Figure 39: The space formerly occupied by the Bar, NCOs' Room and Tap Room, looking east. (DP097515)

9. THE LATER 19TH CENTURY AND EARLY 20TH CENTURY

By the 1880s the Thames forts and their contemporaries in the rest of the United Kingdom were fast becoming obsolete in the face of developments such as small fast-moving torpedo boats, powerful breech-loading rifled guns and the practical experience gained from conflicts and various minor actions, such as the bombardment of the forts at Alexandria, Egypt by the Royal Navy in 1882 (Brown 1997, 116). Of particular concern was defence against the new fast-moving torpedo boats for which the Rifled Muzzle Loader was too slow and heavy, and that the brick-built interlinked casemates of the batteries were now very vulnerable to modern weapons. More specifically, the Defence Committee meeting of 1884 was concerned about the danger of a shell entering through one gun port, disabling the gun inside and then starting a chain of explosions in the adjoining casemates that could destroy the entire battery (www.palmerstonforts.org.uk accessed 21.01.2010).

During the 1880s the Royal Engineers and Royal Artillery Works Committee began to address these problems for all the works of fortification in the British Empire. The recommendations for the Thames forts are contained in three reports dating from 1886 to 1887. The first of these, *Reconstruction of the Casemated forts on the Thames and Medway: Royal Artillery and Royal Engineers Works Committee Report 45,* is dated 13 December 1886 (TNA: WO396/3). In this report Major English (last noted in 1873 as a lieutenant dealing with mantlet bars; see Chapter 5) proposed extensive modifications to the forts to overcome their perceived weakness in the face of modern artillery. His initial proposal noted that, in ideal circumstances, the Thames forts would be replaced by modern low-profile batteries mounting breech-loading guns. However the considerable subsidence problems encountered by the forts during their construction indicated that the local geology would not allow the construction of new batteries without considerable expense. Instead it was resolved that Cliffe Fort and Coalhouse would be strengthened while Shornemead would have minor modifications. English's initial proposals for Coalhouse, Cliffe and Garrison Point, Sheerness involved the rebuilding of the casemate faces with blocks of chilled cast iron (then the latest in hardened metal) and the reinforcing of their internal structure with iron linings. The shields would be increased in thickness to 35in (0.90m).

In *Report 62* dated 4 April 1887 (TNA: WO369/3) the committee further proposed that Cliffe would mount two 12.5- and four 11-inch while retaining two 9-inch guns in the open battery; additionally each of the Thames forts would mount three 6-pounder Quick-firing (QF) guns to cover the controlled minefields and the inshore passages against incursions by small torpedo boats. The committee also considered the Brennan torpedo but decided that it was not yet sufficiently developed to allow a conclusion about deployment to be reached. It further noted that the ditches of the forts should be filled with earth to provide an additional glacis to protect the ammunition stores in the basement. At Cliffe this work alone would cost £3000.

Report 102 of 1 April 1889 *Revision of Armaments: Thames and Medway* (TNA: WO396/4) noted the prohibitive cost of the chilled iron proposal and put forward a revised plan. The committee now recommended removing some of the existing

armament and converting the redundant casemates to traverses by filling them with concrete. The ammunition stores would be 'made secure' by filling the ditch to create an earth glacis capped by a concrete apron.

This proposal would reduce the armament of Cliffe Fort from:

2 x 12.5 inch RML in casemate

9 x 11 inch RML in casemate

2 x 9 inch RML in open battery

To:

2 x 12.5 inch RML in casemate

5 x 11 inch RML in casemate

2 x 9 inch RML in open battery

(TNA: WO396/4)

The mounting of the three quick-firing 6-pounders and three machine guns was also approved. The work proposed would remove the two 12.5-inch RMLs positioned in casemates 1 and 2 to casemates 3 and 5. The 11-inch RMLs would remain in casemates 7, 9, 10 and 11 with 1, 2, 4, 6 and 8 filled up as traverses. The two 9-inch RMLs in the open battery would remain (TNA: WO396/5).

New Glacis

The new glacis, which backfills the ditch at the foot of the face wall and rises to the level of the battery embrasures, is shown in section on the 1899 plan. The 1897 Ordnance Survey map (surveyed 1895; TNA: WO78/5134) shows the glacis with a gentle slope down to a shallow ditch at its foot, a blacker line at the foot of the slope may indicate the course of an unclimbable fence. The ditch follows the trace of the fort ending in line with the corners of the bastions (Fig 40).

Inspection of the heavily overgrown face of the fort shows that the earth glacis still has a shallow slope rising from the shallow ditch which runs parallel to the shoreline and the current flood defence bank. In the ditch bottom, towards the north-east end of the fort, is a short section of unclimbable fence of the same form as remaining sections at Coalhouse and Shornemead. The body of the slope is too overgrown to make any meaningful observations and at its top the current ground surface is level with the base of the embrasures. At Shornemead a concrete apron in this position is very apparent but a similar feature cannot be discerned at Cliffe due to heavy vegetation. Flanking each embrasure, and now beneath heavy undergrowth, are fragmentary sections of what could be shallow traverses although these are not as pronounced as the examples at Coalhouse which rise up to nearly cordon level to cover the former embrasures. The heavy undergrowth at Cliffe makes it very difficult to determine if the traverses here are attenuated or have been kept deliberately shallow to maintain the low shoreline profile of the fort.

Appended to the report of the Royal Artillery and Royal Engineers committee for September 1887 (TNA: WO396/3) is a report on the *Invisibility of Guns and Works*. This advocated 'judicious painting and planting' to break up the regular form of earthworks and to give a background to guns and embrasures. The most innovative suggestion was to paint sea forts in black and white chequers and this was carried out on the forts in Portsmouth harbour. It is unlikely that any elaborate planting schemes were implemented at Cliffe as the very low shoreline would cause anything rising above the fort to give away the position. However the 1897 Ordnance Survey 1:2500 map (TNA: WO78/5134) shows the symbol for shrubs and small trees at regular intervals along the top of the glacis and the symbol for a tree at four positions around the edges of the parade ground, although these may have been intended more for shade than camouflage. Examination of the few sections of face wall visible beneath the ivy show a thick layer of black bitumous paint applied over the light grey granite and this could be evidence of painting to tone down what would have been a light-coloured fort highly visible on the shoreline.

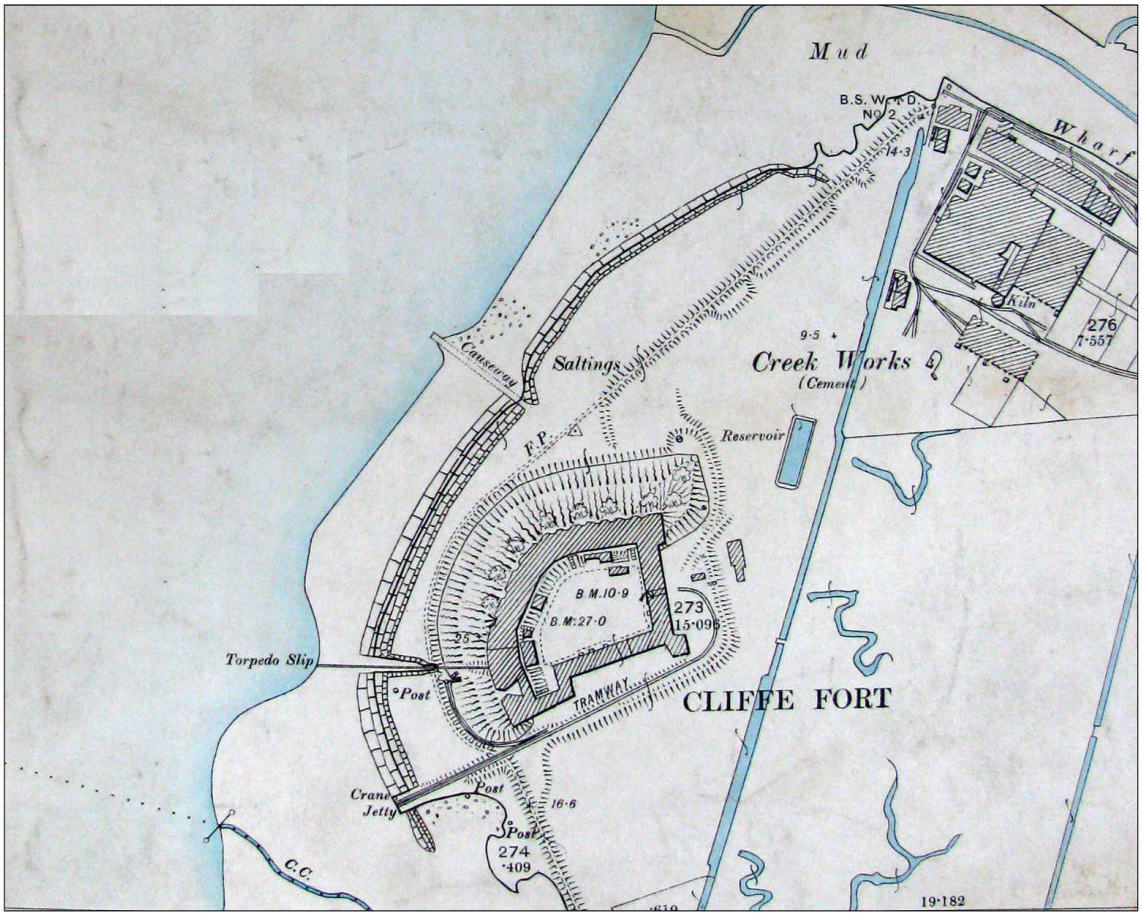

Figure 40: Cliffe Fort depicted on the Ordnance Survey 1:2500 military sheet Kent IV.13 surveyed 1895 and published 1897. Note the symbols for shrubs on the glacis and the slipway for the Brennan installation labelled 'torpedo slip'. (TNA: WO78/5434)

Installation of the traverses

Not all of the casemates specified in the 1889 report (1, 2, 4, 6 and 8; TNA: WO396/4) were converted to traverses. The 1899 plan of the gun floor (TNA: WO78/4963; App Fig 2) shows that casemates 1, 3, 5, 7 and 9 are filled with concrete. By providing a double traverse in casemates 1 and 2 the committee's scheme would have reinforced the most vulnerable point of the battery in its north-east corner. However, this scheme assumed that the blind casemate 9 was a gun position and if this had been the case then the filling of the designated casemates would have achieved a regularly-spaced battery. As casemate 9 is blind the intention to interpose traverses between each gun would have resulted in the removal of an additional 11-inch RML. The scheme that was implemented, filling casemates 1, 3, 5, 7 and 9, maintained the regular spacing with each gun flanked by traverses while retaining the desired number of RMLs (Fig 41).

As part of these changes the shields were removed from the redundant casemates and the consequences of this work are shown on the 1899 plan (TNA: WO78/4963; App Fig 2) with the resulting open embrasures backfilled with concrete. This arrangement is also shown on a section contained within the 1913 plan for proposed 6-inch breech loading emplacements (TNA: WO78/4963). As the face of Cliffe Fort is heavily overgrown it makes it very difficult to confirm the actual arrangement. Wilson notes that at Coalhouse semi-circular brick-built walls were constructed in front of the redundant casemate face walls to allow air to reach the ventilator grilles. The shield position was then covered over with 6in of concrete and the earth fill of the ditch banked up over the brick walls and former casemate fronts (Wilson 1963, 188).

Figure 41: View from Casemate 2 west into Casemate 3 where the gun position has been filled with a concrete traverse and an ammunition recess created. (DP097588)

Figure 42: The south-east corner of Casemate 1. To retain access to the loopholes in the bastion wall on the right-hand side of the picture this corner of the casemate was not filled with concrete when the rest of the position was converted to a traverse. The smooth concrete wall of the traverse is on the left-hand side (the brackets are later additions). (DP097610)

Each redundant gun position was filled with concrete but its associated living casemate was left open. Modifications to the bombproof roof were difficult to identify due to vegetation growth and deterioration of the surface and it is not clear whether the concrete was poured through specially created holes in the vault or barrowed in from the interior of the fort. Tip lines and shuttering marks are visible in the concrete exposed by removing the timber boxing from the ammunition lifts in casemates 2, 6 and 8. To compensate for the loss of floor space around each gun the opportunity was taken to provide recesses for ready-use ammunition. These are incorporated into the traverse in the flanks of each gun position with the surrounding walls rendered and whitewashed. In Casemate 8 the speaking tube has been relocated and now rises up against the position of the ammunition hoist cover.

In all the casemates the concrete fill ends in line with the masonry piers at the rear of each gun position where the removable timber partition would have been erected. In casemates 1 and 8 a timber beam incorporated into the base of the traverse may be the remains of this movable partition. In Casemate 1 the concrete has been carefully poured to create a small room labelled 'general store' on the 1899 plan (TNA: WO78/4963; App Fig 2), giving access to the loopholed wall formerly at its rear (Fig 42).

Within the living casemates the traverses form a smooth, flat, vertical wall of concrete to the north, extending from floor to vault with the shuttering marks from the concrete pouring occasionally visible. The floors of these casemates, whether originally paving or boards, have been taken up for the pouring of the traverses and replaced with a screeded, poured concrete floor. Space has been left between the casemate and traverse walls for intercommunicating doors between each gun position. Scars from frames and hinges (in Casemate 8 these are let into the pier quoins) show that ledged and braced doors were hung on pintle hinges beneath boarded transoms and opened into the gun positions.

Shield alterations

It is not clear if the casemate shields were increased in thickness as per the 1889 recommendations (TNA: WO396/4). The inner faces of all the remaining shields are composed of two large iron-plate cheek pieces with the space between them, and the inner face of the shield, filled with concrete. This certainly suggests a modification, particularly as concrete has been used. However there is no obvious disturbance in the vault, which the later insertion of additional iron work would have certainly caused, and the casemates at Shornemead, which was not on the list to receive thicker shields, exhibit the same features.

Alterations to Casemates 2 and 4

As discussed the work approved by the 1878 committee specified that the two 12.5inch RMLs from casemates 1 and 2 would be moved to casemates 3 and 5. The 1899 plan (TNA: WO78/4963; App Fig 2) shows that these weapons were eventually emplaced in casemates 2 and 4 flanked by traverses in 1, 3 and 5. Unfortunately casemates 2 and 4 have been subject to later modification and there is no evidence of racer rails, which would indicate these changes, left in their floors. Another indicator of the presence of the 12.5-inch RML should be the setting of the wrought-iron loops in the vault, which are still *in situ*, to the measurements unique to this calibre of gun (Moore 1996, 85). This is not the case; survey shows that the loops are set to dimensions that are very near to those for the 11-inch RML. The racer measurements are also unique to the calibre of gun and the 1899 plan shows that they were set to the 'correct' front pivot of 10ft 2in (3.09m) but to an 'incorrect' rear racer set at 18ft (5.48m) rather than 20ft (6.09m). These odd dimensions may demonstrate the problems of manoeuvring the 12.5-inch RMLs in a confined space and the reuse of racers from the previous 11-inch RML.

