifts, one in the south-east corner, the other midway along the east side. A doorway with adjacent single-pane window in the east wall gives access to the East Annexe.

A relatively recent addition to this room is a mezzanine floor, c.2.5m below the ceiling. The floor is of 25mm chipboard with square cutouts for the ceiling pillars, supported on a metal framework, extending from the north wall for about 12m. An electric lift unit against the east wall serves this floor, which can also be reached from the internal staircase.

Teasing Room: 8.65 x 15.35m; ceiling as for the previous room. In the north wall are two blocked windows. An access door, now much widened, at the south end of the west wall gave access to the room to the west. Down the centre of the ceiling runs a substantial 'I' beam, originally supported by three cast iron columns the same as those in the previous room. Only the northernmost survives: the central column has been replaced by an 'I' beam marked

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and the southern one has been removed, though its point of junction with the ceiling beam is visible. In the concrete floor of the room are visible at least 2 north-south rows of 12 rectangular slots, each 1220 x 125mm (4' x 5"), set at 910mm (3') centres. The slots have been filled with concrete.

Cylinder & Fan Room: 3.2 x 15.35m, open to roof (West Block). An access door, now much widened, at the south end of the west wall in line with that in the east wall gave access to the room to the west. The west wall is panelled (3 panels) above eaves height. There are blocked pipe runs through the west wall at a height of c.1.8m. The room north of the access arches is spanned by 6 'I' beams (three 200 x 150m, three 300 x 150m), at c.4.28m above the floor (Plate 24). The spacing between the beams is not uniform. Bolt holes visible in the upper faces of the beams suggest that something lay across them about 600mm from the east wall. On the floor there is a row of filled rectangular slots similar to those in the Teasing Room.

Drying Room: 11 x 15.35m, open to roof. Along the west side of this room are a series of modern flat-roofed toilets, offices and a mess room, constructed in brick on a raised concrete plinth. A blocked access door at the south end of the west wall gives access to the Cooling Room. The west wall is panelled (3 panels) above eaves height. Details of the walls were obscured by shelving and the modern additions already described. This room is spanned by three roof trusses (Plate 25).

Cooling Room: 9.2 x 15.35m, open to roof. This room has been subdivided with modern partitions into a corridor and two workshops, one of which has a suspended ceiling. Most of the walls have been heavily rendered, potentially obscuring much detail. The west wall is panelled (3 panels) above eaves height. Details of windows and doors have already been given. The room is spanned by two roof trusses.

East Annexe: 6.1 x 5.9m internally, divided by an east-west brick partition into two rooms. The south room, 3.9m wide, is entered from the Cotton Waste Room by a door in the north-west corner. This door has a concrete lintel, which also spans the adjacent single-pane window. Examination of drawings in the site archive indicate that the window, and therefore the lintel also, was inserted after the door. Adjacent to this in the east-west partition is a blocked doorway, leading to the north room. The present door to that room is at the other end of the partition. In the south-west corner of the room a fireplace is located diagonally across the corner. Its stack rises directly upwards (Plate 26). The internal walls are painted unplastered brickwork, and details of blocked windows and doors can be clearly seen. The north room is 2.1m wide, subdivided at its west end by 100mm (4") brick partitions into a toilet and washroom. Examination of drawings in the site archive indicates that the north room as built had two toilets at its east end.

Cotton Store: First floor (East Block), 22.75 x 15.35m, open to roof. An area 5.04 x 3.36m in the south-east corner is divided off by a timber-framed matchboarded partition c.4m high (Plate 27), with a boarded ceiling, enclosing a hoist from the ground floor (Plate 28). North of the centre of the room, close to the north loading door, the staircase from the Cotton Waste Room rises through an opening 3.9 x 0.9m, surrounded by a boxed-in timber-framed

balustrade. Midway along the east wall is the concrete-roofed brick-walled recessed porch structure. To the north of this a ceramic wash-basin is mounted on the east wall, along with pipes for hot and cold water and drainage. In the centre of the north wall is the north loading door, now permanently closed and barred (Plate 29). Above the door, supported on brick corbels, runs a length of 200 x 100mm steel channel, marked

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In addition to the hoist, there are two other openings in the floor of this room. One is 1.4m west of the north loading door, over the north-east corner of the Teasing Room, and the other is 2.8m east of the south-west corner of the room, above the large loading door in the Teasing Room. Both measure 1.3 x 1.4m, are presently boarded flush with the floor, and can be seen from below, though no fixtures or fittings are associated with them. The present electrical hoist, which is a modern installation, passes through an identical opening.

2. Services

Electricity: Main fuse/switch box supplying the building appears to be that adjacent to the double access door on the south elevation. The supply cable to the box enters from below, and the cast box has the name CANTIE on it. A smaller box is located on the wall to the right of the first floor access door on the north elevation, though this may only be for lighting in the Cotton Store.

Inside the building, most electrical conduits run along the south wall on the ground floor above window height, branching off as required.

Water: The only original water supply to the building appears to be to the toilets in the east annexe, and to the washbasin in the Cotton Store. The latter supply also serves a fire hose reel mounted on the north side of the recessed porch in the Cotton Store. The modern toilets and related facilities in the west end of the building are supplied by a plastic water pipe carried over the roadway to the south of the building by a service gantry bringing steam pipes to the building.

Steam: As previously mentioned, steam is brought to G431 along a tubular steel gantry spanning the roadway to the south (Plate 10). Steam pipes enter the building through the south wall of the Cylinder & Fan Room, the pipes passing along the east wall above the girders spanning the room. One passes through the blocked window to the north extension: others pass through the west wall at the north end of the room.

In the Cotton Store, an unlagged pipe runs around the south, east and north walls at a height of c.2.5m, exiting at the north-west corner. This pipe currently serves 4 modern Myson radiators on those walls.

Outside the building, a lagged 4" steam pipe is carried westwards from the gantry on projecting brackets along the south wall c.400mm below the oversail, along the west and north walls at the same height, into the north extension. Another pipe leads eastwards from the gantry, entering the south-west corner of the Cotton Store.

3. Passageways & Traverses

None

4. Door & Window Details

Access Doors (Ground Floor): Of the ground floor access doors in G431 only three, in the south elevation, appear to be original. Two of these, in the West Block, each have a panelled door set in buff brickwork recessed only one half brick depth from the outer face of the wall. Above the door is a metal-framed semicircular 7-pane fanlight. External fittings consist of conventional door handles: the inside of both doors is covered by shelving. The third door, in the East Block, has a 15-pane fanlight above a pair of matchboarded doors, set flush with the outside face of the wall. No external fittings were noted: again, the inside face of the door was inaccessible.

Loading Door (Ground Floor): In the south elevation of the East Block is a large rectangular loading door with a lintel consisting of an 'I' beam, painted with red oxide paint, and top-hung sliding metal doors. From the state of the surrounding brickwork, the door is a relatively modern insertion.

Centrally located above the door is an aperture in the wall measuring c. 1.0 x 1.5m. Its quoins are constructed with blue engineering brick, and its lintel, level with the internal ceiling height, consists of two small 'I' beams, side by side. The aperture is closed by two top-hung sliding doors, placed on the inside face of the wall.

Loading Doors (Cotton Store): The north loading door is a double door of heavy-duty matchboarded construction, 2.4m high, with a semicircular fanlight (Plate 29). Each door is hung on 3 hinges, there is an internal lock on the west door and also a Suffolk latch. As already described, the door originally had a 'I' section loading beam passing through it, and is now barred shut. Its interior surface is painted light grey.

The south loading door has two doors of similar construction to the north doors. However, the doors are only 2.25m high, with a pronounced sill, and the fanlight above was originally the upper part of the window which originally occupied this space. Since there is no evidence of an external hoist related to this door, it is difficult to see how it could have functioned as a loading door.

Windows (Main Building): 43-light semicircular arched cast metal-framed windows, overall dimensions 2.2 x 1.68m (Plate 7). A six-pane section at the centre of the window opens on a horizontal pivot, and has a simple stay on its bottom edge. These have been replaced in some ground-floor windows. The main frames have thick rounded glazing bars, with nodules at each junction. The nodules have rosettes cast onto them.

Windows (Annexe): 4-light wood-framed windows, 1030 x 700mm overall, non-opening.

The brickwork surrounding the windows and doors has been described in Section 1.

5. Signs & Instruction Boards

1. On the east elevation, between the ground floor window and the landing to the first floor doorway, is a stone with the legend



(Plate 30)

2. On the east wall of the East Annexe, adjacent to the south-east corner, is a yellow metal sign, black-edged, which reads

G431 SOUTH SITE STORES

(Plate 31)

6. Roof

West Block: Pitched plain gabled roof (originally hipped gable), metal-framed, 27° pitch (Plate 32). Rafters of 'I' section at 10' (3.05m) intervals, joined at the apex by a riveted plate. A truss consisting of two forged rods joined by bolted plates runs between the base of the rafters, held in plates riveted to the ends of the rafters and tensioned by wedges passing through those plates (Plate 33). Each truss is supported by four hangers, each consisting of two 100 x 12mm strips, fastened together with bolts and spacers, and bolted to the rafter and truss. From the roof apex to the lower end of the inner hangers, and from the upper end of the inner hangers to the lower end of the outer hangers, run forged tensioning rods, each with a threaded adjustable sleeve near the top end (Plate 34). Five wooden purlins sandwiched between lengths of steel angle run along each pitch. To these are nailed the roof boarding, of 165 x 40mm section boards. According to a surviving drawing in the site archive the roof was originally slated: at present it is rather crudely felted and battened.