Possible further evidence for the installation of the larger 12.5-inch RML in Casemate 2 may be provided by alterations to the living half of this casemate. The

fireplace and its accompanying vent in the west wall have been demolished with the resulting arched opening in the casemate wall forming the entrance to a passageway into Casemate 3; the ceramic flue pipe for the former fireplace has been retained for ventilation opening in the side of the new opening behind a metal grille. A similar opening beneath an irregular arched head rising into the casemate vault has been made in the east wall, opening into Casemate 1. This has been subsequently blocked and the blocking rendered over. The purpose of creating a through-route that connected casemates 1, 2 and 3 may have been simply to bypass the larger 12.5-inch RML which now blocked the usual route through the gun position. Further evidence for the problem of fitting a larger gun into a casemate intended for a slightly smaller weapon may be provided by crudely shaped cut outs in the quoined jambs of each masonry and brick pier at the rear of the gun position in Casemate 2.

Alterations to Casemates 10 and 12

Evidence for the wholesale repositioning of the racer rails in casemates 10 and 12 suggests that the traverse of these guns was altered at some point. The provision of a cogged rail in Casemate 12 further suggests that a new or different carriage was provided for the RML in this position (Fig 43). A chart, dated to circa 1890 by the armament listed in the annotations, shows the range arcs for the RMLs after the reduction to five 11-inch RMLs and the installation of the 12-pounder battery on the roof (TNA: WO78/4963). It is noticeable that all of the RML arcs intersect on the centre of the deep water channel to the north-east of the fort. The arcs to the west of the fort are covered by the 12-pounders. As the crews of the 12-pounders were firing through auto-sights this separation may have prevented the splashes of the 12-pounder shot (vital for aiming in these circumstances) being confused with those of the 11-inch. It may be that the work on the racers in casemates 10 and 12 was to alter the bearing of these guns, which originally would have faced more to the east, to conform with this fire plan.

Figure 43: The cogged racer rail in Casemate 12 suggesting that alterations were made to the carriages in this casemate. (DP097629)

The floor of Casemate 10 shows evidence for two sets of racers. It can be assumed that the racer rails

embedded in granite sets date from the original construction of the fort and the mounting of the 11-inch RMLs. The inner racer of this phase is 11.5 cm wide and positioned 2.4m from the face of the gun shield. A cement-filled channel (presumably where a racer rail has been removed) in an arc of granite sets set at 4.04m from the shield face is witness to the position of the outer racer. Cracks in the concrete floor show where this racer would have extended into Casemate 9 before it was infilled. This set of racers was replaced with rails embedded in concrete. The 6.5cm wide wrought-iron inner racer of this set is closer to the shield, at 1.31m from the inner face. Its associated outer racer is set at 3.79m from the shield face in a channel, 30cm wide, which has been cut out of the concrete leaving a formed edge on one side.

The racer rails in Casemate 12 are somewhat more complex. Within the embrasure the inner racer is set at 1.20m from the shield face embedded in concrete in the stone floor. The tooled surface of this floor suggests that it has been cut back, probably to remove the original course of the racer rail. A second inner rail has been placed at 2.18m from the shield face set in the poured concrete floor but with its ends cut into the tooled stone slab. A cogged band intended to engage with the toothed wheels on the gun carriage is set at 4.05m from the shield face. This is also set in a broad band of concrete. A band of granite flags and patches of concrete set at approximately 5.0 m from the shield face indicates the former position of a racer rail and it appears that this was replaced by a racer set at 5.52m from the shield face. This consists of two separate sections of rail, the only example found in Cliffe Fort, joined at the apex of the curve and all set in concrete. At their rear is a band of granite sets with the gap between these and the rail filled with cast lead. The band of sets and the lead infill probably indicate the course of the original rail or the brass training arc.

Ammunition Supply Alterations

Despite the reduction in the total number of guns by the construction of the traverses it appears that all of the cartridge and shell stores were retained, the 1899 plan (TNA: WO78/4963; App Fig 1) identifying all the stores in the basement, other than the two ammunition stores [82, 83] in the north-east corner, as for either shell or cartridge. This plan also shows that, rather than sacrifice a shell or cartridge store, the ammunition stores [82, 83] were converted from sections of passage and a lamp store (see Chapter 6). Examination of the shell and cartridge stores shows that none have been blocked or converted to other purposes, even the stores intended to serve the Casemate 1 gun position which was filled with concrete and its lift blocked, were retained.

Study of the 1899 plan (TNA: WO78/4963; App Fig 1) shows the arrangement of the ammunition supply after the removal of four 11-inch RMLs and the conversion of some casemates to traverses. The guns are grouped. Group A comprises the two 12.5-inch RMLs in casemates 2 and 4 labelled as guns A1 and A2 respectively. Group B is the two 11-inch RMLs facing to the north-west in casemates 6 and 8, they are labelled B1 and B2. Group C are the three 11-inch RMLs in casemates 10, 12 and 14, labelled C1, C2 and C3 respectively. The single open emplacement for the 9-inch RML is not labelled on the gun floor plan but on the basement plan appended to the label 'No 17 Shell Store' is the alpha numeric 'D1' suggesting that the guns in the 9-inch battery were D1 and D2.

The alpha-numeric group numbering is appended to both the lifts and the shell and cartridge store label shown on the 1899 basement plan (TNA: WO78/4963; App Fig 1). Gun A1 is served by No 1 Cartridge Lift (A1) and No 2 Shell Lift (A1) which in turn are served by No 1 Shell Store (A1) and No 2 Cartridge Store (A1). Tabulation of these numbers shows that each gun is provided with a shell lift, a cartridge lift, one shell store and one cartridge store. This arrangement leaves a spare Shell Store (No 5) [92] and a spare cartridge store (No 7) [93]. In the basement there is fragmentary physical evidence for this scheme. On the shifting passage wall to the north of the entrance to No 17 Shell Store (D1) [58] is a 'D' painted in black.

Further painted numbers, not in the alpha numeric sequence, can be seen towards the south end of the basement. Just outside the doorway of No 12 Shell Store [100] is the store number in black paint and '13' is painted on the wall in black at the entrance to No 13 Cartridge Store [101]; the number 15 is painted on the wall to the west of the door in the passage between No 15 Cartridge Store [103] and No 14 Shell Store [102]. These numbers match the numbering scheme included on the 1899 plan (TNA: WO78/4963; App Fig 1), which follows the regulations from the Royal Engineers Department for the numbering of all stores sequentially from right to left (Moore 1996, 23). In the basement at Cliffe the stores are numbered in sequence from No 1 Shell Store in the north-east corner through to No 16 Shell Store. Interestingly, the shell and cartridge lifts are numbered in the same manner [1 to 14] in addition to the regulation labelling of the lifts with the number of the gun they served, for example A1, B1 (Moore 1996, 27). Lamp recesses are also numbered on the 1899 plan, the sequence running from right to left as per the regulations (Moore 1996, 27). Each recess had an oval number plate attached to the wall with copper nails, usually on the right hand side of the recess (Fig 44). The marks where these plates have been removed can be clearly seen at lamp recesses No 6, for No 3 Shell Store [89] and No 21 lighting the passage north of No 11 Cartridge Store [99] amongst others.

Figure 44: Lightbox to No 13 Cartridge Store showing the position of a copper number plate. (DP097434).

The 1899 plan (TNA: WO78/4963; App Fig 1) shows that shell lifts are provided with recesses while cartridge lifts have a shaft opening in the vault of the shifting passage. This arrangement reflects the different comparative weight of shells and cartridges and the need for mechanical assistance to winch the heavier shells up to the gun floor (see Chapter 6). The exceptions to this rule are No 1 and No 4 cartridge lifts which are provided with recesses and No 3 shell lift which has no recess. These lifts are allocated to the 12.5-inch RMLs A1 and

A2 and the cartridge lifts were presumably modified to allow for the greater weight of the double cartridge used in the 12.5-inch gun (Moore 1996, 58). In this respect it seems very unlikely that No 3 Shell Lift was without a winch recess, despite the depiction on the 1899 plan. In reality the weight of the 12.5-inch shell (850lb) (Wilkinson Latham 1987, 58) would have made a winch essential for its movement up to the gun floor.

Survey demonstrated that even the arrangement recorded on the 1899 plan (TNA: WO78/4963; App Fig 1) is no longer extant. Every lift, other than No 13 cartridge lift adjacent to No 15 Cartridge Store [102], and the two examples beneath the 9-inch RML open battery adjacent to No 17 Shell Store [58], now has a recess, presumably for a winch. It must be considered that, although not inconceivable as the RML was not declared obsolete until 1904 (Wilkinson Latham 1987, 55), it is unlikely that the 1899 plan is accurate in this respect, and the surviving lift arrangement actually dates from before 1899. The replacements for the RMLs used a different type of ammunition that required new storage arrangements. Modifications would not have been made to an ammunition supply system that was as obsolete as the guns, the RMLs, it served. In support of this, it should be noted that the majority of the RMLs, particularly the 11-inch examples, would be disused at Cliffe and Coalhouse after 1891 when the 10-inch and 6-inch breech loading (BL) battery was constructed at East Tilbury (Brown 2003, 2). A reasonable suggestion is that the work on the recesses was done during the 1889 modifications as installing winches would speed up the ammunition supply, so that the fewer number of guns could maintain the same rate of fire, and allow any lift to be used for either cartridge or shell.

Other than lifts 1, 2, 3 and 10, which have segmental arched heads to their recesses suggesting they are the original form of shell lift (see Chapter 6), all the others (numbers 4, 5, 6, 7, 8, 9, 11 and 12) have recesses 1.5m high with one jamb, usually the southern one, built from bull-nosed brick of a distinctive orange colour. All the recesses have substantial sandstone sills and lintels, and immediately above the lintel a single course of reset stretchers, often with slivers or a thick mortar course, shows that the lintels are inserted. It should be noted that No 4 cartridge lift, which could conceivably have been altered before the other lifts as a consequence of the relocation of the 12.5-inch RML A2, has the same jamb, lintel and sill as the others supporting the suggestion that the insertion of recesses was undertaken as a single campaign. The majority of recesses have iron studs set in the sill as evidence for removed winch machinery. Examples of the winch machinery were removed in the 1970s into Coalhouse Fort (V Smith pers com). In No 6 Shell Lift the rectangular recess is divided in two by a centrally-placed brick pier. The eastern recess has a cut out in the sill while the other has three iron mounting studs. In No 7 Cartridge Lift and No 8 Shell Lift a slight variation, possibly related to the type of machinery in use, is found where a horizontal channel is cut into the face of the central brick pier. In both the recesses for No 8 Shell Lift the remains of the winch mechanism can be seen.

That the stores in the basement remained in full use until 1889 is illustrated by the rebuilding of No 13 Cartridge Store [103] to provide a new lamp store. This must have been carried out in 1889/1891 when the basement was altered to accommodate the Brennan torpedo installation. The construction of the Brennan installation involved the blocking of the light passage adjacent to No 16 Shell Store [104]; this

severed the light passage from the lamp store in the south-west corner beneath the open battery at the same time as the lamp store in the north-east corner was rebuilt as part of the new store for QF ammunition [82]. It appears that to make good this deficiency and to use a section of light passage that otherwise ended in a dead end a new lamp store was built. This involved dismantling the end wall of No 13 Cartridge Store [103] leaving rendered patches in the vault where the wall was removed and the brickwork repaired. The current replacement wall was constructed further back to the west reducing the size of the cartridge store and incorporating magazine lights for both the store and its adjacent branch shifting passage. The resulting larger recess on the lighting passage side could have functioned as a lamp store. Later modification to the Brennan torpedo installation involved the demolition of No 16 Shell Store [104] and its associated lighting passages. This work has left the blocked entrance to these passages in the south wall of the lamp store.

Rangefinding

Until 1887, when Colonel Watkins perfected his optical Depression Range Finder (DRF), most RML batteries were aimed by a process that amounted to the gun crew sighting along the barrel of their gun. The DRF provided a scientific and centralised method of determining the range of an enemy ship for a battery or group of guns, based on optical sighting, triangulation and tables of known ranges. Soon after its introduction, Colonel Watkins introduced a further refinement; the long base Horizontal Position Finder based on the same principle but with greater accuracy in finding the horizontal distance to a target. At Fort Gilkicker, Gosport, two DRF positions were placed on the roof and used to determine the targets for each gun group of four guns. The Horizontal Position Finder consisted of a transmitting and receiving cell a known distance apart and the long base was achieved by placing the transmitting stations on the shore line in low profile earthworks situated up to quarter of a mile from the battery. The receiving cell at Gilkicker was mounted in a disused 11-inch RML position on the battery roof (www.fortgilckicker.co.uk accessed 25.01.2010).

At Cliffe Fort the 1899 plan (TNA: WO78/4963; App Fig 3) shows three positions for DRFs set at the rear of the roof in the parapet wall. Presumably two served the 12.5-inch gun group (A) and the 11-inch gun groups (B and C). The 9-inch guns, due to their intended role, may still have been sighted by eye. The plan also shows and clearly labels a receiving cell (for the Horizontal Position Finder) set in a large concrete blister above Casemate 2 at the north end of the roof. The location of the transmitting cells for the horizontal position finder may be marked by two earthwork platforms on the north and south flanks of the fort shown on the 1897 Ordnance Survey 1:2500 map (TNA: WO78/5134). Each platform is quarter of a mile (0.23km) from the fort and connected to it by a pathway running along the shoreline. Their depiction strongly suggests that they have a military function as both are inside the War Office boundary and are annotated with levels related to the fort datum, the only positions outside the trace of the fort to be provided with this information. It should also be noted that Coalhouse Fort was provided with a very large position finder blister on its roof (TNA: MPHH171/1) incorporating both the position finder and the battery commander's position. Presumably the transmitting and receiving stations at Coalhouse could triangulate with those at Cliffe. The roof plan

at Shornemead shows no indications for either arrangement (TNA: WO78/78/4369). An exact date for the decommissioning of the DRF system is not available. The receiving cell at Cliffe was certainly disused by 1901 as an order (Gravesend 611 of 5 January 1901) appended to the 1899 plan approves its conversion to an officer's shelter. The receiving cell is now subsumed beneath the 1913 6-inch gun position and the earthwork platforms beneath modern flood defences, though the DRF positions are still *in situ* on the roof (App Figs 3 and 8).

The three DRF positions are located at the inner edge of the roof of the casemated battery and were served by a metal walkway (labelled balcony on the 1899 plan) that ran below the parapet. Each position is different, with a semi-circular parapet to the northern position, above casemates 2 and 3 (Fig 45 and 54), a rectangular parapet to the central one above Casemate 7 and a V-shaped parapet to the southern one which is located above Casemate 15 adjacent to the end wall of the open battery. The 1899 plan shows that all incorporated the standard centrally-placed pillar for the mounting of the DRF telescope. The recesses are very neatly inserted into the parapet. The surrounding brickwork in the relevant section of parapet has been taken down and rebuilt to form the corners of each recess. The recesses were neatly capped with a moulded-stone parapet but this is now incorporated into the base of a shallow barbette which has been covered in asphalt and blended into the casemate roof. There is no visible evidence for the DRF pillars.

Figure 45: Exterior of Casemates 2 and 3 showing the semi-circular recess for the DRF position and the stanchions for its associated walkway set in the parapet wall above the casemates. The circa 1913 Battery Observation Post can be seen above. (DP 097568)

The metal walkway for the three DRF positions ran from the north-east corner of the roof, where it was accessed via a short flight of steps rising from the *chemin de ronde*, to the DRF recess above Casemate 15. It was supported on cast-iron **I**-section beams retained by L-shaped brackets set in slots cut into the brickwork of the parapet wall. In some cases this has been done very neatly, in others poorly with large amounts of mortar and half bricks used to fill the oversized holes. The **I** beams have differential flanges to allow decking to be laid down flush with the top rib of the beam. This decking was composed of sections of cast-iron grill, the remains of which can be seen above Casemate 7. The inner edge of the sections sat in a channel chased out of the brickwork. The **I** beams end in a shaped bracket secured with two bolts to take an end plate and presumably a handrail stanchion. Larger and more elaborate pierced brackets supported the walkway sections around the DRF positions, these sections corresponded with ladders depicted on the 1899 plan (TNA: WO78/4963; App Fig 3) descending from the balcony to the casemates. Presumably these provided quick communications between the DRF crews and the gun crews in the casemates below.

It appears that DRF positions were still in use at the time of the construction (circa 1890) of the rooftop quick-firing battery. The construction of this battery obscured the view from the central rectangular-shaped DRF position and it was replaced with one on top of the roof in line with the parapet of the QF battery. The new position has been subsumed in later additions to the roof but on the 1899 plan (TNA: WO78/4963; App Figs 3 and 8) it is shown as a rectangular-shaped recess set in a concrete apron with the Submarine Mining Officer's (SMO) position immediately to the north. Examination of the sequence of concrete pours in this area confirms that the SMO position and sections of the apron are later additions. A note to change the DRF into a BC (battery command) post, probably circa 1901 judging by the similarity of hand writing to another dated addition, is shown on the 1899 plan.

Later Rangefinding

The 1905 war plan (TNA: WO33/395) notes that Cliffe Fort was part of the Coalhouse Fort fire command and would receive orders via a dedicated telephone cable which was to be laid by the GPO across the Thames during the precautionary period (the months before the outbreak of hostilities). The telephone line would connect Coalhouse with Cliffe, Shornemead and New Tavern forts, along with Hope Battery. Cliffe was also in touch with the Port War Signal Station by telephonic apparatus and, in an emergency, telegrams could be sent from Cliffe Post Office.

The end of the RMLs

The last documentary reference to the 11-inch RMLs is in an Armament Return dated 1 December 1902 (Dobinson 2000, 243) and it can be assumed that they were removed soon after that date. The 1899 plan (TNA: WO78/4963; App Fig 2) suggests that the 11 and 9-inch RMLs may have been redundant, or in the process of being decommissioned, at the turn of the century. It shows the racers for the guns and labels all the gun positions but does not indicate if the guns are mounted. Annotations on the plan show that the rangefinders for the RMLs at Cliffe were

certainly not required by 1901 when the receiving cell was converted to an officer's shelter. One 9-inch RML was removed in 1889/1891 to make way for the Brennan torpedo (see Chapter 10) and the absence of the alpha-numeric identifier for the remaining 9-inch RML, D1 in this case, on the 1899 plan of the gun floor suggests that it was no longer included in the fort's fire control scheme at this date and so was probably disused or had been removed (App Fig 2). It is possible that the process of decommissioning the 11-inch RMLs at Cliffe began as early as 1891 when the RMLs at Coalhouse Fort, covering the Thames around to Hope Point, were superceded by East Tilbury Battery. This battery had two 10-inch guns and four 6-inch BL guns (Brown and Pattison 2003a, 6) and presumably these modern weapons could also cover the arcs of fire of the 11-inch RMLs at Cliffe.

The 1905 war plan (TNA: WO33/395) still listed the two 12.5-inch RMLs as mounted and ready for use. From comments in the Owen Committee report (TNA: CAB16/1) it is clear that these guns were retained as 'running past' guns, laid on a fixed bearing and charged with special case-shot shells that acted like a giant shotgun cartridge. Presumably the two guns at Cliffe would provide, along with three identical weapons at Coalhouse, a one-shot backup to the QF batteries and would be fired on the orders of the battery commander at Coalhouse, hopefully riddling the upper works of any attacking torpedo boat with shot. The Owen Committee reported that trials had proved the idea ineffective and ordered the removal of any remaining RMLs.

The Roof and the Quick-Firing batteries

The 1889 report on *Revision of Armaments -Thames and Medway* (TNA: WO396/4) approved the installation of three 6-pounder quick-firing guns to cover the minefield laid between Cliffe, Shornemead and Coalhouse forts against attempts by torpedo boats to work a passage around it in the shallow channels and then sneak up stream. It is assumed that the new guns were installed on the roof of Cliffe Fort but in 1895 three 3-pounders rather than three 6-pounders were reported as being mounted at the fort (TNA: WO 396/5), suggesting the actual revisions may have differed from those laid out in the 1889 report. The Wing Battery at East Tilbury is the only one that survives and was built between June 1889 and July 1893 as a detached quick-firing battery for Coalhouse Fort. It was later extended from two guns to four and then reused as searchlight emplacements (Brown and Pattison 2003a, 8).

The record plan of 1893 (TNA: WO78/5132) shows that the battery at East Tilbury had two gun emplacements with a very distinctive apsidal shape, set out on a linear plan and widely spaced. Only one emplacement - emplacement 2 at the south-western end of the battery - survives in original (circa 1889) condition. It is built in concrete with a raised gun floor terminating in a low barbette with canted sides, all set in a low earth mound. The gun holdfast is a distinctive 'D' shape with ten bolts. A broad flight of steps at the rear of the gun floor leads down to a concrete floor behind the emplacements which is protected on the flank by a 1.80m (6ft) high rendered wall. Each emplacement has two ready-use lockers, one in each flanking wall. The ready-use lockers are nearly identical with simple openings and 1.05m (3ft 5in) wide by 0.90m (3ft) deep by 1.26m (4ft 2in) high, with rebates for frames but no evidence

for doors. Of note is the small recess between each pair of emplacements, 0.44m (1ft 5in) wide by 0.24m (9in) deep by 0.23m (9in) high. It is rendered internally but otherwise featureless. These may have held fuses for the guns (Brown and Pattison 2003a, 10-14).

Fragmentary evidence for an early rooftop battery possibly survives at Cliffe (App Fig 8). Two of the three gun positions were probably subsumed in the later 12-pounder QF positions at the south end of the roof above casemates 14 and 15. The third gun position may have been at the north end of the roof above Casemate 6, incorporated in the south flank wall of a later 12-pounder position. Projecting from this wall is a flat concrete slab with a single broad step down on to the roof which does not appear to be related to the 12-pounder battery and in form resembles the set of shallow steps found at the rear of the 6-pounder positions in the East Tilbury battery (Fig 46).

Figure 46: Shallow steps protruding from one of the flank walls of the 12-pounder battery which may represent the remains of an earlier rooftop battery
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It is possible that rebuilding for the later 12-pounders above casemates 14 and 15 involved the replacement of the original barbettes by the larger 12-pounder version, but retained the earlier flanking walls. Possible evidence can be seen at the junction

of these barbettes and their flanking walls with a pronounced vertical joint and colour difference between the two areas; this is particularly apparent on the north side of the most southerly position. The flanking walls exhibit ready-use locker arrangements with the same characteristics noted at the East Tilbury Wing Battery, such as rebates for frames but no evidence for hinges. At the foot of the covered way between the 12-pounder positions is a smaller locker similar in size (0.34m by 0.20m) to the fuse locker described at the East Tilbury battery. A similar sized locker can be seen on the south side of the stepped concrete slab above Casemate 6.

Further evidence for the construction of these gun positions may survive below them in Casemate 15. The construction of brick walls on the north and south sides of this casemate running from the face wall to the masonry piers may have been carried out to reinforce the vault and roof above for the mounting of guns. The western half of the casemate has a brick-built segmental vault running north-south with the blind west (face) wall constructed of large well-tooled sandstone blocks rising to the springing point. As built this was an extension of the casemated gun battery divided from the adjoining RML gun position in casemate 14 by a removable timber wall which could be removed to increase the working area around the RML in times of war. The 1899 plan (TNA: WO78/4963; App Fig 2) shows the timber partition wall replaced by the current brick wall, its acute angle providing clearance around No 14 Shell Lift on the south side of the gun position in casemate 14. This wall is still *in situ* and extends into the crown of the vault; it is built in English bond of a hard red brick and witness marks at its foot show that a suspended timber floor was in place when it was constructed. This feature is similar to those found at the foot of the concrete traverses in the casemated gun positions and suggests that they and this wall are contemporary. The southern wall uses the same redder brick as the north wall and rises into the crown of the vault beneath the gun positions on the roof. Subsequently this wall was further modified for the installation of the rising observation tower for the Brennan installation (see Chapter 9).

12-pounder Battery

The chronological window for the installation of the 12-pounder battery is narrow. In 1895 Cliffe Fort (TNA: WO396/5) listed three 3-pounder QF guns but on the 1899 plan (TNA: WO78/4963; App Fig 3) barbette emplacements for four 12-pounder QF in two pairs (called A and B groups in the 1905 list) are shown on the roof (TNA: WO33/395). At Cliffe the northern pair (A) were built above the gun positions in casemates 6 and 8 and the concrete-filled casemates 5 and 7 may have acted like the possible reinforcing walls found in casemate 15. The southern pair (B) may have reused the site of two earlier gun positions described above. What appear to be arcs of fire noted in pencil on the plan show that the northern group was restricted to bearings to the north-east while the southern group had a much wider all round arc.

The 12-pounders were emplaced to deal with the increasing size of torpedo boats, something started, ironically, by the Royal Navy at the end of the 19th century. The torpedo boats of the 1880s were 200 tons but by the end of the century they had grown in size to 500 tons and would continue this trend into the 20th century (Brown 1997, 116). The early marks of the 12-pounder were the smallest calibre to use separate shell and cartridges, an arrangement know as a separate loading

QF (Hogg and Thurston 1972, 54) The ammunition ready-use arrangements were accordingly different with separate lockers required for shells and cartridges compared to the single lockers for the combined round used in the 6-pounders.

The emplacements at Cliffe are standard for 12-pounder QF guns, consisting of polygonal gun platforms set behind a low concrete barbette encompassed in a sloping concrete apron. In the case of the Cliffe batteries, an enlarged section in the 1913 plan (TNA: WO78/4963) for emplacing two 6-inch guns over the A group of 12-pounders shows the apron in section, keyed into the brickwork of the casemate roof and gradually sloping to finish at the granite cordon. Contiguous with the barbette was a covered way connecting the two gun positions and protected by a parapet.

As built the holdfast consisted of a circular metal plate, fixed into the concrete platform with six large hexagonal securing bolts towards the outer edge set for a radius of 0.48m (1ft 7in). Within the ring of bolts is a circle of raised flanges and within them nine pairs of holes. The plate was placed centrally in the polygonal gun floor and was the standard pattern of holdfast for the small calibres of QF guns (Lowry 1995, 94). This arrangement is shown on the 1899 plan (TNA: WO78/4963; App Fig 3) but only No 1 position (to the north) in the B group survives in its original form (Fig 47; App Fig 8). The other two surviving emplacements exhibit an array of adaptor plates and additional bolts that relate to later mountings. In common with all examples of this type of emplacement, all have the metal fittings for a removable protective rail around the rear face.

Figure 47: View of the north end of the fort roof from the 12-pounder B group, with a holdfast for this weapon in the foreground. The hut in the centre of the photograph dates from the Second World War; beyond it are the 6-inch gun positions and the associated BOP tower. (DP097739)

The south pair of emplacements (B group) survives largely as built (Fig 48). A flight of concrete steps at the side of each gun floor leads down to ammunition handling areas on the roof of the casemates. Ammunition was relayed to the guns from three ready-use lockers all of similar dimensions (0.90m wide by 0.90m high) located under the gun floors. Reflecting the separate loading of ammunition for the 12-pounder QF guns there are different lockers for shells and cartridge. The shell lockers (the central and northern-most lockers) have a rebate for a frame but no hinges, while the southern locker has a metal frame and hinges for doors to protect the cartridges. A recess above the central locker indicates the position of a bulkhead light and a line of mortar indicates the position of the conduit for the electrical wiring. In this group the presumed remnants of the 3 or 6-pounder gun battery have provided each gun position with an additional ready use locker in the flanking walls, as well as the former fuse locker beneath the covered walkway.

The second pair of gun emplacements (A group) is shown to the north on the 1899 plan (TNA: WO78/4963; App Fig 3). Of these two emplacements, the one to the south has been substantially modified at a later date (see below) but the emplacement to the north survives. As with the B group this also has three ready-use lockers beneath the polygonal gun platform. All three lockers are roughly the same dimensions as the southern pair but with the central locker as a shell store and flanked by the cartridge stores. A scar above this central locker may mark the position of a bulkhead light. As with the B group, the ready use lockers are presumed to be from the earlier 3 or 6-pounder positions, but are now at the base of a covered walkway on the south flank. Any additional ready use lockers for the southern gun position in A group are incorporated into a rebuilding associated with the installation of the 6-inch gun positions in 1913 (see below).

Figure 48: The most southerly of the surviving 12-pounder gun emplacements with ammunition lockers, steps to the gun floor and metal brackets for the guard rail visible at the rear of the emplacement. © Historic England

QF Ammunition storage and supply

It is impossible given the current dearth of sources and only the slight technical differences between 6 and 12-pounder QF ammunition to distinguish the arrangements at Cliffe intended for 6-pounder ammunition storage (if these guns were indeed mounted) from those for the later 12-pounder. However, given the special storage arrangements required for QF ammunition, it is reasonable to assume that new ammunition stores would have been provided as soon as QF guns were mounted at Cliffe, regardless of their size.