East Block: Hipped gable, metal-framed, 27° pitch. 'I' beam rafters: three each side, across width of building, one down each gable ridge, one down centre of each end gable from ridge. At each end of the main roof ridge, 5 rafters joined together by a complex arrangement of riveted plates. Below each rafter is truss consisting of forged rods, similar to those in the West Block, held in plates riveted to the ends of the rafters and tensioned by wedges passing through those plates. At their inner ends, the trusses are bolted to circular plates. There are three of these, located beneath the centre and ends of the main ridge. The trusses are supported by hangers, each consisting of two 100 x 12mm strips, fastened together with bolts and spacers, and bolted to the rafter and truss. The three cross trusses each have four hangers, the diagonal trusses three, and the end trusses two. From the roof apex to the lower end of the inner hangers, and from the upper end of the inner hangers to the lower end of the outer hangers, run forged tensioning rods, each with a threaded adjustable sleeve near the top end. Five wooden purlins sandwiched between lengths of steel angle run along each pitch. To these are nailed the roof boarding, of 165 x 40mm section boards. The interior of the roof, as well as all the steelwork, is painted white.

On the outside, the roof is slated, with lead flashings on the ridges. At each end of the main ridge is a three-pronged lightning conductor.

East Annexe: Hipped gable, slated, with lead flashings. As the annexe has an internal ceiling, details of the roof construction cannot be ascertained.

7. Interior Fixtures & Fittings

Unloading Hoist (Ground Floor): From the top centre of the upper part of the large loading door in the south elevation an 'I' beam 150 x 300mm projects horizontally for at least two metres. Cutouts in the small upper loading doors allow them to close without fouling the beam. This beam, which is in two sections, continues across the ceiling of the Teasing Room, midway between the main support beam and the west wall, fastened to the steelwork supporting the ceiling by bolts and clips. Its north end has been set into the north wall. The beam is marked

DORMAN LONG & CO L^D MIDDLESBOROUGH ENGLAND

The paint on the edges and upper surface of the lower flange of the beam has been abraded, presumably by the traverse which ran along the beam. Set into the north wall, on the west side of the beam, is a rod ending in an loop, to which must have been attached a wire rope connected with the traverse. It is evident that this hoist cannot have functioned with the large loading door in its present state, as the lintel would have prevented the traverse from transporting objects through the door. Furthermore, the small traverse door has properly constructed quoins, albeit an insertion into the wall, whereas the loading door sides have been crudely cut back.

8. Lighting

External: On the right-hand side of the first-floor door, east elevation, is an oval wall-mounted light, linked by conduit tubing to a switchbox below, thence to a larger fusebox

Cotton Waste Room: Above the mezzanine, there are two different systems, apparently unconnected. A single row of metal-shaded lights linked by conduit tubing down the central bay appear to be earlier than an arrangement of lights with smaller, green/white enamelled shades and bayonet sockets, operated by ceiling mounted cord pull switches, which must have been installed, or adapted, when the mezzanine was constructed. The area not covered by the mezzanine is lit by three large polished metal light units, apparently modern.

Teasing Room: No light fittings survive, though the conduit linking them is still in situ on the ceiling.

Cylinder & Fan Room: Two different systems. Suspended from the roof on long lengths of conduit were originally four light units, of which only the northernmost survives, with a

green/white enamelled shade. Laid across the tops of the beams spanning the room is a conduit with five lights attached, fitted with similar shades.

Drying Room: 5 runs of four lights each, suspended from the roof as in the previous room. Only the west run survives intact.

Cooling Room: Details not visible because of modern false ceilings. Probably similar to previous room.

Cotton Store: 3 runs of conduit down the length of the room attached to the roof trusses, linked at either end. Suspended from this by chains were a large number of modern fluorescent units, now mostly removed. One shaded light remains near the centre of the room, a large bulb in a grey/white metal shade. Switches for the lights are located on the east wall, south of the recessed doorway.

East Annexe: Access was not possible, so full details could not be recorded. The fitting in the south room is a conventional ceiling-mounted unit.

9. Heating

In the Cotton Store, five modern Myson radiators are mounted on the south (2), east (2) and north walls. These are linked to the steam pipes passing through the room.

10. Buildings Close by with Obvious Relationship to this Building

G431B, the extension built to the north of the East Block in the 1960s

11. Communications

External: On the south-east corner of the East Block is a complex of telephone wires, junction boxes, etc. From this corner brackets for telephone cables run along the south and east elevations of G431. On the south elevation brackets are located along the length of the building (Plate 36), c.650mm below the string course and oversail, at c.3m intervals. Each bracket carries two insulators (Plate 35). Three types of insulator are present:

1. White ceramic, cylindrical, 2 concentric grooves below a conical head.
2. White ceramic, two cones with a flat top.
3. Brown ceramic, double 'cotton reel' shape (smaller than the other types).

On the Annexe chimney are three 'phone line brackets, at the string course levels and the oversail. The middle one lines up with a bracket on the north corner of the elevation. Insulators on these locations are mostly of a dark grey material, cylindrical in shape with two concentric grooves below a flat top.

As no wires remain, the destination of these routes remains uncertain.

Internal: The only internal sign of telephones is a group of junction boxes on the wall adjacent to the window in the east end of the partitioned lift room in the Cotton Store.

12. Floor

Ground: Concrete, now much worn and scarred. Marks in the floor of the Teasing Room and Cylinder & Fan Rooms attest to long-vanished fittings, but are too obscured for detailed appraisal. In the south-east corner of the Cotton Waste Room an area of the original composition floor, 25mm thick, survives beneath modern machinery. Its upper surface has shallow grooves, mimicking paving slabs.

First: The first floor over the Cotton Waste and Teasing Rooms is concrete, 75mm thick, supported on a network of east-west 'I' beams, each 150 x 300mm. This is supported in turn by similar 'I' beams running in a north-south direction, set into the walls. In the Cotton Waste Room these are carried on and bolted to six cast iron columns, each 5.75m long and 230mm (9") diameter. Three identical columns supported the ceiling in the Teasing Room: only the

northernmost remains. The central column has been replaced by an 'I' beam, and the southernmost is missing, its location marked by bolt holes and an unpainted area on the north-south beam.

13. Additional Observations

Phasing: A great many alterations have been made to this building: the dating of many of these is discussed in the text above.

Acknowledgments

I would like to acknowledge the assistance of Royal Ordnance staff G.G.Vincent, Trevor Wilson, Ed Andrews and Lynne Lennard. Wayne Cocroft of the RCHME Keele office. Malcolm McLaren once head of management services RGPF Waltham Abbey. The Hertfordshire Archaeological Trust recording team led by Bob Zeepvat. Amanda Kennedy and Melissa Eyears for research work at the PRO. Photographs are reproduced here by kind permission of the Waltham Abbey Trust Company Limited whose collection is at present administered by the Epping Forest District Museum in Sun Street, Waltham Abbey.

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- Supply 5/861 1903-1938 Photograph Album - RGPF Explosions and Plant
- Supply 5/862 1903-1930 Photograph Album - RGPF Various
- Supply 5/863 1940-1941 Photograph Album - Damage by Enemy Action
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Appendices

Appendix 1: Photographic Register

Photographic Register

| | | |
|---|---|----------------------|
| WALTHAM ABBEY RGP SOUTH SITE | Date: August 1997 | Initials: RJZ |
| Building: G431 Guncotton Factory | Film: 400ASA Colour Slide & Monochrome | |

| Shot No. B/W+Col | Description | Scale used | Neg. No. B/W |
|-----------------------------|--|-----------------------|-------------------------|
| 1 | East elevation from east | - | 1/0 |
| 2 | East elevation, east annexe, from east | - | 1/1 |
| 3 | North elevation, east annexe, from north-east | - | 1/2 |
| 4 | South elevation, east annexe, from south | - | 1/3 |
| 5 | East elevation, 'foundation' stone above central window | - | 1/4 |
| 6 | Chimney stack above east annexe, from north-east | - | 1/5 |
| 7 | North-east corner, from north-east | - | 1/6 |
| 8 | Bricked-up arched opening, east wall of east annexe | 500mm | 1/7 |
| 9 | West elevation, from south-west | - | 1/8 |
| 10 | North elevation, west end, from north-east | - | 1/9 |
| 11 | North elevation, first floor of east end, from north-east | - | 1/10 |
| 12 | Detail: first-floor window (north elevation) | - | 1/11 |
| 13 | Detail: pipe and cable runs along north elevation | - | 1/12 |
| 14 | First floor loading door and canopy, north elevation | - | 1/13 |
| 15 | Drain pipe, guttering and oversail, north elevation | - | 1/14 |
| 16 | South elevation, west end, from south-west | - | 1/15 |
| 17 | South elevation, east end, from south-east | - | 1/16 |
| 18 | Access door west of loading door, south elevation | - | 1/17 |
| 19 | Large access door east of loading door, south elevation | - | 1/18 |
| 20 | Loading door, south elevation | - | 1/19 |
| 21 | First floor loading door (former window), south elevation | - | 1/20 |
| 22 | South-east corner and chimney stack, from south | - | 1/21 |
| 23 | First floor interior, from north-east corner | - | 1/22 |
| 24 | First floor interior, from north-west corner | - | 1/23 |
| 25 | First floor: partition around hoist area | - | 1/24 |
| 26 | First floor: interior of north loading door | - | 1/25 |
| 27 | First floor: interior of south loading door | - | 1/26 |
| 28 | First floor: bracket for hoist, south-east corner | - | 1/27 |
| 29 | Detail of roof ironwork, east end of ridge | - | 1/28 |
| 30 | Outer end of truss, showing bracket and wedge | - | 1/29 |
| 31 | Roof truss, north-east corner. Note the bent hanger | - | 1/30 |
| 32 | Cotton Waste Room: upper end of columns, and joists supporting upper floor | - | 1/31 |
| 33 | Detail of column and associated ironwork | - | 1/34 |
| 34 | Archway from Cotton Waste Room to Teasing Room | - | 1/35 |
| 35 | Interior view of upper section of large loading door | - | 1/36 |
| 36 | Interior view of upper section of large loading door | - | 1/37 |
| 37 | Cylinder & Fan Room, from south | - | 2/0 |
| 38 | Drying Room, detail of west wall and roof | - | 2/1 |

| | | | |
|----|---|---|-----|
| 39 | Teasing Room: slots in floor | - | 2/2 |
| 40 | Window over access door, south wall of Fan Room | - | 2/3 |
| 41 | Cable/telegraph runs, south elevation | - | 2/4 |
| 42 | Signs on east wall of east annexe | - | 2/5 |