QF ammunition is very different to RML ammunition and consists of a brass case which contained the explosive propellant with the shell inserted in the top either during the manufacturing process or by the gun crew. Due to this combination QF ammunition was under no circumstances to be stored with any other type of ammunition or explosives except the structurally similar small arms (SA) ammunition (Evans 2006, 106). The 1899 plan (TNA: WO78/4963; App Fig 1) of Cliffe shows this complete segregation with the QF and SA stores isolated in the north-eastern corner of the basement. This was achieved by blocking the shifting passage at its north-east corner; the blocking is a brick wall keyed into the recess for the shell lift to the former No 1 casemate (now a traverse) and incorporates air bricks of a late 19th-century pattern. Within the newly segregated north-east corner of the basement a lamp room, and the north end of the light passage, were rebuilt into an enlarged QF ammunition store with an entrance into the former shifting passage. The now redundant section of shifting passage in the north-east corner was reused as the SA store, presumably for machine gun ammunition and the personal weapons of the gun crews.

To compensate for the loss of the north-east shifting passage and its lobby, replacements [88] were built immediately to the south. They were constructed by knocking down the end wall of the branch shifting passage adjacent to No 2 Cartridge Store [86] to make a route between the lighting passage and the main shifting passage. At this end of the passage evidence for shifting arrangements in the form of marks showing the position of a bench and clothes hooks are visible. At the lighting passage end disturbed and patched brickwork in the vault and straight joints in the west wall mark the course of the end wall and the blocking of the original doorway into the cartridge store. The former branch passage now opens into a junction in the adjoining lighting passage. This entrance retains the mountings for a timber control barrier including the copper hook to retain the barrier in an open position. The junction, which includes doorframes inserted along with their brick jambs into the north and south sides of the lighting passage, is beneath a large, flat masonry lintel inserted in the passage vault. From here the vaulted entrance tunnel was driven through the south wall of the lighting passage and beneath the rampart. The entrance from the parade ground was created by using the existing flight of steps to the casemates as its eastern traverse. The earth rampart was removed from the west side of these steps, which has left a section of Portland cement waterproofing exposed, and a new brick-built traverse wall was constructed to form the west side of the entrance and retain the remaining section of earth rampart.

There are a number of later modifications to this area. This work, along with the blocking of the south end of the lighting passage adjacent to No 2 Cartridge Store

[86], is not shown on the 1899 plan nor on a block plan appended to alterations to the former Brennan torpedo area dated 1916 (TNA: WO78/4396). To create direct access to all the passage doorways [QF store, lighting passage and shifting passage] from the parade ground the original flight of steps, traverse and the associated sections of wall were demolished leaving only a stub of the step riser wall projecting 3.95m; this was retained as it forms the west jamb of the QF ammunition store doorway. The steps were replaced by a new flight constructed over the west traverse wall of the new shifting passage entrance leaving the earlier coping visible below the flight of brick-built steps.

No evidence for any contemporary mechanical methods for the movement of QF ammunition to the roof such as chain or table lifts is visible. It appears that the movement of ammunition from the stores to the roof for the 3 or 6-pounder battery was accomplished by manpower alone. For the 12-pounder gun battery four davits, each one aligned with a 12-pounder, were provided and their sockets remain set into the base of the inner parapet walls. A single complete example survives at the north-east end of the fort in the corner of the north-east bastion. This example, which is not shown on the 1899 plan (TNA: WO78/4963; App Fig 3), must have been intended to winch up supplies from outside the fort directly to the roof.

QF Gun Shed [67]

This building is labelled on the 1899 plan (TNA: WO78/4963; App Fig 1) and is located to the west of the parade ground immediately below casemates 11 and 12. Only the concrete base and the 0.26m (9in) thick brick rear and south walls of this structure survive. The rear wall incorporates substantial cast iron shelf brackets set 2m off the floor and spaced at 0.90m. The plan shows that the gap between the rear wall and the wall of the lighting passage was filled with concrete to form a traverse. On the section included with the 1899 plan the roof is depicted as of Fox and Barratt construction with an asphalt covering. The building had an open front divided into three bays by stanchions or posts (Fig 49). The depiction of these posts includes what appear to be kerbs, bumpers or deflectors usually associated with protecting the corners of buildings or vital structural elements from damage from horse-drawn wagons or drays or, in this case, limbers, gun carriages or wagons. It was intended to store the barrels of the QF guns from the exposed rooftop batteries to keep them free

Figure 49: The parade ground dated circa 1915 by the equipment of the men on parade. Behind and to the right are the QF Gun Shed and the Stores RA and RE. To the left of the picture an open door, the entrance to the Brennan Torpedo installation, disused at this time, can be seen. Courtesy of Victor Smith

from corrosion during periods of stand down. Similar sheds were provided at Beacon Hill, Harwich, and Landguard Fort, Felixstowe (Brown and Pattison 1997, 200; Brown *et al* 2004, 89).

Stores RA and RE [68] and Battery and Small Store [69]

These small buildings set into the rampart to the north of the QF shed are brick with 0.26m. Fragments of the walls of the Battery and Small Store [69] remain as traverse walls to retain the earth rampart. The concrete floor slab and the north wall of the Royal Artillery and Royal Engineers stores [68] remain. Both buildings retain substantial cast iron shelf brackets set in these walls. The 1899 plan (TNA: WO78/4963; App Fig 1) shows that both buildings were set back into the rampart with a concrete retaining wall at their rear. Both had corrugated iron roofs and a section through the Battery and Small Store [69] shows that these were supported on lightweight timber trusses. The 1899 plan shows that the Stores RA and RE [68] was divided into unequal sections by a brick partition wall, the scar of which is still visible. On the 1899 plan the smaller section is labelled 'RA Oil Store' and this usually refers to a store for gun lubricating oil (Brown and Pattison 1997, 200). The rest of the building is labelled for RE stores; the RE detachments at Cliffe manned the searchlights, the Brennan Torpedo installation and, in the event of war, would secure the Cliffe end of the Thames telephone cable (TNA: WO33/395). The Battery and Small Store [69] held supplies for the QF battery such as gun spares, covers and polishing rags (Brown and Pattison 1997, 200).

The rather inconvenient distribution of the ammunition and general stores for the QF battery on the roof may suggest that the RML batteries were still in commission when the quick-firing guns were installed. If the casemates were still in use as gun positions then they could not be reused as stores for the QF battery. Similarly, the living casemates behind the gun positions had to be retained for the gun crews of the RMLs. Instead, the facilities for QF ammunition storage, gun crews and gun stores had to be fitted into the relatively small fort in some other way. This may also explain the primitive ammunition handling arrangements as new mechanical lifts could not be driven through the casemates. Some confirmation for this theory is provided by the northern brick reinforcing wall in Casemate 15. As previously discussed this was possibly constructed to support the probable 3 or 6-pounder battery on the roof and appears to have been set at an angle to leave space around No 14 Shell Lift, seemingly still required to serve the 11-inch RML in No 14 gun position.

Commander's Position

QF batteries were usually provided with a commander's position set on the walkway between two gun positions. There is no evidence for the construction of such a position at Cliffe. Instead, on the 1899 plan (TNA: WO78/4963; App Fig 3) is an annotation that the former rooftop DRF recess (see above) was converted to a battery commander's position under Gravesend order 561 which would be circa 1900. The 1905 war plan notes that as the guns in the 12-pounder gun battery at Cliffe were fitted with auto-sights, and so did not require provision for a rangefinder, once ordered to open fire they could then be aimed and fired by their crews independently of the battery command at Coalhouse Fort (TNA: WO33/395).

Crew Shelters

The 1899 roof plan (TNA: WO78/4963; App Fig 3) includes annotations in red ink for the position of two gun crew shelters, neither of which survive. The shelter for the A group guns is to the north of the gun position built over the flank wall. The shelter for the B group is also on its north side between the northern emplacement and the DRF/gun commander's position. A section of the A group shelter is included in the enlarged sections on the 1913 drawing (TNA: WO78/4963) for the proposed 6-inch gun emplacements. This shows that a section of the flank wall was cut down to accommodate the shelter. The shelter itself was essentially a flat-roofed timber box with a window in its west wall. The outline of the B shelter has the same dimensions as the A shelter and it is reasonable to assume that they were identical.

Rooftop Barbette Battery of 1913

The 1906 Owen Committee report on the armament of the home ports (TNA: CAB 16/1) designated the Thames as liable only to C class attack, the lowest grade with the chances of its occurrence practically non-existent. The committee further noted that the 6- and 12-pounder QF guns were ineffective against modern warships and should all be removed. On the lower Thames four 6-inch BL guns recently installed on the roof of Coalhouse Fort would provide the only defence. All other weapons and searchlights including the Brennan torpedo at Cliffe would be stood down and removed.

This decision was revisited in the 1909 war plan which considered that defences against a warship, disguised as a merchant vessel, attempting to sneak up the Thames and attack ships at anchor in the upper reaches of the river, should be put in place. The defence measure adopted would be to establish an Examination Ground, covered by 6-inch guns, to stop and search all shipping proceeding up the Thames (Dobinson 2000, 147). It is conceivable that the proposal to rearm Cliffe fort with two 6-inch BL guns as shown on a drawing dated May 1913 titled 'Cliffe Fort: Proposed Emplacements for 2 6 " BL Guns on Top of Fort' (Fig 50) was the practical result of the recommendations in the war plan.

The plans for the emplacements are dated May 1913 but it is not clear when the work was completed. On the outbreak of war in August 1914 the Examination Ground, recommended by the 1909 report, was established in the Thames upstream of Hope Point, practically midway between Cliffe and Coalhouse Forts, with Coalhouse as the designated examination battery; the limits of the Examination Ground appears as a chained line in red ink on the BC (battery command) fire plan chart included with the *Fort Record Book 1911-1943* for Coalhouse Fort (TNA: WO192/48). The fort record book and the 1909 mobilisation plan make it clear that Cliffe was a sub-battery of Coalhouse and presumably the intention was to cover the Examination Ground in a cross fire between the two forts.

The plans and sections in the 1913 plan (TNA: WO78/4963) show that the emplacements proposed (and eventually constructed) at Cliffe are nearly identical to contemporary emplacements for the 6-inch BL gun marks 1 – VII such as the Coalhouse Fort rooftop battery or Landguard Fort Right Battery of 1901 (Brown et al 2004, 54). The Armament Return for 1914 (TNA: WO33/636) does not list

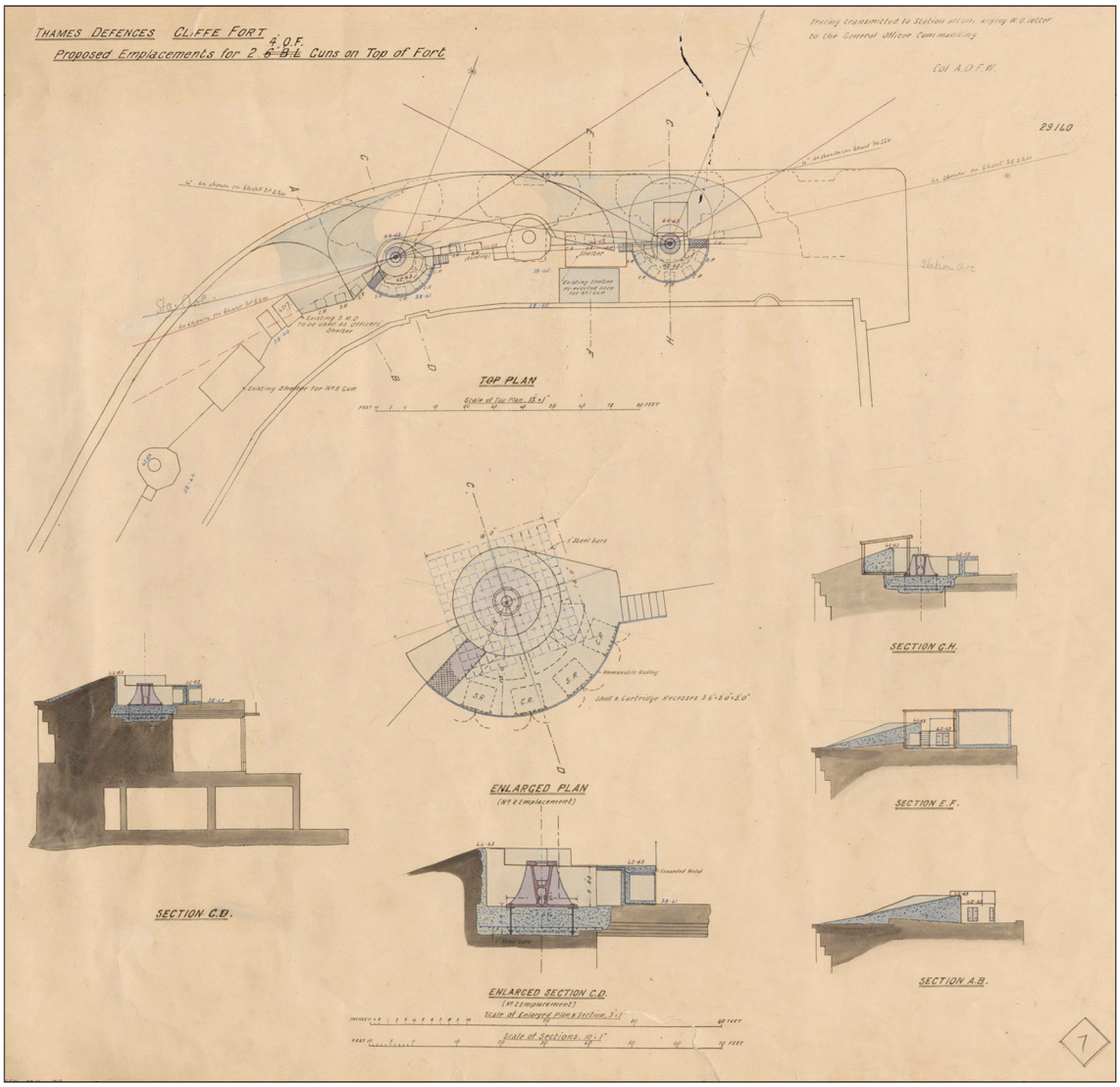

Figure 50: Plan for the proposed emplacements for two 6-inch BL (struck out and replaced with two 4-inch QF) guns on the roof of Cliffe Fort dated 9 May 1913. (TNA: WO78/4963)

any armament for Cliffe. However the *Fort Record Book* for Coalhouse describes in some detail the transfer of two 6-inch BL by barge to Cliffe in September 1914 (TNA: WO192/48). The armament return for 1918 (TNA: WO33/874) lists two 6-inch Mk VII BL guns as allocated to Cliffe with a corresponding drop in the Coalhouse allocation from four in 1914 to two in 1918.