Appendix 2: Archive Contents

Archive Contents

Survey plot of the G431 at 1:100
Surveyed section of the G431 at 1:50
Survey data on zipped disc using CAD12
Bound copy of typescript report
One set of monochrome prints from 35mm film
One set of Colour slides (35mm)
3 ½" floppy disc with text and photographic registers

**Appendix 3: Essex Sites and Monuments
Record Summary Sheet**

Essex Sites and Monuments Record

Summary Sheet

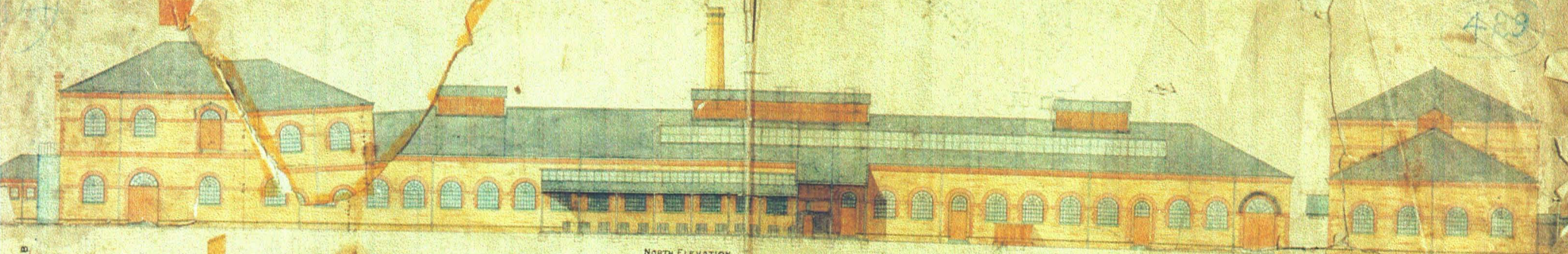
| | |
|---|---|
| Site name/Address: Guncotton Factory G431, South Site, Waltham Abbey Royal Gunpowder Factory, Essex | |
| Parish: Waltham Abbey | District: Epping Forest |
| NGR: TQ 3820 9980 | Site Code: WASS 97 |
| Type of Work: Building record/survey | Site Director/Group: Steve Chaddock / Prince Research Consultants |
| Date of Work: 01.07.97 - 31.08.97 | Size of Area Investigated: - |
| Location of Finds/Curating Museum: Essex Records Office | Funding Source: Environmental Services Group, Royal Ordnance plc |
| Further Seasons anticipated?: NO, as site is due to be developed and this is last stage of recording. | Related SMR Nos: - |
| Final Report: - | |
| Periods Represented: 1888-9 to 1989 | |
| SUMMARY OF FIELDWORK RESULTS: A recording brief, carried out on the Guncotton Factory of the South Site Guncotton Factory, included a survey of the building in plan and sections through the building, and photographic coverage. The Guncotton Factory was built on South Site in 1888-9 to produce guncotton in large quantities as a new chemical explosive. The introduction of cordite, with guncotton a major ingredient, as the new service propellant in 1892 led to the expansion and modification of the guncotton factory. The surviving part of the Guncotton Factory [G431] was the cotton store, the cotton teasing room, the cylinder and fan room, the drying room and the cooling room. These separate processes are just the start of a much longer process. A large rectangular brick-built structure consisting of three distinct elements: a) the <i>West Block</i> , a single-storey structure (24.5 x 16.4m) with a plain gable roof, formerly slated but now felted: b) the <i>East Block</i> , a two-storey building (23.7 x 16.4m) with a slated hipped gable roof: c) the <i>East Annexe</i> , a small single-storey structure (6.4m square) with a slated hipped gable roof on the east end of (b). These elements are all of a single build. The building (now 54.7m long) originally extended further to the west. A flat-roofed brick extension (G431B) to the north of (b) was constructed in the 1950s, and is not included in this survey. | |
| Previous Summaries/Reports: 1996 ECC FAG Nitroglycerine Washing House Report by Stuart Foreman 1996-7 Archaeological Evaluation of South Site by S. Chaddock including Site Survey in CAD Environment, Component Sheets for all buildings and text report detailing remains and processes carried out on site. | |
| Author of Summary: S. Chaddock | Date of Summary: 04/09/1997 |

Appendix 4: The Plates

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H

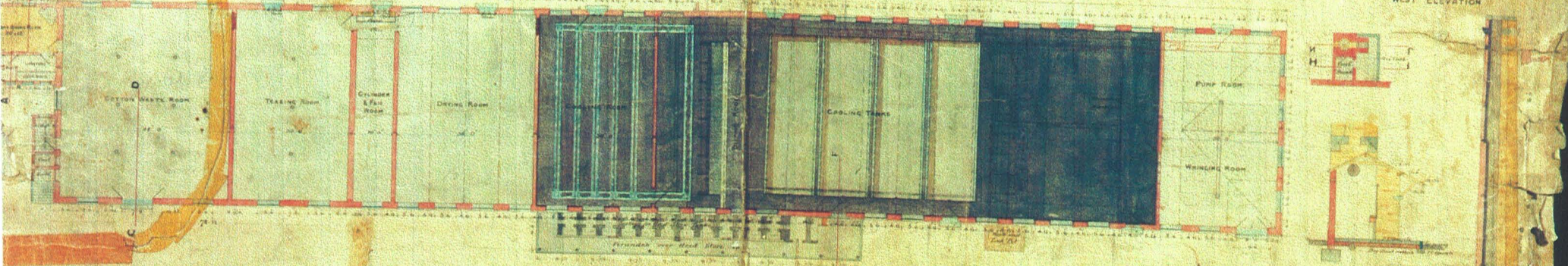
WALTHAM ABBEY
GUN COTTON FACTORY

489



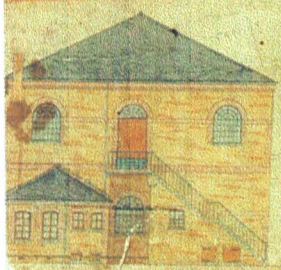
NORTH ELEVATION

WEST ELEVATION

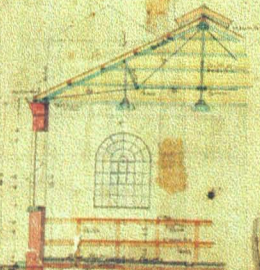


GROUND PLAN

SECTION H I



EAST ELEVATION



SECTION G H



A
C
I
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T
O
R
E



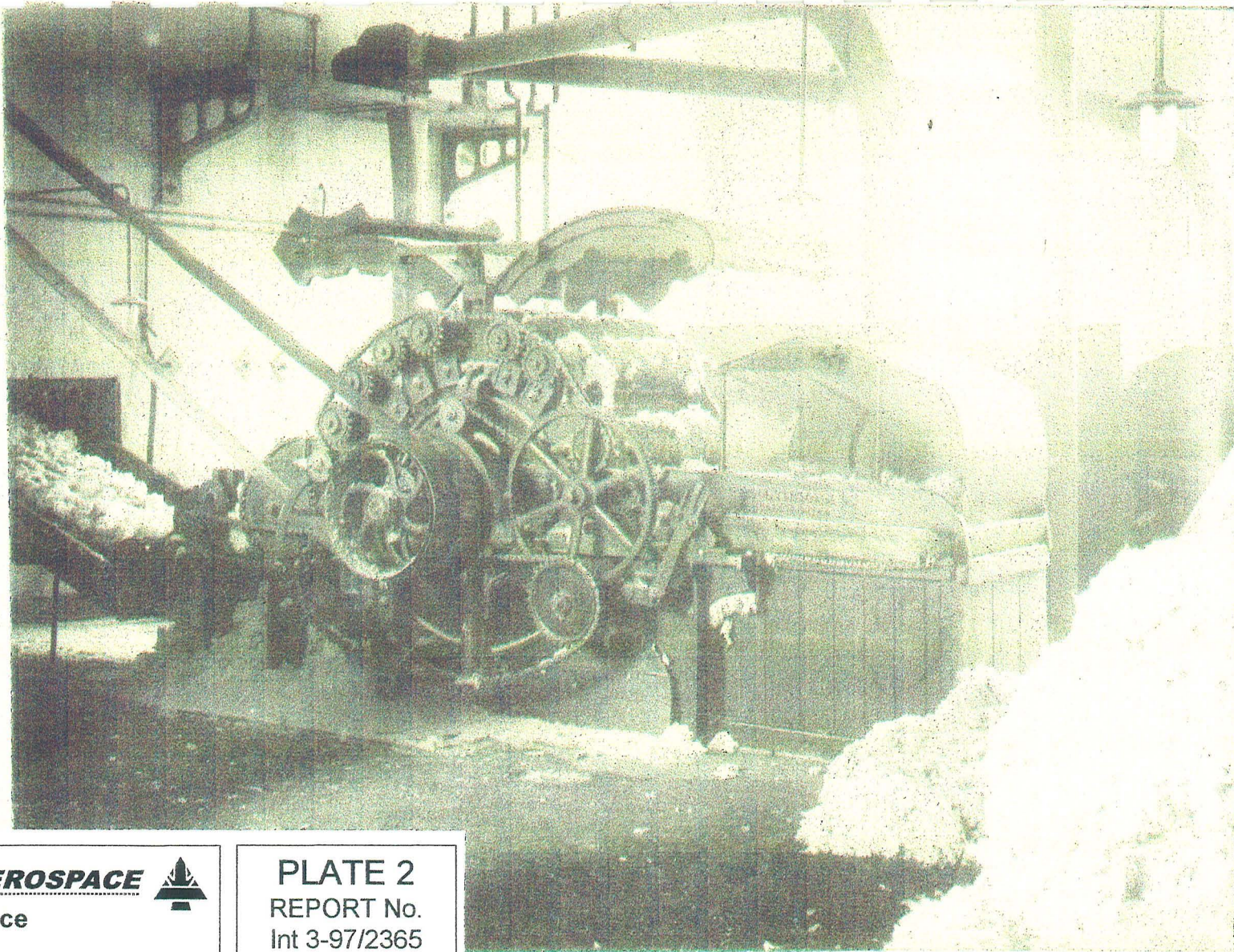
COTTON WASTE STORE

G43/B12

BRITISH AEROSPACE
Royal Ordnance



PLATE 1
REPORT No.
Int 3-97/2365



BRITISH AEROSPACE



Royal Ordnance

PLATE 2
REPORT No.
Int 3-97/2365

No 247. Seasing Machine - Open. Neg. No 27.

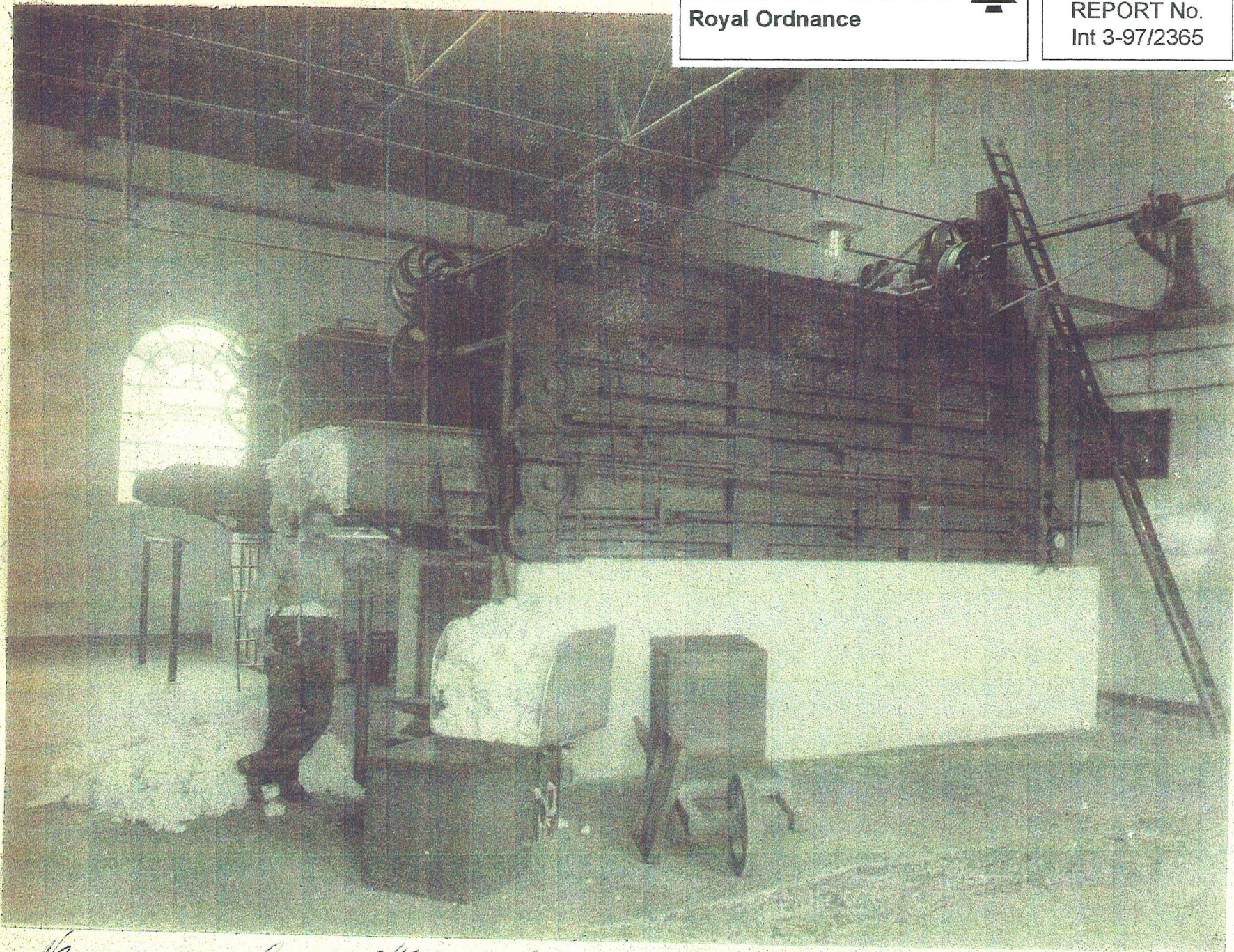
BRITISH AEROSPACE



Royal Ordnance

PLATE 3

REPORT No.
Int 3-97/2365



No 253

Bottom Works During D...

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BRITISH AEROSPACE

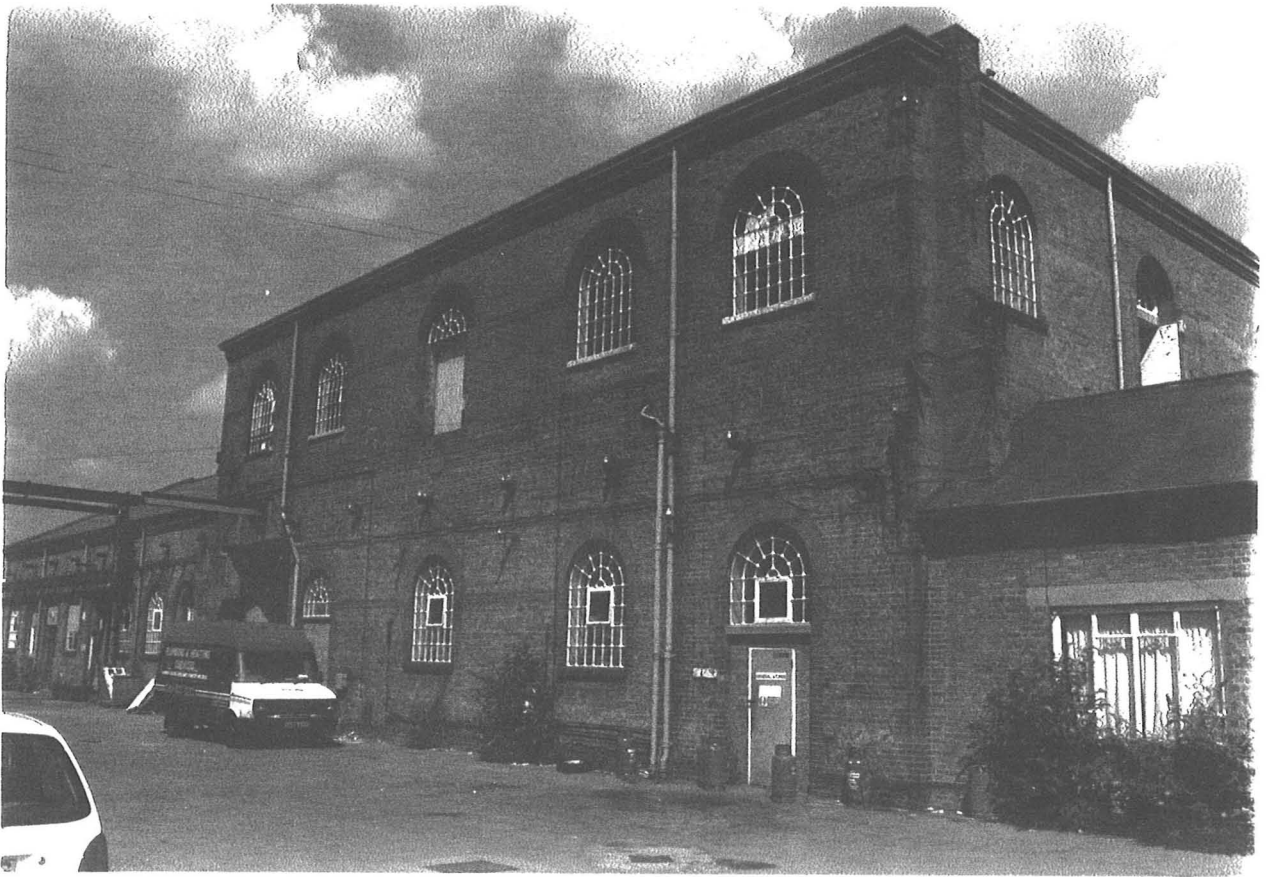


Royal Ordnance

PLATE 5

REPORT No.