The 1913 plan (TNA: WO78/4963) for the construction of the 6-inch barbette positions has several annotations related to the installation of the 4-inch guns, not least of which is the striking out of '6" B.L.' in favour of '4" Q.F.' in the plan's title. It also notes the changes in ranges and arcs of fire but includes no annotation regarding modification to the barbettes or the mountings as the 4-inch Mk V gun was a naval weapon and the coast defence examples were transferred from naval stocks (Hogg and Thurston 1972, 89). It is not clear when these guns were withdrawn, although the Armament Return for 12 November 1927 lists two 6-inch guns as allocated to

Cliffe (Dobinson 2000, 242) suggesting that these weapons, withdrawn in 1918, were returned so displacing the 4-inch guns.

The 1919 armament return (TNA: WO33/942) lists the two 6-inch at Cliffe as 'temporarily withdrawn for special purposes'; it also lists two 4-inch Mark V on Mark III QF carriages, presumably as replacements for the two withdrawn 6-inch guns. Two further primary documents have annotations indicating that these 4-inch guns were mounted at Cliffe. A copy of the 1897 Ordnance Survey map with annotations dated November 1918 (TNA: WO78/5134) labels the battery at Cliffe as two 4-inch QF along with their searchlight mountings. This comprehensively annotated plan shows only the two 1913 barbette mountings with no indication of any other mountings, supporting the suggestion that the 4-inch guns were direct replacements for the removed 6-inch. The BC (battery command) fire plan included in the Coalhouse Fort record book, dated 1918 by the latest annotation on the plan, shows fire arcs for two 4-inch Mark V guns mounted at Cliffe along with the arcs for the two 6-inch guns at Coalhouse (TNA: WO192/48).

There has been speculation that the two 4-inch guns were allocated to Cliffe as anti-aircraft (AA) weapons. This may be derived from Hogg and Thurston's (1972, 89) statement that during the later years of the First World War 24 Mark V 4-inch guns (a weapon produced in great numbers for mounting on warships) were converted to land-based anti-aircraft guns in single mountings. However the aggregated returns for anti-aircraft guns for June 1918 do not list any 4-inch weapons in the Thames district – it only lists two 4-inch guns in the whole of the UK (Hogg 1974, Appx 12). The 1918 plan of the AA gun allocations for the south of England (TNA: MR1/1907) shows no AA gun of any type mounted at Cliffe Fort but a 3-pounder gun in a single mount with an accompanying searchlight mounted at Cliffe village.

6-inch barbette positions

The 6-inch barbette gun positions at Cliffe Fort are nearly identical to other contemporary 6-inch positions such as No 1 gun position in the right battery at Landguard Fort, Felixstowe (Brown et al 2004, 98) built in 1898 and modified in 1913. The two pedestal mountings and their barbettes were constructed at the north-eastern end of the roof (App Fig 9). Gun position 1 was constructed on the site of the former receiving cell which by this time had been converted into an officer's shelter. Gun position 2 replaced the western gun position of the 12-pounder battery A group leaving a single disused 12-pounder gun position between the two barbettes. The 1913 (Fig 50) drawing for this work includes three enlarged sections showing that both positions are located over a concrete traverse in the former casemates and anchored into this concrete by removing the brickwork vault and putting down a grid of 1in steel bars and then 2ft (0.85m) of concrete. This steel grid also locates the retaining nuts for the long securing bolts running down from the pedestal holdfast.

The concrete gun emplacements essentially comprise a circular gun pit 4m in diameter surrounded by a gun floor, with a low barbette and sloping semi-circular apron to the front and a flat working area at the same level as the gun pit floor to the rear (Fig 51). The barbette rises 1.38m above the gun floor to the lip of the apron

which protected the front of the emplacement. The apron slopes down to meet the cut back slope of the earlier glacis retained from the receiving cell and the 12-pounder battery respectively. On the flanks of each gun pit the barbette is continuous with wing walls each 1.38m in height which provide protection to the working floor. The gun floor forms a level platform 1.19m (3ft 9in) above the base of the gun pit. The gun floors are connected to the working areas by a flight of steps on their south and north sides respectively. At the rear of the floor six pairs of steel brackets bolted to the vertical face indicate the position of removable stanchions for the protective handrails.

Access from the working floor to the interior of the pit is via a narrow passage through the gun platform. This was originally capped by a steel chequer plate,

Figure 51: The western barbette of the 6-inch gun emplacements, the large concrete block (for mounting a Second World War 6-pounder gun) cast in the original gun pit can be seen in the centre of the photograph. (DP097671)

shown on the 1913 plan, for which the rebate is visible. In the centre of the pit was the holdfast for attaching the gun and its mounting. Evidence for the holdfast has now been obscured by a concrete block and undergrowth in gun position 1 but it is just visible in gun position 2 beneath the later concrete block. The holdfast consists of a ring of eight quarter-inch (41mm) mounting studs set in the base of the pit. The holdfast size and design varied between mountings and any evidence for them has been removed at a later date. The 1913 plan (Fig 50) shows no detail of the holdfasts but does indicate two concentric rings – the 16 holdfast bolts for the 6-inch gun were placed in concentric rings – in the base of each emplacement.

Beneath the gun platforms, set in both the pit face and the working floor face, are

recesses for the storage of cartridges and shells. Gun position 1 has five lockers in the outward/working floor face and four in the pit face. The external lockers measure 0.9m high, 0.9m deep and 1.07m wide and all have rebates for a metal frame and a pair of pintle hinges at each side for mounting doors. This is usually evidence for cartridge storage but the 1913 plan (Fig 50) clearly labels two of the recesses for shell storage. The design of 6-inch positions at Landguard (which is thought to conform to the generic plan for these positions) was provided with a large number of cartridge recesses and a single shell recess in the wing wall (Brown et al 2004, 48). This recess is present in the wing wall to the east of gun position 1 but is equipped as a cartridge recess and labelled on the plan as such. As is conventional for these positions, a row of large bolts above the lockers indicates the position of a galvanised hood for suspending a waterproof curtain over the ready-use lockers (Fig 52). The hood is indicated on the section in the 1913 drawing with the notation 'expanded metal'. The remains of two bulkhead light fittings can be seen above the lockers along with a junction box and the course of a connecting metal conduit indicated by a pronounced mortar line.

Figure 52: Ammunition lockers associated with the western 6-inch gun position. Hinges for doors on the two flanking cartridge lockers are visible as well as bolts that carried a rain hood above all three lockers. (DP097746)

The four recesses located in the south (rear) face of the pit are 0.77m deep with internal splays, the locker on the east side of the pit has been divided in half with an inserted vertical partition. In a conventional 6-inch gun position they would be ready-use cartridge lockers supplied from a band lift with an opening at pit floor level

adjacent to the mouth of the passage (Brown et al 2004, 48). With no lift in place and as none of the lockers have evidence for doors they are presumably shell lockers. In both positions there is no evidence for a lift and no indication of their presence on the 1913 plan. There is no obvious explanation as to why lifts, a standard feature of the barbette mounting for the 6-inch BL gun, were not installed at Cliffe Fort. A large steel socket measuring 0.07m in diameter and projecting 0.17m and 0.29m from the internal face is set at each side of the pit. These are not shown on the 1913 plan or on the plans of any contemporary 6-inch positions but have been identified as stops to limit the traverse of the gun for safety (V Smith pers comm).

Gun position 2 is constructed over the position of the No 2 (A Group) 12-pounder and is nearly identical to gun position 1, except for the orientation of the passage, steps and traverse stops. It has one less cartridge locker than gun position 1, probably to accommodate the angle at which the barbette meets the flank wall of the 12-pounder B Group. Above the ready-use lockers, on the working floor face are two recesses retaining the remains of range indicator dials. These are not present at gun position 1.

The 1913 plan (Fig 50) shows that a number of pre-existing shell recesses and cartridge lockers from the possible 6-pounder and the 12-pounder gun batteries were reused. The former 6-pounder ready-use lockers are at the base of what is now a covered way connecting the north flank wall of the No 2 6-inch gun position to the redundant No 1 (A Group) 12-pounder position. One 0.81m deep, 0.71m high and 1.84m long, appears to be unmodified and is described on the 1913 plan as 'S.R. [shell recess] existing'. The second recess has been modified from a locker of similar dimensions to what is shown on the 1913 plan as 'C.R.' (cartridge recess). This work has been accomplished by building a new concrete front including a steel frame and hinges onto the ready-use recess, creating a cartridge locker 0.93m deep, 0.94m high and 1.07m wide. Above this locker is a small rectangular recess 0.46m long, 0.23m high and 0.24m deep of unknown function.

The 1913 plan (Fig 50) shows that both gun positions were intended to reuse locker positions provided for the 12-pounder gun positions in the flanking walls on their west sides. Given the man-powered ammunition supply these lockers may not have held a sufficient reserve and have been replaced by the current blocks of larger lockers, both constructed in the positions indicated as gun shelters on the 1913 plan. The blocks are brick-built and weatherproofed with cement render, all measure 0.9m high and 0.96 deep but with a central wider locker at 1.28m as opposed to 1.06m in the lockers at either side. The roofs of the lockers are barrel vaulted and the flanking ones are equipped for cartridges with frames and pintle hinges for pairs of doors; a row of four square-headed bolts marks the position of the galvanised rain hood running across the heads of all three lockers. The construction of the lockers for No 2 gun appears to have entailed significant remodelling of the area with the 12-pounder gun flanking wall, ammunition recess and the former gun commander and Submarine Mining Officers position mostly demolished to be replaced by a new flanking wall following a straighter course which forms the rear wall of the new lockers.

Modifications for mounting 4-inch guns

As the 4-inch gun also used on a pedestal mounting the existing 6-inch gun emplacement would not have required extensive modification to take 4-inch guns other than a new holdfast. This compatibility may have been one of the reasons for deploying these 4-inch weapons as replacements for the withdrawn 6-inch guns. It is unsurprising that this change in armament has left no physical evidence.

Battery Observation Post and Electric Light Director

Along with similar 6-inch batteries both home and abroad, and notably its counterpart at Coalhouse, a new Battery Observation Post (BOP) and an attached Electric Light Director (ELD) to control the fort's searchlights were constructed at Cliffe. Other examples of these installations date from 1914 (Landguard; Brown et al 2004, 48) and 1913 (Heugh, Hartlepool; TNA: WO78/4218); an undated but very similar structure can be seen at Coalhouse. These changes seem to reflect a general upgrading of the fire control of close defence batteries in the increasing international tension immediately before the outbreak of the First World War. The development of the fort's searchlight emplacements is discussed in Chapter 11.

The combined BOP/ELD position co-located the battery's gun and searchlight commanders. Internally, this was reflected in the division of the position, usually by a partition wall, into BOP and ELD halves. The BOP position could be distinguished by a concrete pillar, for mounting the depression range finder, which was set behind observation slits that usually occupied the majority of the front wall of the position. The ELD usually had its own entrance and an observation slit but no distinctive internal fittings (Brown *et al* 2004, 48).

The combined BOP and ELD at Cliffe is built on the north-east end of the roof above Casemate 1 and adjacent to gun position 1 of the 6-inch battery (Fig 53; App Fig 8). It is orientated to face west with views across the Thames to Coalhouse point. Unlike the Landguard (Brown et al 2004, 48), Heugh

Figure 53: The Battery Observation Position looking east. The chinmey stack of the projecting single-storey structure obscures the view from the observation slits. The hut on the roof dates from the Second World War. (DP097671)

(TNA: WO78/4218) and Coalhouse examples it has two storeys. Survey evidence suggests that the Cliffe BOP/ELD was built as a single-storey structure and then increased in height by the addition of a first floor. Precisely when this occurred is not clear although similarities in material, plan and fittings suggest it was by 1916 (Fig 54). This work must be related to Cliffe's historic problem of a low lying position providing a lack of elevation for observation.

The building is built of poured and shuttered concrete with a covering of render. On all sides there is a clear joint line between the ground and first floors and on the east and south sides this takes the form of a pronounced step which has been weatherproofed with a concrete fillet. A colour difference in the exposed concrete is also visible between the first and second floors. The ground floor is equipped with all the relevant features for a combined BOP and ELD of this period. Set at the top of the west (front) wall and the north walls are regularly-spaced rectangular observation slots (1.16m by 0.31m), four in the west wall and two in the north. They are provided with internal timber frames which retain marks showing the position of shutters hinged at the top. The ground floor has a substantial bombproof roof of concrete jack arches springing from axial, steel I-beams. Examination of this roof shows that one I-beam is centrally placed perhaps forming the location for a partition wall that divided the building into north and south halves. Each side of the interior has its own door and window in the south-east (rear) wall although the door to the southern half has been blocked at a later date with shuttered concrete. Set at the foot of the east wall, beneath the window opening adjacent to the blocked doorway, is another slot of similar dimensions to the observation slots in the front wall. This seems too low for observation but could be provided as a route for telephone wires or similar. Internally it is difficult to assign roles to each half of the building although the BOP probably occupied the northern half, which has the majority of the observation slits, while the ELD was in the south side (Fig 54).

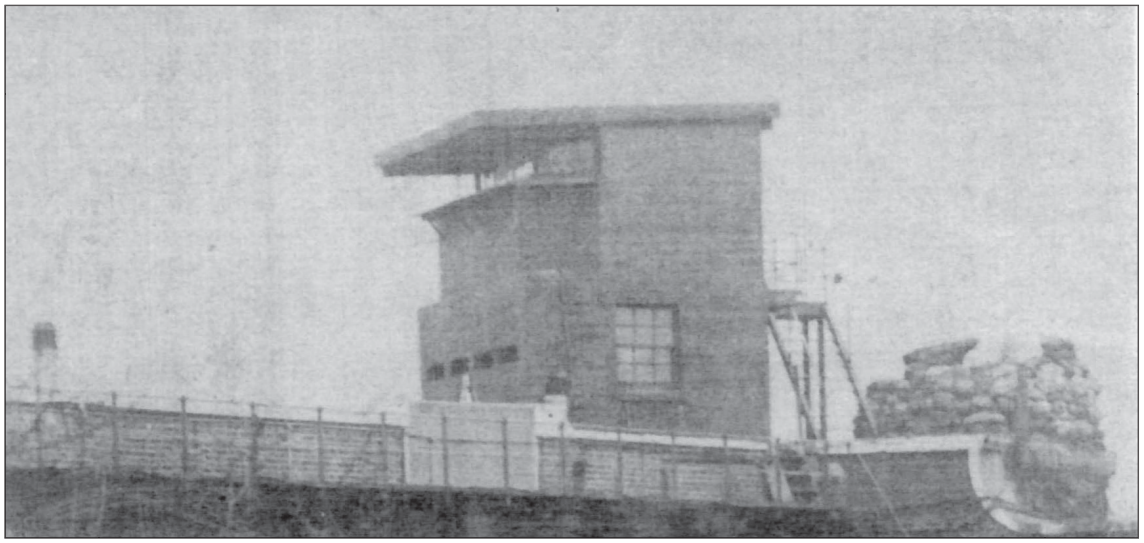

Figure 54: The BOP in the First World War (1916). The sandbagged emplacement on the right hand side of the picture is thought to be a position for a Barr and Stroud rangefinder. (Photograph courtesy of Victor Smith)

The plan of the first floor is a near replica of the ground floor, complete with the separate doors in the rear wall for the BOP and ELD respectively. They are served by an open-tread steel stair rising to a shared landing. The entire structure is beneath an oversailing concrete slab roof supported on steel I-section posts and carried over the observation slits which rise into the roof on beams of the same section. The observation slits like their counterparts on the ground floor, run around the north and west walls. Unlike their ground-floor counterparts, but in common with the 1914 example at Landguard (Brown et al 2004, 48), they were equipped with outward-opening steel shutters which, when open, rested on steel brackets cantilevered out from the wall below the slits. In the 1916 photograph the open shutters can be seen resting on these brackets (Fig 54).