Int 3-97/2365



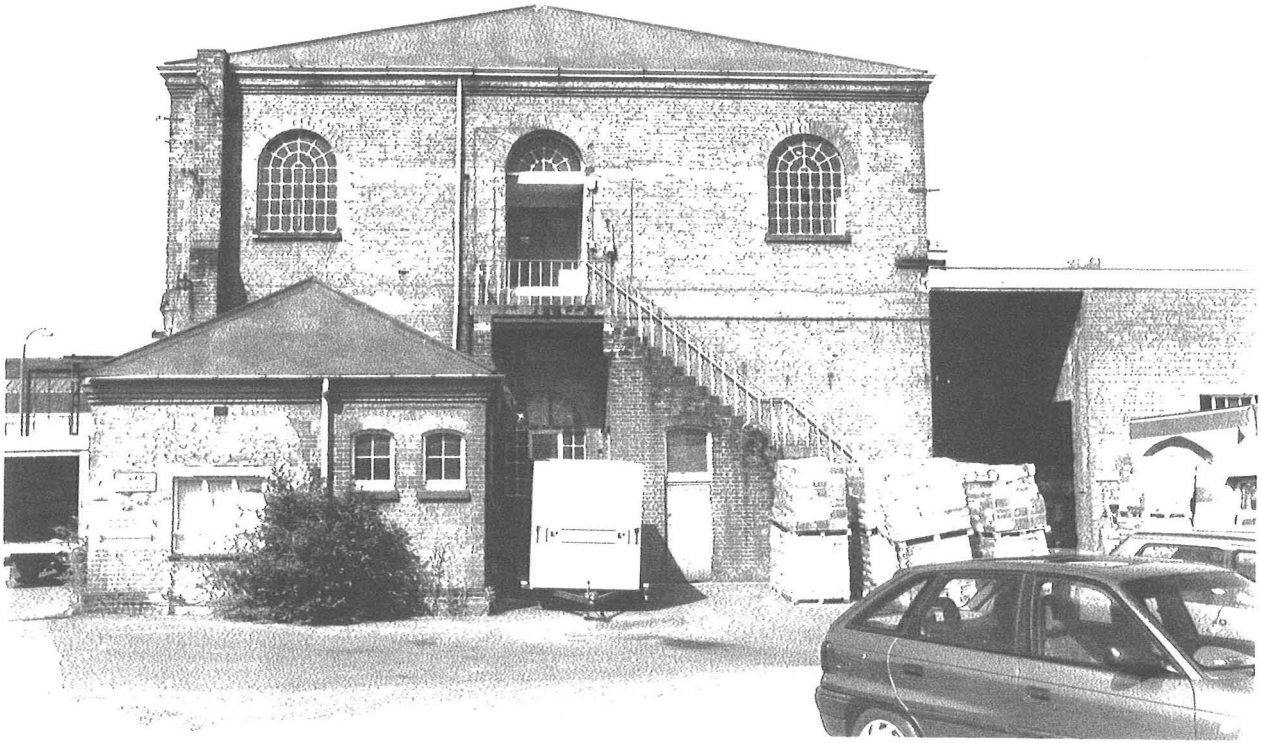
G431 PLATE 6 - SOUTH ELEVATION, EAST END, FROM, SOUTH WEST

INTENTIONALLY BLANK





G431 PLATE 7 - DETAIL: FIRST-FLOOR WINDOW (NORTH ELEVATION)



G431 PLATE 8 - EAST ELEVATION, FROM EAST

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G431 PLATE 9 - DRAIN PIPE, GUTTERING AND OVERSAIL, NORTH ELEVATION



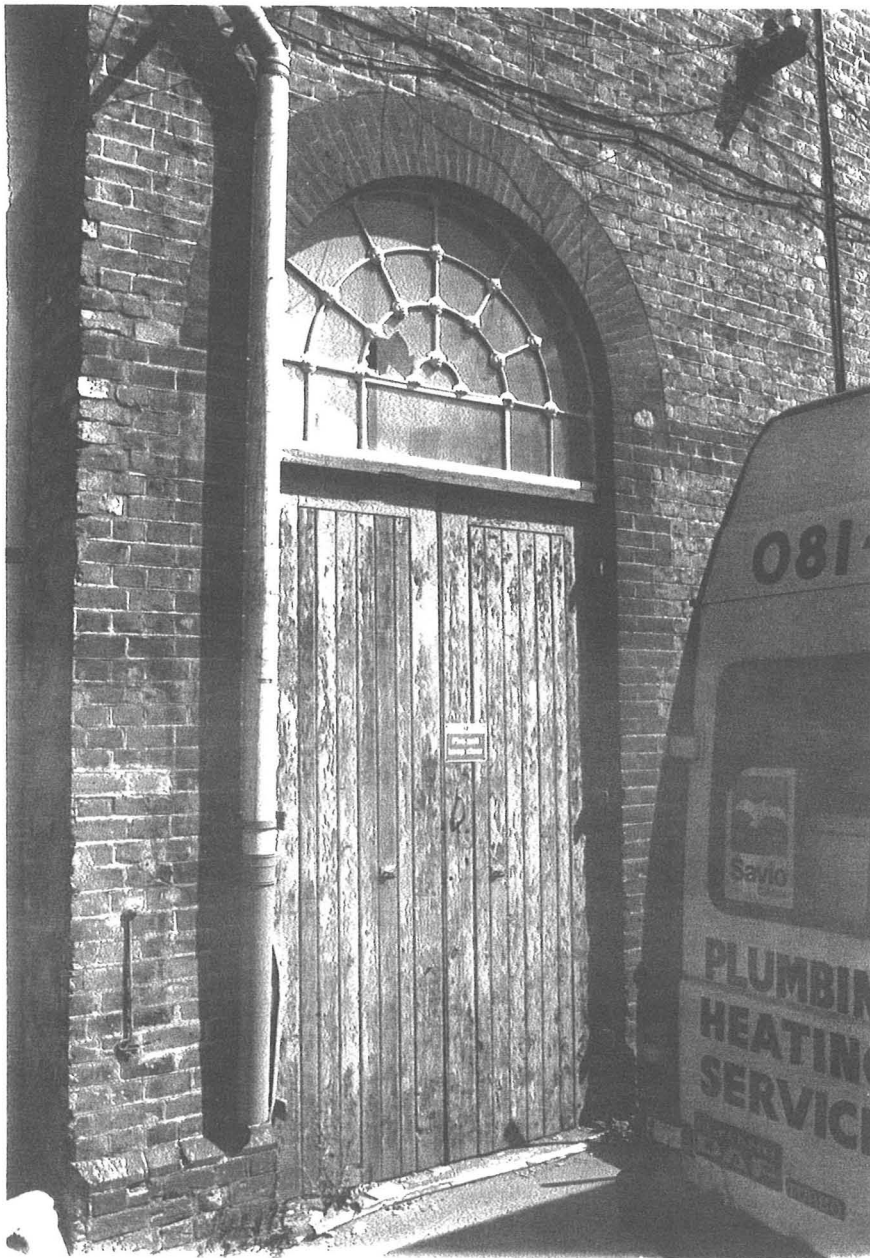
G431 PLATE 10 - SOUTH ELEVATION, WEST END, FROM SOUTH WEST

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G431 PLATE 11 - LOADING DOOR, SOUTH ELEVATION

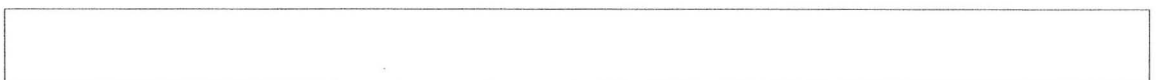


G431 PLATE 12 - LARGE ACCESS DOOR EAST OF LOADING DOOR, SOUTH ELEV.



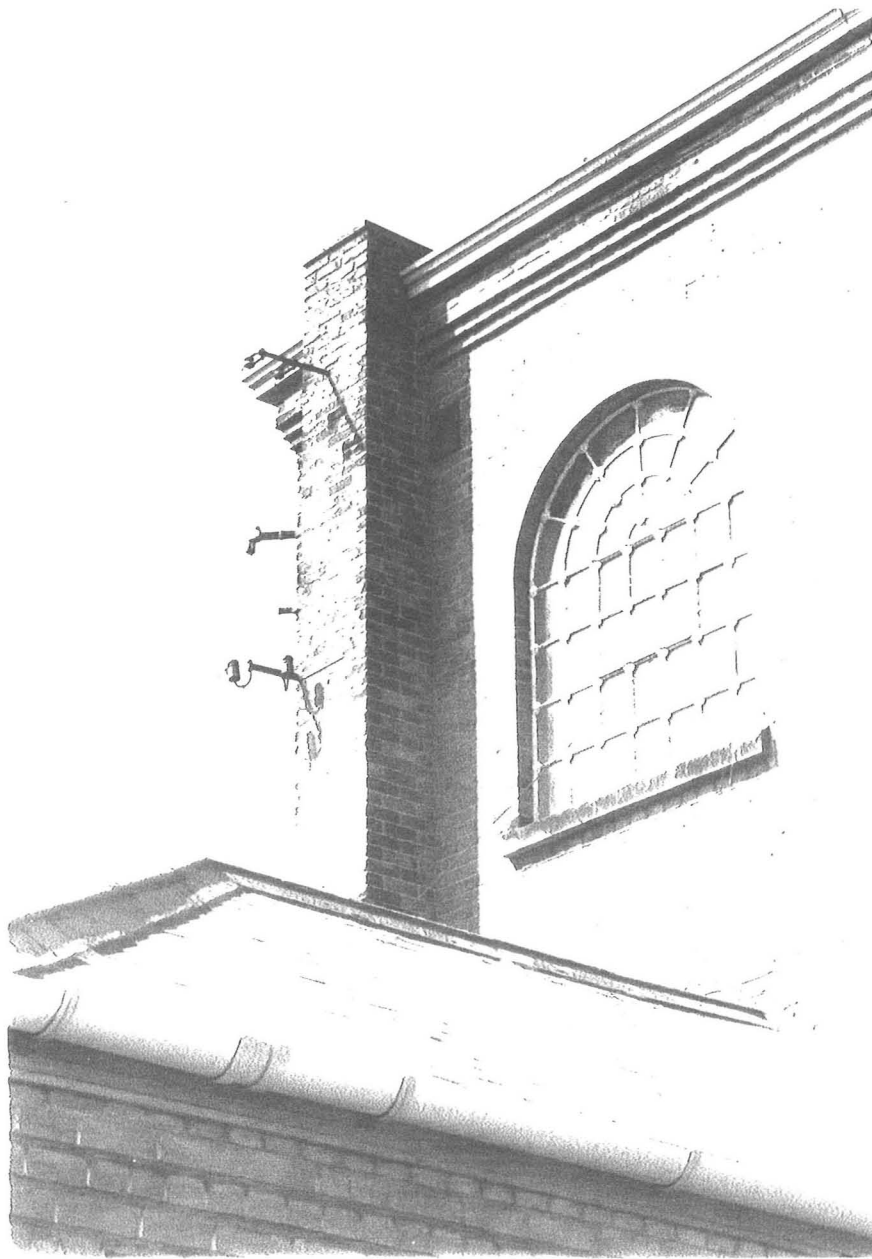
G431 PLATE 13 - SOUTH ELEVATION, FROM SOUTH

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G431 PLATE 14 - FIRST FLOOR LOADING DOOR (FORMER WINDOW), SOUTH ELEV.