The interior of this floor was not inspected due to health and safety concerns but a photograph taken in 2011 (www.flickr.com\photos\badwabbit\451874439 created 01/07/2011) shows a patch in the north-west corner which may be the cut down base of the range finder pillar. Examination of the same area on the ground floor shows a substantial concrete pillar in this position rising up through the vault; this pillar may incorporate the base of the original DRF pillar for the single storey BOP. To accommodate the new or lengthened pillar the surrounding vault has been rebuilt, with transverse vaulting and with a new transverse beam inserted to reinforce this reformed area around the pillar. Levels on a sight diagram dated 26 November 1918 (TNA: WO78/4963) show the casemate roof, which would correspond with the ground floor of the BOP, at 38ft (11.50m) above mean water level and the DRF and Electric Light Director 16ft (4.8m) higher at 54.65ft (16.60m). This suggests that both these positions were on the first floor of the BOP. Interestingly, the 1919 armament return includes details of the range finder (II* Depression Range Finder) allocated to Cliffe for the two 4-inch QF guns which was set at 47ft (14.0m) above datum (TNA: WO33/942). This height would place it on the top of the concrete apron around the barbette gun positions; however, this should be treated with caution as it is not clear if the 1918 and 1919 heights share a common datum.

With the construction of the new first floor, the ground floor was converted for other uses. Judging from the other examples such as the BOP/ELD at Beacon Hill, Harwich (TNA: WO78/1886) the most likely reuse would have been as a telephone exchange, although an alternative suggestion would be as an observation and firing point for the controlled minefield laid in the Thames (Smith 2002, 39). Further discussion of Cliffe's function as an observation point for successive generations of controlled minefields can be found in Chapter 11. The need to feed cables from either telephones or the minefield into the ground floor may explain the slot at the foot of the east (rear) wall on its south side. The window opening immediately above this slot has been blocked by filling it with concrete; this may have been to provide more wall space for mounting equipment. Cables can be seen running over the parapet wall in the 1916 photograph (Figure 53) and evidence for these remains in the form of conduits, timber mountings and a steel box sunk in the parapet wall.

Later Modifications to the BOP

Built against the north-west wall of the bottom floor of the BOP is a small single-storey extension with a lean–to roof (App Fig 8). This extension has 9in (0.26m)

brick walls in stretcher bond and the majority of the exterior is rendered with an incised masonry effect. The extension blocks the observation slots in the ground floor of the BOP and a chimney for a hearth in the extension's north wall rises in front of the observation slots on the BOP first floor, although it is aligned with the observation slot jamb in the area of the partition between the BOP and ELD halves. The hearth, domestic-sized windows in the south and west walls, evidence for a suspended timber floor and a very neatly constructed coal bunker against the north wall suggest that the extension was intended as accommodation for personnel. The south and west wall of the extension can be clearly seen on a still taken from a 1941 British Pathe newsreel concerning the activities of the Royal Naval Auxiliary Patrol on the Thames (www. britishpathe.com/record.php accessed 4.12.2011). This shows it unaltered, other than the presence of the roof and window frames, from its current appearance. The darker tones of the render on the extension, compared to new construction work on the BOP roof (see Chapter 12), and the uniformity of this colour, including the chimney, with that on the BOP suggest that the lean-to had been built some time before 1941. The 1941 British Pathe newsreel also shows a door and window in the south wall of the BOP replacing the single window opening with a sash frame shown in the 1916 photograph (Figure 53). Again the uniform colour of the surrounding render suggests that this is not a recent modification.

The first floor of the BOP was not entered during the survey and it is unclear to what extent the chimney of the lean-to obscures the view from the first-floor observation slots observation slots. If the chimney leaves the view over the river relatively unobstructed from the DRF pillar in the north-west corner of the BOP, then the lean-to could date from the later part of the First World War, perhaps as heated accommodation for the personnel. However if this view is obscured it suggests that it was constructed after the BOP ceased to be used for gun and searchlight direction, possibly as late as 1936 (see Chapter 12). Dobinson (2000, 242) notes that an armament return dated 12 November 1927 shows two 6-inch guns as allocated to Cliffe Fort. Even with these gun mounted, Cliffe Fort would, like Coalhouse Fort, be in care and maintenance during the 1920s and 1930s (TNA: WO192/48) and it is hard to conceive of a situation during this period that required the construction of accommodation for personnel manning the BOP position in shifts.

During the Second World War an observation post was constructed on the BOP roof (see Chapter 12).

Crew Shelters

The shelters erected in 1900 for the 12-pounder gun crews were reused for the 6-inch battery. On the 1913 plan (Fig 50) the shelter for the 12-pounder A group is annotated 'Existing Shelter re-erected here for No 1 Gun' with the shelter shown as moved from the flank wall of the 12-pounder gun position to the back of the roof with its rear wall against the parapet. The site of this shelter is no longer discernable. No 2 gun reused the other shelter for the 12-pounders and its site is also no longer discernable. Adjacent to its former position is a flight of concrete steps rising from roof level to a landing just below the brow of the parapet wall but it is not clear if the two are related.

Gun and Tackle Store/Recreation Hut

The former laboratory on the west side of the fort was reused as a Gun and Tackle store according to an annotation on the 1899 plan (TNA: WO78/4963; App Fig 3). The plan notes that a timber recreation hut measuring 25ft by 20ft was constructed on the roof of this store at a cost of £115 in November 1915. The site of this hut is discernable by a series of marks left by the floor joists and some bolts projecting from the asphalt roof covering of the laboratory/tackle store. The annotation indicates that the route from the roof to the hut was via a stair that rose from the store roof to the top of the rear traverse of the former open battery. No physical evidence for this stair survives but an open tread ladder stair in the correct position is just visible in the corner of a photograph of the parade ground taken circa 1915 (Fig 49).

War Shelters

The timber crew shelters on the roof were designed to provide shelter from the weather only. For protection against bombardment the gun crews were provided with a War Shelter. Survey suggests that casemates 3, 4, 5 and 6 were converted into war shelters for the battery immediately above them (Fig 55). This work must have been undertaken for the battery built in 1913 and not for its predecessors as a 12.5-inch RML was mounted in Casemate 4 until 1906.

Figure 55: Casemate 6 was probably enclosed with a permanent brick wall at the time the 6-inch battery was built on the roof in order to provide a crew shelter. (DP097599)

A series of modifications were probably undertaken to convert the casemates. The wall at the rear end of Casemate 3 has been rebuilt in a sandy-coloured stock brick laid in stretcher bond. It incorporates a doorway at the north side and two small windows to the south, all underneath flat vertical-coursed heads picked out in a lighter coloured brick. The jambs of the doorway are also picked out in this brick. At the top of the wall omitted headers form an air vent with a pronounced brick lintel and sill. Internally the wall is reinforced by a centrally-placed brick buttress. Casemate 6 has a similar wall but without a doorway.

Similarly placed walls in casemates 4 and 5 have been demolished leaving concrete foundations, mortar and smashed bricks in their former positions. Internally changes in floor height between casemates 4, 5 and 6 have been levelled out and the tracks for the removed racer rails in casemate 4 have been backfilled with concrete. In casemates 4 and 6, which retained gun positions, the embrasures in the shields have been blocked. The embrasure in Casemate 6 has had a window frame inserted with vertical external bars added to the shield face while the embrasure in Casemate 4 is blocked with the same colour stock brick as the rampart end walls. All of the casemates were painted blue-green over a red undercoat with Casemate 4 having a black line running at waist height. All retain evidence for electric lighting in the form of timber battens and plugs secured to the vault or along the walls marking the positions of electric lighting conduits. The remains of a bulkhead light fitting can be seen in Casemate 5. The fireplace in casemate 4 has been blocked, while those in 3 and 6 have been modified to accept a stove flue. Casemate 3 appears to have been an office or officers' accommodation, the remains of shelf brackets are visible in the west walls and a rendered decorative surround has been added to the fireplace.

Immediately outside Casemate 5 are the mounting points for a flight of steel open steps not shown on the 1899 plan (TNA: WO78/4963; App Fig 2) and now removed, which would have connected these casemates with the battery above. The landing for these steps remains *in situ* supported on steel beams cantilevered out from the parapet wall and connected to the roof by a short flight of brick steps.

First World War Close Defence

There is enough fragmentary physical evidence to suggest that the gorge side of the fort (the rear of the battery) was placed in a state of defence during the First World War. The nearby batteries at Grain, particularly Wing Battery, had a number of slit trenches and machine gun pits added to their rear during this period (Brown et al 1998, 64). Though suggestions of trenches survive on the north side of the glacis at Cliffe dense vegetation makes confident interpretation of these features impossible.

A defensive position was probably constructed on the roof of the south-east bastion in this period (Fig 56; App Fig 8). Its construction date is not clear but it is visible on a 1941 aerial photograph (RAF 26UK1455/2045 14-MAR-1941). Unlike other features from the Second World War which are surrounded by evidence of very recent construction, the roofed position on the south-east bastion appears established and undisturbed by the recent work.

The position in the south-east bastion comprises a roofed platform. The sandstone

slab walkway of the *chemin de ronde* has been replaced by a concrete slab extending across the bastion and sitting on two steel or iron beams running east-west. These beams sit on sandstone pads let into joist pockets cut into the walls and are supported mid-way along their lengths by brick piers. On top of this slab, at its western edge, are two further piers, 1.8m high, constructed of bricks which have been recovered from inside the fort; several are whitewashed. These are opposed by two shorter brick piers constructed on top of the parapet wall after removal of the capstones. The alignment of these piers along with a thin layer of concrete obviously intended to level out the top of the tall piers suggest that they supported a roof over the concrete platform; this is visible on the 1941 aerial photograph. Two well-formed embrasures in the east face (overlooking the main landward approach to the fort) using the piers as jambs with further brickwork forming the embrasure indicate the defensive nature of the position. There is no obvious evidence for a ladder or steps to this platform and it may have been reached via the remaining sections of *chemin de ronde*.

Figure 56: The probable First World War defensive position constructed in the south-east demi-bastion. (DP097579)

Evidence in the former B group of 12-pounder gun positions, above casemates 10 through 14, suggests that these gun positions were also reused. The southern-most of the two emplacements has the same holdfast plate which has been drilled with two extra holes at the very eastern edge and is covered over with a layer of bitumen which may be part of the very new coat of black paint covering the 6-inch barbette and the parapet that can be seen on the 1941 British Pathe newsreel. A series of 7 or possibly 8 radiating cement scars are visible beyond the holdfast plate. Each scar has a stud at each end and a witness mark for a batten or plate suggesting that it may have supported a platform around the gun. Two pairs of similar scars beyond the holdfast to the east may relate in some way to the firing angle of the gun (Fig 57).

Figure 57: Most southerly 12-pounder emplacement with possible evidence of adaptation at a later date. (DP097777)

That this use post-dates the disarmament of Cliffe, following the recommendations of the Owen Committee of 1906 (TNA: CAB16/1), is demonstrated by the remaining 12-pounder gun position of the A group (disarmed in 1906 when the 12-pounders were withdrawn) which has its holdfast thoroughly removed leaving only a few cut down studs rather than the complete plates found in the B group positions. The absence of any white scarring around these positions or a shadow cast by the barrels on the 1941 aerial photograph (RAF 26UK/1455 2045 14-MAR-1941) suggests that no guns were mounted at this date; the two 6-pounders allocated to Cliffe in 1940 for close defence were mounted on new concrete platforms in the 6-inch barbettes. This suggests that the complete holdfast plates and concrete additions in the 12-pounder A group positions date either from the First World War or its immediate aftermath when smaller calibre guns may have been supplied to Cliffe Fort for practice or saluting duties.

10. THE BRENNAN TORPEDO INSTALLATION

The Brennan torpedo was the world's first practicable guided weapon, operated by the Royal Engineers at eight sites for the defence of harbours or estuaries in the United Kingdom and overseas between 1890 and 1906. Little information about the Brennan torpedo has survived due in part to the great secrecy that surrounded its development and use (Beanse 1997, 1).

Brennan torpedoes were installed in locations that covered a channel or harbour entrance within reach of the torpedos' maximum range of 2000yds (1829m) while providing maximum protection to the very elaborate operating installation (Beanse 1997, 28). All the installations formed part of an integrated defence scheme with minefields and quick-firing gun batteries. Cliffe is unusual in that its installation defends a river passage rather than the estuary or harbour entrance covered by the majority of installations. It appears that the installation at Cliffe was a solution to a unique tactical problem concerning the defence of the entry into London, at that time the world's busiest port, and the vital facilities of the Woolwich Arsenal. When the Thames forts were constructed, a boom or minefield across the Thames where it narrows into deep water channels below Hope Point, had been part of the defence plan (see chapter 5). Booms had been part of the Thames defence plans since the 1500s and would again be deployed in both world wars (Smith 1998, 41). Minefields became an important adjunct to boom defences and by 1878 a Submarine Mining Depot had been established at Shornemead Fort responsible for laying a controlled minefield across the Thames (Smith 1997, 41). As the Thames was the world's busiest shipping lane this minefield could not be left in place and so would have to be laid immediately after the outbreak of war. It was estimated that laying the small minefield at the mouth of Falmouth Haven would take 12 hours (Linzey 2000, 144) and presumably the much larger Thames minefield could take up to a week. In this period London was vulnerable to an attack either by fast warships forcing their way up stream or by blockships which could be sunk in the narrow channels blocking access to the Port of London.