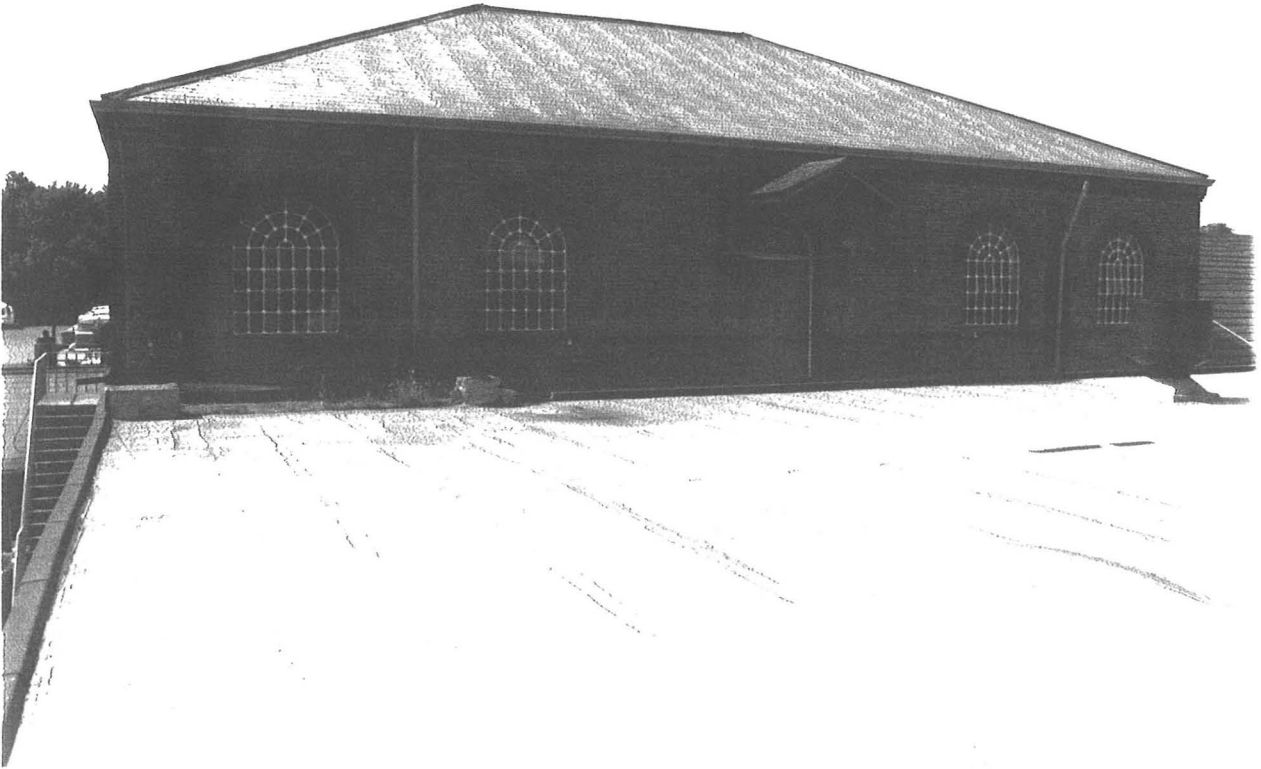
G431 PLATE 15 - CHIMNEY STACK ABOVE EAST ANNEXE, FROM NORTH EAST



G431 PLATE 16 - BRICKED-UP ARCHED OPENING, EAST WALL OF EAST ANNEXE

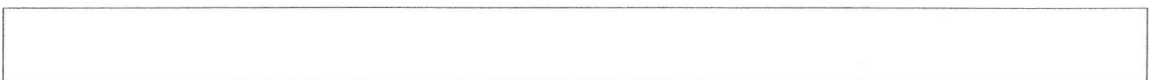


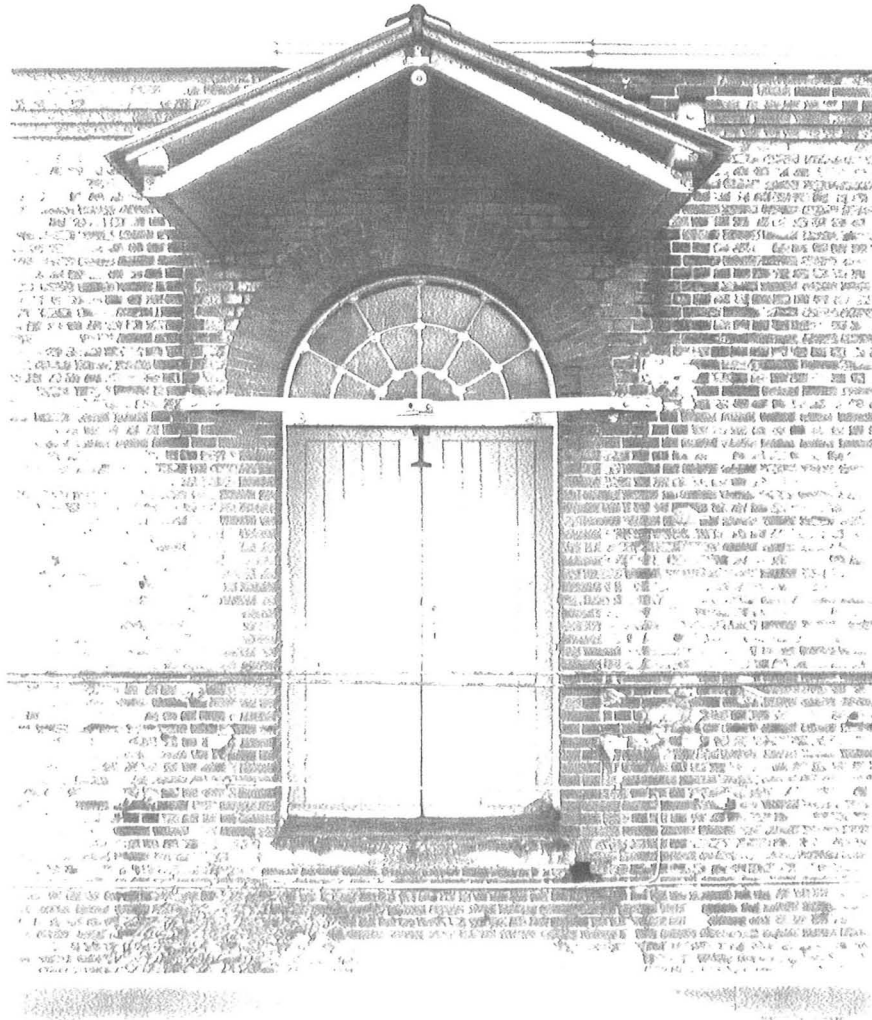
G431 PLATE 17 - NORTH ELEVATION, WEST END, FROM NORTH EAST



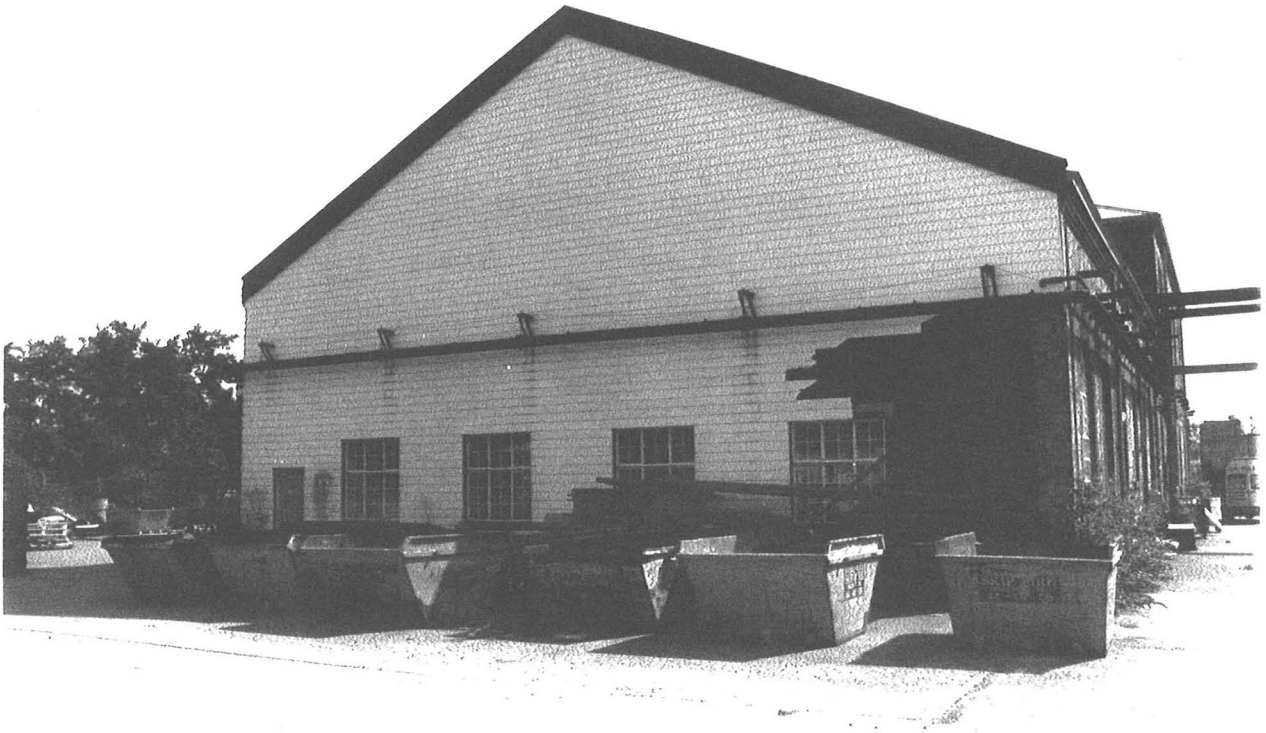
G431 PLATE 18 - NORTH ELEVATION, FIRST FLOOR OF EAST END, FROM N/EAST

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G431 PLATE 19 - FIRST FLOOR LOADING DOOR AND CANOPY, NORTH ELEVATION