The Brennan torpedo provided a means to address this vulnerability by being, by the standards of the day, a weapon at near instant readiness, once the boilers got up steam, (Beanse 1997, 28) and it could be supported by the infrastructure (the searchlights and observation positions) installed for the minefield. For this reason the Brennan installations were manned by detachments of the Royal Engineers Submarine Mining Companies, in this case 34 Mining Company based at Shornemead Fort (Anon 1904).

The Brennan Torpedo

A detailed description of the workings of the Brennan torpedo can be found in Alec Beanse's 1997 book *The Brennan Torpedo*. A summary of the principal components, based on Beanse's account, is provided in this report.

The torpedo itself is a steel cylinder approximately 22ft (6.7m) long, elliptical in cross section and tapered at each end. To launch, the torpedo would be released down an

inclined slipway running on four small flanged wheels in its belly which engaged with a pair of rails (similar to railway lines) set 7in (0.178m) apart. The body of the torpedo is divided into sealed compartments. Immediately behind the nose cone is the warhead consisting of 200lb (90.7kg) of wet guncotton. Behind this a further sealed compartment contained the depth regulating mechanism; the exact design of this component remains unknown. Removing an access plate in the centre of the torpedo reveals two drums on a common longitudinal axle both full of tightly wound wire, approximately 2000 yards (1829m) on each drum. This wire ran back through the body of the torpedo via two sets of pulleys and associated governors. As the wire was reeled back on to the shore one pulley set turned the propellers while the other operated the steering in response to changes in the differential speed of the two wires. The wires emerged through the hollow propeller shaft and, as a further example of the ingenuity and complexity of this weapon, the hollow shaft incorporated a mechanism that released a brass ring every 60 yards (54.8m) to keep the wires together.

When mounted in a service installation, a launch-ready Brennan torpedo would have sat at the top of the inclined launch rails that ran from a specially constructed building, usually termed the Torpedo Store, into the river, harbour or estuary. Projecting from the front of the store and set at least 6ft (1.8m) above the torpedo would be a steel or wrought iron beam aligned with the inclined launch track. Suspended from this was a carriage incorporating a series of pulleys and a counterweight. Prior to a launch the crew would thread the two wires from the rear of the torpedo up through the carriage pulleys and into the store where eventually they would be threaded on to an empty winding drum on a stationary steam engine; this engine and its boilers were in separate buildings usually to the rear of the store. Immediately prior to launch the crew would erect a 15ft (4.6m) mast hinged on the top of the torpedo which had a light on top, powered by a cell (battery) in the body of the torpedo, and retire to a safe distance. The launching sequence was then remotely controlled by the driver in the engine room. As the steam engine increased speed any steam was channelled through condensers (water-cooled pipes) to prevent an exhaust plume giving away the engine's location. A sound from the front of the torpedo would indicate that the liberating bolt that retained the torpedo on the slipway had been withdrawn via a mechanical linkage from the engine room. The wires would visibly tighten as the engine started to wind them onto the drum and the torpedo propellers would start to turn. The light on top of the mast would come on, activated by the wire putting pressure on a switch inside the casing, and the torpedo would then roll down the slipway. When the torpedo entered the water the pulley carriage on the beam above the slipway would start to follow keeping the wires aligned and taut and gathering speed as it did so. When it reached the end of the rail about 30ft (9.1m) it would hit a spring loaded buffer and the wire would disengage from the lower pulleys to just run over the pulley at the top of the carriage.

Once in the water the torpedo had a maximum speed of 22 knots. The mast and the light on top allowed its course to be followed by observers on the shore. A directing officer, placed on top of the fort, aimed the torpedo by observing the target's course and ringing down speed and course changes – essentially left, right or centre - to the engine driver via an electrical instrument similar in concept to the ship's

telegraph. Practice runs were directed against a target towed by a support vessel. Between 1904 and 1906 four of the established Brennan Torpedo stations in Britain competed annually for a challenge cup and the results were printed in the Royal Engineers' magazine *'The Sapper'*. Cliffe won on three consecutive occasions and the photograph of the victorious 1904 team (standing outside Shornemead Fort) is printed in *'The Sapper'* for this date (Anon 1904, 47). Cliffe also has the dubious distinction of being the only known Brennan torpedo station to sink a ship, albeit in error. In August 1901 a ketch, W.S. Flower, was struck by a torpedo on trials. The torpedo, containing a full charge but no detonator, made a large hole below the ship's waterline and it quickly sank. Fortunately no one was injured and the vessel was recovered (Anon 1901, 6).

At the end of a practice run the torpedo could be retrieved by the crew of the target vessel and towed back to shore. The wire disengaged from the torpedo drums after 2000yds (1829m) and was completely wound back into the fort; this process also released the pulley carriage and returned it to the fort end of its beam. The torpedo weighed about 1 ton and a crane would have been required to lift it from the water and place it on a handling cradle for wheeling back to the torpedo store. Once the torpedo was returned to the store it would have the secret depth mechanism removed and placed in a safe. The electric cell would be removed for recharging and the warhead removed and weighed to check that the sealed guncotton charge was not drying out. Inside the engine room the wire drum, now with 4000yds (3657.60m) of wire coiled onto it, was removed from the engine and pushed through to a wire room where it was unreeled, treated against salt water corrosion using quick lime, dried and then wound back on to two torpedo drums via a special set of winding machinery (Beanse 1997, 28 - 36).

The Brennan Torpedo at Cliffe Fort

Documentary Evidence

It is not known precisely when the Brennan Torpedo Station was first established at Cliffe Fort but it must have been between 1887, when the War Office purchased the rights to use the Brennan patent (Beanse 1997, 3), and 1891, when a minute to the Director of Artillery from the Inspector General of Fortifications notes that seven installations including Cliffe, are completed or in progress (TNA: WO32/6064). It is assumed that the installation was completed with a single slipway, the southern-most of the two built at Cliffe, depicted on the 1897 (surveyed 1895) Ordnance Survey 1:2500 map (TNA:PRO WO78/5434). The second slipway to the north is not shown until the 1908 (surveyed 1907) Ordnance Survey 1:2500 map (see App Fig 6).

A more precise date for the construction of the installation is suggested by surviving correspondence between the Chief Royal Engineer (CRE) Gravesend and the Sewer Commissioners dated April 1888 to October 1889 (CKS: S/NK/AC 1/17). This discusses alterations to the glacis of Cliffe Fort and the section of sea wall in front of it, along with the construction of observation posts in the sea walls at Cliffe, Coalhouse and Shornemead. The plan shows that these are of the type for controlled

minefields although this is not mentioned specifically in the letters. Unfortunately the letters from the CRE are evasive in tone as he is clearly trying to avoid giving exact details of the proposed works. This secrecy suggests the works may be connected with the then very secret Brennan installation. A later letter, in the same series, the CRE offers to conduct a representative of the Commissioners around the site but will not provide any plans or details.

Further detailed documentary evidence, similar to the set of plans and sections which exist for the Brennan station at Garrison Point Fort, Sheerness (TNA: WO78/5116) has never come to light for Cliffe Fort. The sources with the most graphical information about the Cliffe installation are the second and third editions of the 1:2500 Ordnance Survey of the area and in particular the 1897 (surveyed 1895) edition with the confidential military details (TNA: WO78/5434; Figure 40). This shows the southern launching bay labelled 'torpedo slip' depicted as a funnel-shaped indentation in the river flood defences with an indication of the course of the slipway along its centre. The slipway line is shown extending across the muddy foreshore into the river and back up the glacis to end at the fort face at the northern open gun position. This position, unlike the southern open gun position, is shown as roofed over with no indication of an embrasure. A siding left the tramway (see Chapter 5) at a point level with the fort's south-west bastion and followed the course of the ditch at the foot of the glacis to terminate at the Brennan launching slipway in a levelled area with a small structure. The available copy of the 1908 Ordnance Survey 1:2500 map (surveyed in 1907) is the civilian edition and all military structures are redacted; only the outlines of the two launching bays, the newer northern bay is a wedge-shaped interruption to the river defence, are shown. A single line represents the rails of both launching bays running out 60m and 73m respectively into the river over mud flats.

Fragmentary evidence for the installation has survived on plans for Cliffe Fort in the National Archives. The 1899 basement plan (TNA: WO78/4963; App Fig 1) indicates the course of a 6in waste pipe and a 3in water pipe, labelled as *'suction pipe'*, running from the underground water tanks in the parade ground into the entrance to the basement adjacent to the launching slipways. A 3in suction pipe for the engine water supply along with a 6in pipe draining water from the engine condensers were standard fittings for Brennan steam engines (Beanse 1997, 31). A slightly earlier drainage plan for Cliffe dated 1891 (with additions dated 1893) also shows the additional water feed (suction) pipe intended for the steam engine (TNA: WO78/3427).

A number of ancillary buildings, mostly adapted from earlier structures and housing equipment such as accumulators used by the Brennan torpedo, are the only indication of the installation's presence on the 1899 plan (TNA: WO78/4963; App Fig 1), although the blank area on the plan around the open battery casemates is a good indication as to the whereabouts of the secret installation. A *'Record Plan of Oil Store'* dated 1916 (TNA: WO78/4963) is a proposal to convert one of the basement casemates in the blank area on the 1899 plan into an oil store. This drawing labels the adjacent casemate as *'old engine room'*. In the margin of this plan is the notation *'disused rising tower'*, likely to be a reference to the rising observation tower

provided for the Brennan directing officer at some point in the late 1890s or early 1900s (Beanse 1997, 42).

Beanse suggests that all of the Brennan installations were designed to principles set out in a series of generic drawings, dated 30 April 1888, by Captain Willock RE (TNA: WO78/4468; Beanse 1997, 28). Of particular interest is the drawing which shows a solution for a situation where the topography of the site requires the torpedo launching slipway to start on the torpedo store roof to achieve the required slope, as exists at Cliffe. It shows the launching slipway passing into or over a torpedo store with separate rooms for the boiler and engine at its rear. The whole is shown with contemporary bombproof protection in the form of an earth bursting layer and steel and concrete jack-arched roof. The suggestion for the removal of the torpedo from the slipway down to the store below is by a rising stage running through a slot in the roof.

Surviving remains

Launching slipways

In April 1993, during sea wall repairs, a survey of both the north and south slipways was undertaken (Pattison 1993, 1). It notes that the two launching slipways are both constructed predominately of concrete and timber and laid in deep cuts made through the riverbank, which was presumably remodelled when the Brennan slipways were constructed. At their lower (river) ends the launching bays were protected from erosion by a continuous revetment of vertical timbers of considerable thickness (0.3m by 0.1m) (Pattison 1993, 6). The concrete slipways slope up from the river bank ending at concrete platforms in the shallow scarp of the ditch at the foot of the fort glacis. Beyond this it is suggested that they crossed the ditch by a removable bridge and then ran up the glacis to end level with the gun floor storey of the fort in front of the open battery positions on the south-west corner (Pattison 1993, 6). The southern slipway aligns with the northern position in the open battery; the northern slipway aligns with the masonry wall marking the transition point between the open battery and the casemated battery (see App Figs 6 and 7).

The north slipway consists of a concrete chute widening gradually towards the river and sloping at an angle of circa five degrees. Flanking the chutes through the counterscarp and riverbank are concrete retaining walls sloping outwards at circa 30 degrees from the vertical and at a height of between 1.35m and 2m above the chute floor. The floor is composed of contiguous slabs circa 0.35m thick and of varying sizes depending on location (Pattison 1993, 7). Near the high water mark the chute walls stop and the floor descends towards the river bed protected by the remains of timber revetment walls. The launch rails, set at a gauge of 7in and mounted in yokes, are supported on steel pillars placed at regular intervals in the chute floor (Fig 58).

The land ends of both slipways are very similar in design and dimensions. The chute finishes with a series of broad steps leading up to a concrete platform incorporating a central slot which allows the launching rail to pass through. This concrete platform is 0.6m high (from the floor of the chute) and 2m wide, this makes it flush and the same width as the path along the top of the sea wall. These dimensions, but not their relevance, are discussed in the 1889 correspondence with the Sewer Commissioners

Figure 58: The north slipway and launching rail looking back towards the open battery of Cliffe Fort. The slots for the timber boards mentioned in the letter of 1889 are in the flanking walls above the short flight of steps. (DP097353)

(CKS: S\NK\AC1\17). Access from the floor of the chute to the top of the platform is via a flight of four steps. Presumably these steps were provided for the Brennan crew to inspect the launch rails and undertake day to day maintenance. The parallel-sided groove for the launching rail to pass through the platform can be closed off from the river by inserting timber boards in slots in its sides. This is presumably the measure against high tides detailed in the letter from the Chief Royal Engineer to the Sewer Commissioners dated April 1890 (CKS: S\NK\AC1\17).

On the landward side of the slots are opposed flights of six steps allowing descent from a shore line path down to the level of the launching rails and, via the slot and the flight of four steps, to the floor of the chute and the Thames. The landward face of the platforms are abutments for what is assumed to be a small removable bridge that carried the launching rails over the ditch and then, via another concrete abutment just visible in the undergrowth, upwards to the fort. Alignment of the rails at the junction of the chute and the removable bridge was presumably maintained by metal plates bolted to a timber sleeper set in the concrete floor in a central position in the slot. The concrete base around this mounting is carefully concave to allow for the cross section of the torpedo as it ran down on the rails.

At the time of survey (2010) the northern bay retained the large brass plate for aligning the launching rails, three complete pairs of launching rails each 4.5m long and their associated steel post supports and yokes seen in 1993 (Pattison 1993, 8) showed little significant change.

The southern bay retained a single pair of rails *in situ* anchored to a timber sleeper at the end of the bridge abutment platform with a ferrous plate. The central section of

this bay, for a length of approximately 15m, has been filled in with gabions as part of the river bank consolidation work. At the river end of the slipway the bases of timber supports for the rails could be seen with sections of rails lying on the floor of the slipway having been deliberately removed by sawing through the supports (Pattison 1993, 9).

The entire glacis area in front of the open battery position is covered in dense undergrowth and investigation was limited due to the potential hazard of the slot in the roof of the torpedo store. Preliminary inspection and historic and contemporary aerial photographs show that a considerable section of the glacis (roughly 10m) has been removed to provide a V-plan trench with a levelled or very gently-sloped base and its apex at the face wall of the fort. To the north the flank of the glacis forms a traverse to protect the launching rails and equipment. To the south, what may be the spoil from the trench has been heaped to provide a traverse in the otherwise shallow slope of this part of the glacis.