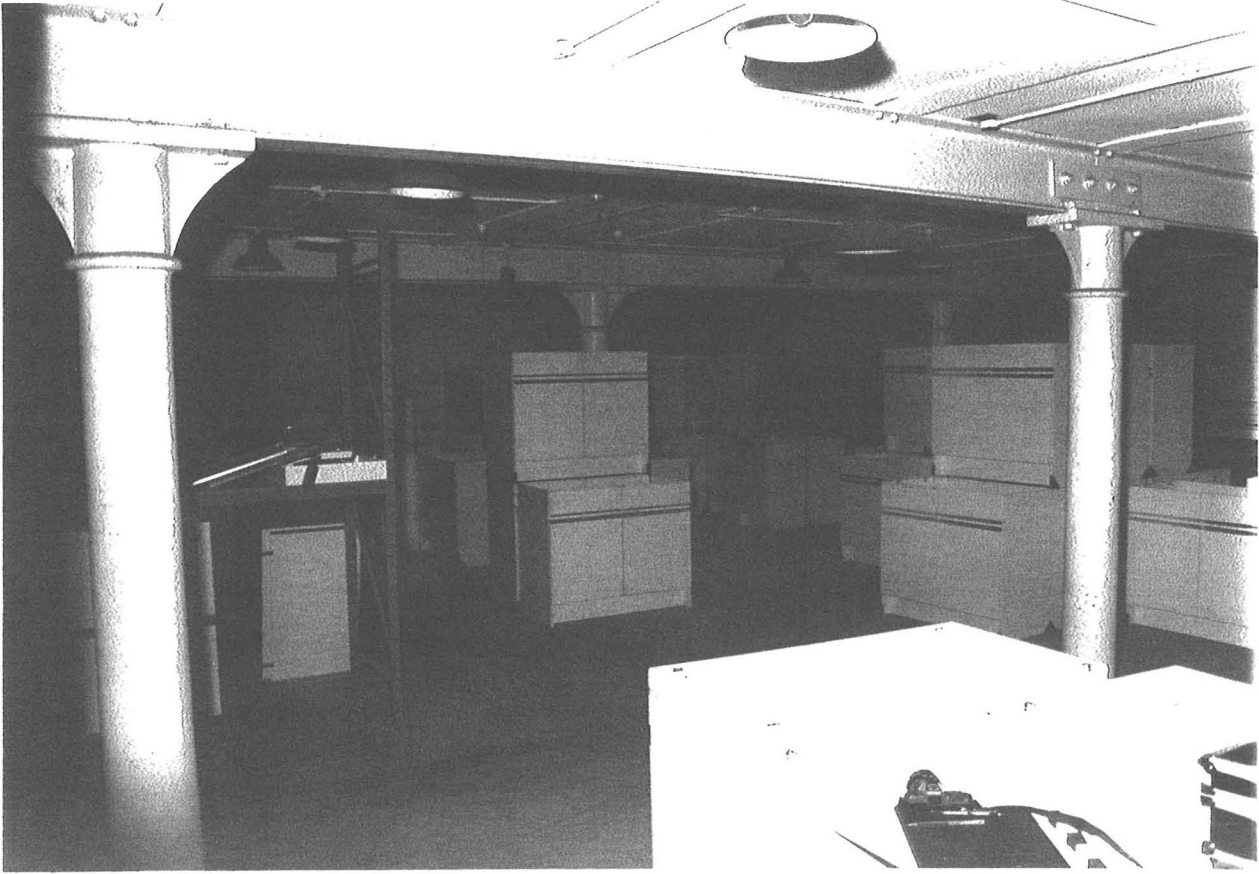
G431 PLATE 20 - WEST ELEVATION, FROM SOUTH WEST

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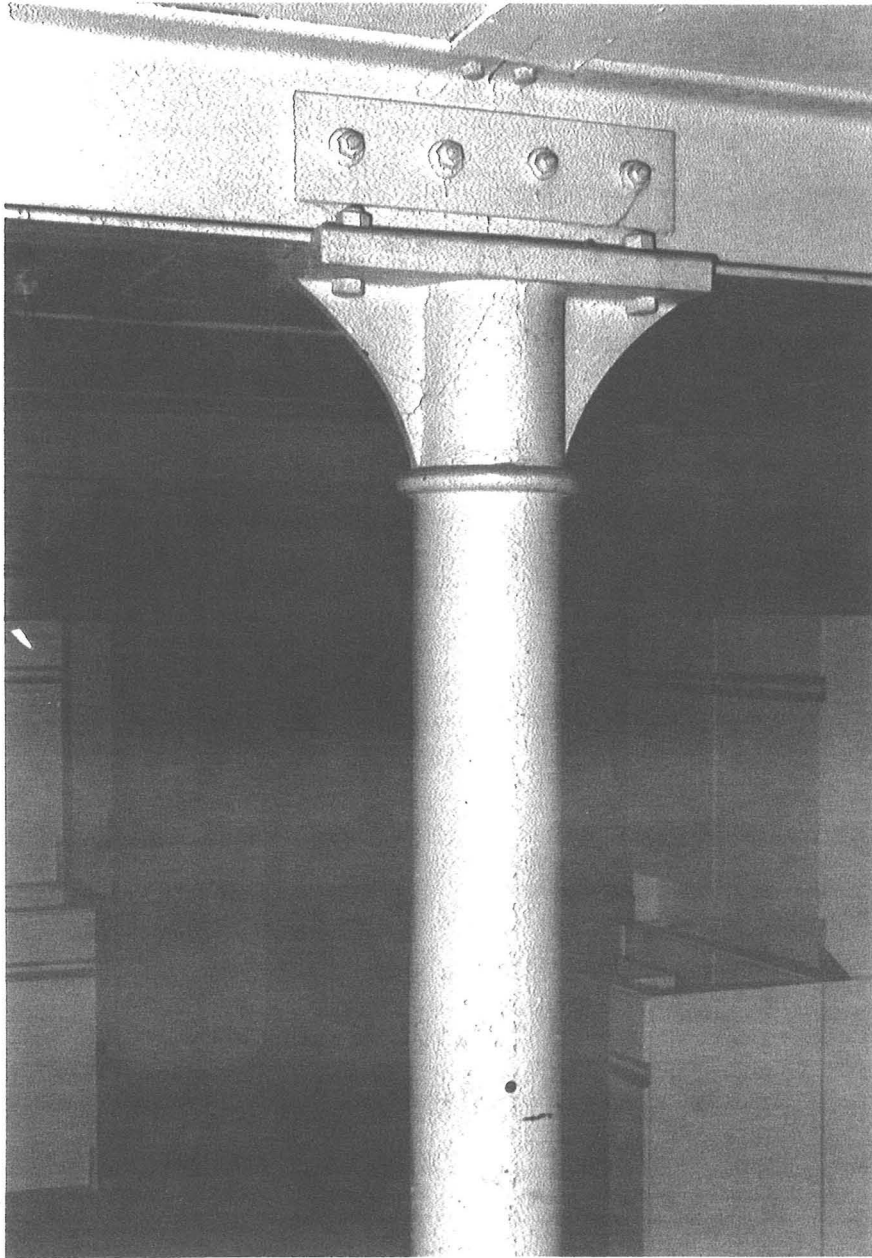
G431 PLATE 21 - ARCHWAY FROM COTTON WASTE ROOM TO TEASING ROOM



G431 PLATE 22 - COTTON WASTE ROOM: UPPER END OF COLUMNS & JOISTS SUPPORTING UPPER FLOOR

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G431 PLATE 23 - DETAIL OF COLUMN AND ASSOCIATED IRONWORK



G431 PLATE 24 - CYLINDER AND FAN ROOM, FROM SOUTH



G431 PLATE 25 - DRYING ROOM, DETAIL OF WEST WALL AND ROOF

INTENTIONALLY BLANK

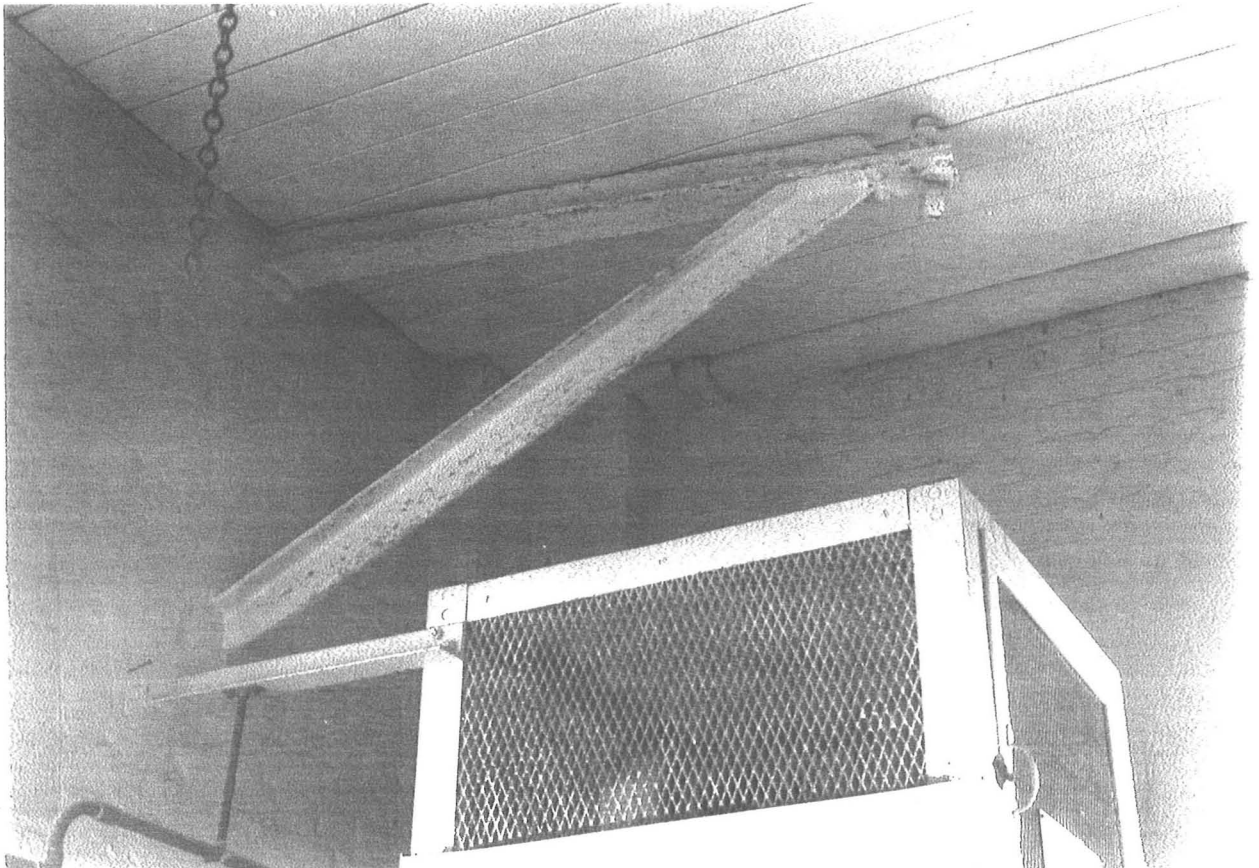




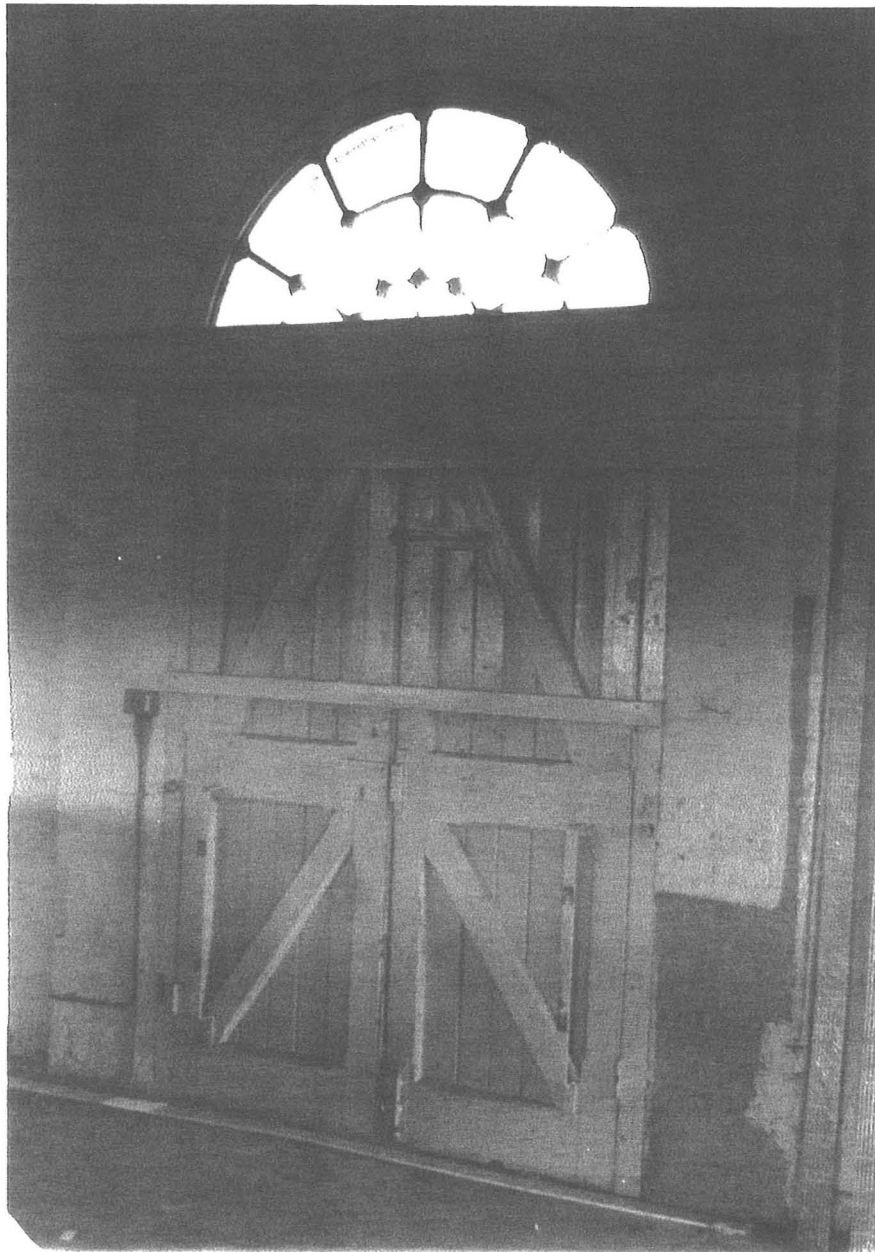
G431 PLATE 26 - SOUTH EAST CORNER AND CHIMNEY STACK, FROM SOUTH



G431 PLATE 27 - FIRST FLOOR: PARTITION AROUND HOIST AREA



G431 PLATE 28 - FIRST FLOOR: BRACKET FOR HOIST, SOUTH EAST CORNER



G431 PLATE 29 - FIRST FLOOR: INTERIOR OF NORTH LOADING DOOR



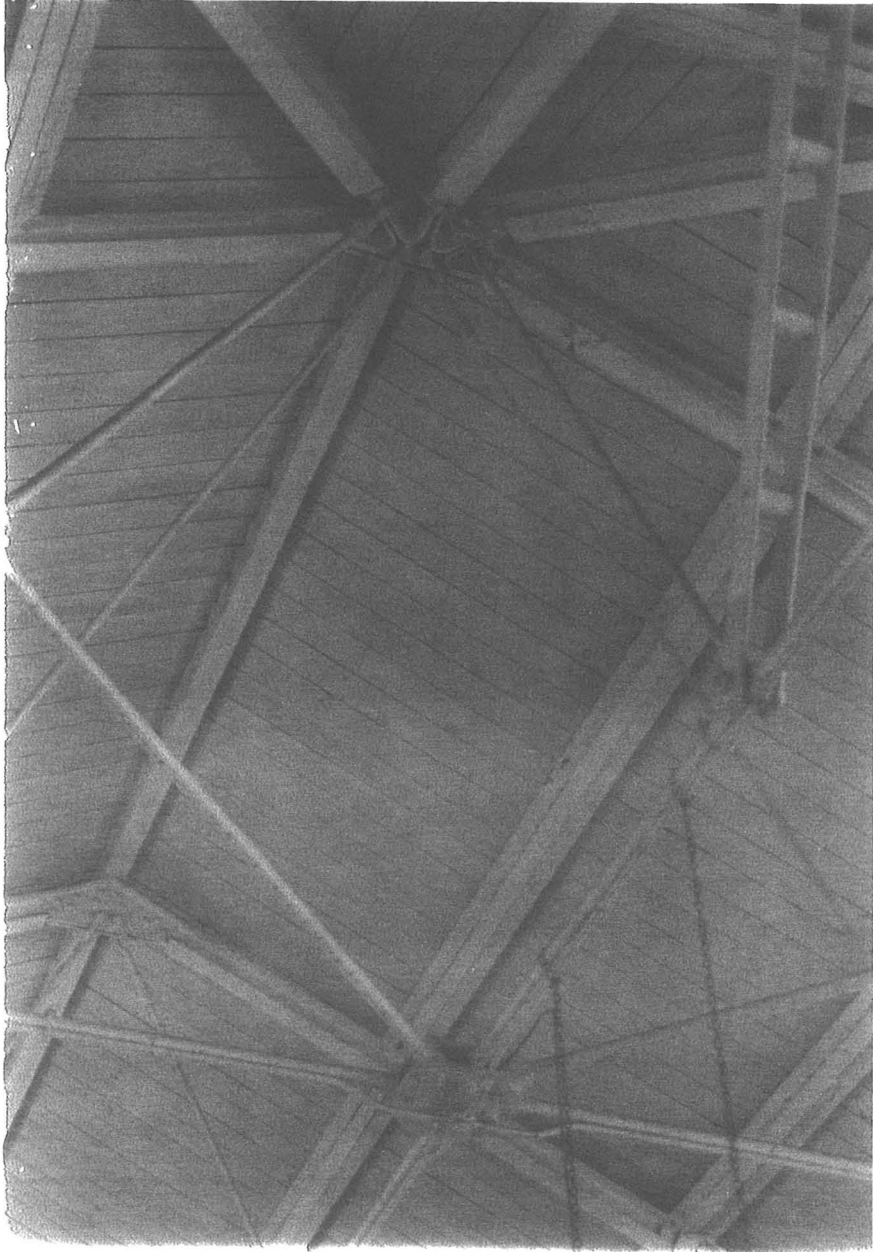
G431 PLATE 30 - EAST ELEV, 'FOUNDATION' STONE ABOVE CENTRAL WINDOW

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G431 PLATE 31 - SIGNS ON EAST WALL OF ANNEXE



G431 PLATE 33 - DETAIL OF ROOF IRONWORK, EAST END OF RIDGE



G431 PLATE 32 - FIRST FLOOR INTERIOR, FROM NORTH WEST CORNER

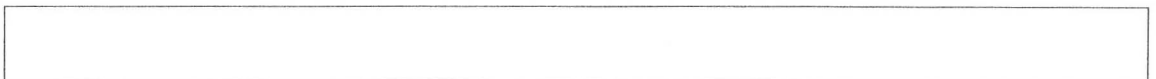
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G431 PLATE 34 - ROOF TRUSS, NORTH EAST CORNER. NOTE THE BENT HANGER

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G431 PLATE 35 - DETAIL: PIPE AND CABLE RUNS ALONG NORTH ELEVATION



G431 PLATE 36 - CABLE/TELEGRAPH RUNS, SOUTH ELEVATION



G431 PLATE 37 - EAST ELEVATION, EAST ANNEXE, FROM EAST

Appendix 5: The Figures