Following the line of the northern launching slipway back up the slope of the glacis reveals, on its north side, a smooth concrete wall 3m high and 1.5m thick which meets the face wall at a point just south of the masonry wall that marks the transition from the casemates to the open battery (App Fig 7). This wall runs down to the foot of the glacis, its course marked by small bushes and trees. On its south side immediately to the west of the fort face wall is an area of smooth flat concrete, presumably the roof of the torpedo store. At a distance of 3m from the traverse wall there is a pronounced upward step in this roof and the two sections are connected by a small flight of concrete steps at the east end of the lower section. Another short flight of steps at ninety degrees to the first flight connects the roof to a narrow walkway running across the front of the former open casemate. At the south end of this balcony a single handrail stanchion remains. There appears to be no access from this balcony to the open battery behind or any evidence for stairs or ladders to the roof of the fort. A flight of steps on the torpedo store roof rises to a narrow balcony, created by cutting the current level platform into the sloped profiles of the face wall below the embrasure. This could have given access to the beam and the pulley carriage when it was in its pre-launch position above the end of the slot to allow the wires to be threaded through it from the torpedo on the launching rails (Beanse 1997, 28).

Following the line of the southern launching slipway down the glacis reveals a section of concrete wall in the undergrowth. This runs north-south nearly parallel to the face wall of the fort and has an opening towards its southern end now blocked with brickwork. No dimensions were taken as immediately in front of the opening is a water-filled pit. The wall and blocked opening is in the approximate position of the levelled area and small building at the end of the tramway siding shown on the 1897 Ordnance Survey 1:2500 map (TNA: WO78/5134; Figure 40). Beanse suggests that this area is the entrance to the torpedo store for the recovered torpedoes which were loaded by crane at the jetty on to handling trucks and then pushed back up the tramway branch to this entrance into the torpedo store. The levelled area coincides with a quadrant-shaped concrete revetment wall in the counterscarp identified by the 1993 survey (Pattison 1993, 2). Both Pattison and Beanse suggest that this provided a bay to turn a torpedo through ninety degrees and push it back into the torpedo store (Beanse 1997, 41). A photograph taken by Victor Smith circa 1970 shows

the area with less undergrowth and the line of the tramway can just be discerned. Beanse further notes that a flight of steps, not seen during the recent survey, connected this opening to the roof of the store and provided an access route between them for the Brennan operating crew (Beanse 1997, 42).

Internal areas of Brennan Installation

The Willock generic plans (Beanse 1997, 28) envisaged purpose-built store, boiler and engine rooms, set beneath a scarped earthwork located close to the sea wall, producing a compact and discrete installation of three interconnected rooms and the launching slipway. At Cliffe and the other installations in casemated works (Garrison Point, Sheerness; Fort Camden, Cork and Fort Albert, Isle of Wight) the restrictions of the fortifications and their locations meant one or two components, usually the engine and boiler rooms were located inside the fort. At Cliffe the torpedo store was constructed in the glacis placed, as per Willock's suggestion, beneath the slipway to achieve the correct slope angle for the torpedo launch. The practicalities of achieving this slope placed the store against the face wall of the fort leaving no room for the engine and boiler rooms in the new structure. Instead these rooms were located in the basement of the fort, initially in two adapted casemates that had accommodated the shell and cartridge stores for the northern gun of the open battery (Fig 59). It should be noted that survey in these areas was restricted due to flooding.

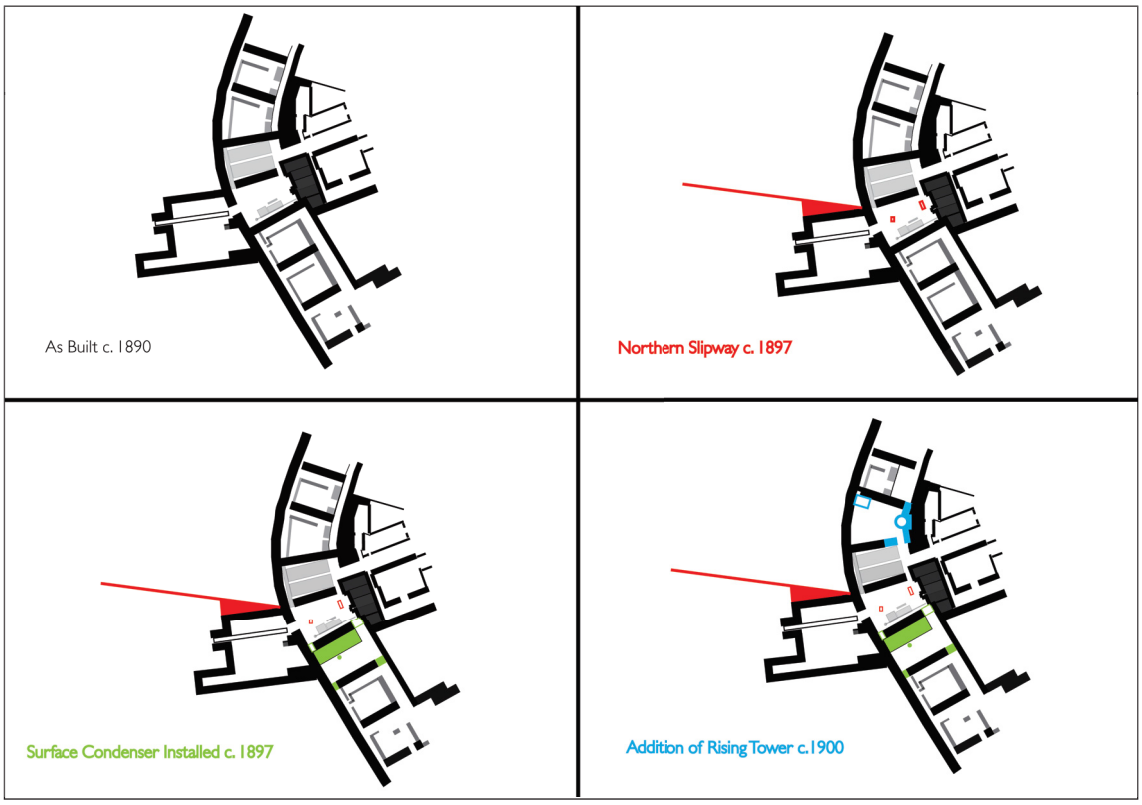

Figure 59: Diagram showing the development of the Brennan installation from its construction circa 1890 until its final modification (the addition of the rising director tower) around 1900. The position of the engine bed and the Cornish boilers are indicated in light grey. Based on sketch survey and the 1899 plan (TNA: WO78/4963; App Fig 1).

Torpedo Store

The Torpedo store is constructed in the apex of the V-shaped trench dug into the glacis (App Figs 6 and 7). It is clearly based on the generic design prepared by Willock dated 30 April 1888 (TNA: WO78/4468) which shows a building with a sloped roof to accommodate a launching slipway, the torpedoes reaching the slipway via a slot in the roof. The southern launching slipway probably ran over the substantial roof of the torpedo store, which is composed of closely spaced (circa 0.3m centre) steel I section beams about 1ft (0.30m) in depth running east-west. These are all set in concrete with a further layer of concrete poured over them. The walls of the store, which are presumably the same thickness as the roof, are cast from shuttered concrete; there are significant cracks in the north and south walls and a crack in the south-east corner of the south wall retains a lead tell-tale dated 2/6/97 [1897]. The east wall of the store is formed from the face wall of the fort and contains the entrance to the connecting passage to the engine room. To the north of the passage the roof beams rest on pads cut into the Kentish rag masonry base of the face wall. On the south side the rag has been removed exposing the inner brick leaf of the face wall and leaving a significant set back. The entrance to the caponier was located in this area and it may be that this change in the wall is evidence of work that removed the caponier and blocked its entrance passage. The substantial construction of the store not only supported the weight of the launching rail and torpedo but also provided some blast protection to the contents. Inside the store were a number of stored torpedoes, it is suggested between 12 and 20 (Kitson 1999, 230), with permanently attached warheads of 200lb (90.7kg) of wet guncotton. Based on the Willock generic plan, it is reasonable to suggest that as constructed the store was buried to the level of the roof in the earth traverse as a further safety measure.

Inside the store the pronounced east–west slope of the roof is immediately apparent and it is clear that it accommodates the incline of the launching slipway above. The handling slot for the torpedoes is formed by omitting the concrete fill between a pair of roof beams that are set further apart than the others at 0.50m. The slot runs the length of the store, starting above the arched entrance to the engine room passage. It passes through the west wall in an opening just wider than the slot and framed by ferrous stanchions. It continues in this narrow extension of the store for some 6m finishing at a concrete end wall (Fig 60).

In the south-west corner of the store a low, narrow bay projects to the west. The opening at the western end is blocked with bricks although a chink of daylight is visible where a brick is missing. This blocking corresponds with the entrance identified during the survey of the glacis and confirms that this narrow bay is the access route for torpedoes being returned to the store after practice firing.

No evidence either for handling rails, skids or other mechanisms for moving the torpedoes can be seen due to flooding. As the torpedoes were 22ft (6.7m) long and weighed one ton, it is clear that some means of mechanical handling had to be provided and cranes, winches, trolleys, skids and slipways are shown on the generic plans and the plans of other service installations (Beanse 1997, 43; TNA: WO78/5116). In the ceiling close to the south wall are a series of scars and a shallow

Figure 60: The interior of the Torpedo Store looking west and showing the slope of the roof to accommodate the top of the south launching slipway. The vertical timbers in the foreground mark the course of the torpedo handling slot © Wayne Cocroft

depression which is defined by axial ferrous trimmers. The absence of bolt holes and the small size of the marks and trimmers are not suggestive of a mounting for a winch beam but the depression may indicate the site of part of the captive-bolt torpedo release mechanism in the rooftop launching slipway. It should be noted that any elaborate mechanism for moving the torpedoes up to the slipway, akin to say an inspection lift in a garage, would occupy a great deal of the space immediately below the slipway and this would conceivably divide the store in two with the long and heavy torpedoes restricted to the southern half of the store adjacent to the access corridor in the south-west corner.

Against the north wall, and extending from floor to ceiling, are three timber uprights and the witness marks for at least two others. These might have supported shelving or racking; they are certainly too insubstantial for torpedo storage. Similar racking can be seen in a photograph of the store for the installation at Risacoli, Malta (Beanse 1997, 54) although this could relate to the later use of this store as an engine room. All Brennan torpedo stores were provided with a safe for the depth mechanisms. In many of the installations, notably Pier Cellars, Plymouth and Ricasoli, Malta, the safe was set into the store wall (Beanse 1997, 53-54). At Cliffe there is no apparent evidence for the safe's location other than a small recess in the rebuilt southern half of the face wall.

The entrance to the passage to the engine room has a segmental brick head set flush with the ragstone masonry of the face wall. The height of the passage vault (2.5m) is immediately apparent. Above the head of the passage entrance is a substantial concrete block set flush with the ragstone. In its soffit is a channel ending flush with the top of the passage vault. Set into its face are four threaded studs defined by a prominent rectangular-shaped rust mark. In the wall to the immediate south of the passage opening is a similar arrangement which corresponds with a 1m deep hole in the floor at this point. Beanse suggests that the wires from the torpedo entered the body of the fort via the slot in the torpedo room roof and were then lead down this passage to the winding drum on the engine via pulleys (Beanse 1997, 42). The height of the vault would give clearance for the wire run and the studs and slots suggest the location of the pulley mountings.

Between the torpedo and the slot the wire had to be threaded onto the pulley carriage running on a beam suspended over the torpedo launching rail (Beanse 1997, 26). It appears that the front of the northern gun position of the open battery was extensively modified to accommodate this beam. The survey revealed that, in this position, the embrasure, its surrounding wall and the immediate flanking walls on the north side were removed and the resulting space filled with concrete to produce a block 4m deep rising to the full height of the surrounding traverse walls (2.5m). The front (west) face of the block is topped with an angled kerb of concrete slabs. The outline of this work, along with the position of the boiler exhaust flue is shown on the 1899 roof plan (TNA: WO78/4963; App Fig 3). Examination of the south-west corner of the concrete block from inside the gun position shows the cut stub of an iron beam protruding from the top of this corner. This stub aligns with a witness mark running across the roof and into the wall of the gun position (Fig 61). Extrapolation of the 1993 and recent surveys suggests that for the pulley beam to align with the southern slipway it would have to be located in this corner of the block and this cut off end may be its remains. As there is no direct access from the slipway to the interior of the position, it can only be assumed that the beam protruded back into the gun position as a counterweight.

Figure 61: The interior of the north gun position of the former open battery looking west, showing the position of the pulley beam for the original south slipway. The cut off end of this beam is visible as a dark coloured square in the wall with a corresponding witness mark running along the ceiling.

This projection, and the interior of the gun position, probably served no other purpose as, in this phase, the torpedo, its rails, wire runs and pulley beam were located outside the fort on the torpedo store roof.

Basement Casemates [60B, 60E, 60C]

Originally, the two casemates that form the basement beneath the former north open battery position were each subdivided into shell and cartridge stores with accompanying shifting and lighting passages (see Chapter 6). As site restrictions made the construction of new buildings for the Brennan boiler and engine rooms impractical, these bombproof and capacious casemates provided a good alternative. Initial work for their conversion was straight forward: the partition walls of the ammunition stores and passages were removed leaving witness marks in the form of bands of darker coloured brick running across the vaults; these enclose the rendered ceilings of the former stores. Below the springing line rendered-over scars mark the junction of store walls with the casemate walls. The arched openings for the shifting passage at the front (face wall) end of the casemates have been blocked, although several have been adapted for new purposes. The two casemates are now interconnected through the opening in the casemate wall for the former lighting passage which ran at their rear. The dismantling of the rear wall of the casemates removed the west wall of this passage and has incorporated its high set vault, which springs from the substantial traverse wall at the rear of the open battery, into the body of these casemates (App Fig 6).

For security and practicality, as both casemates contained boilers and machinery, access to this space could not be via the basement passages that served the rest of the fort. These were blocked where they entered the Brennan installation severing the ammunition stores and light passages in the south-west corner from those in the rest of the basement. For access to the installation a separate secure entrance was created by adapting the light passage on the north side of the laboratory which ended at the rear traverse wall of the open battery. From the end of this passage a new entrance was driven through the thick rear wall beneath a very substantial three-course arched head. It emerges beneath a similar head in an area that had been the light passage adjacent to the south wall of the northern casemate. It is noticeable that, unlike the entrance to the shifting passages this new passage is 2.15m wide, straight and gently sloped to allow bulky items and equipment to be transferred.

The functions of the casemates are clear. The passage from the torpedo store opens through a broad doorway in the fort face wall into the southern of the pair of casemates. The generic installation plans show that the engine room was always directly connected to the torpedo store (Beanse 1997, 48; TNA: WO78/4468). The same plans show the boiler room located next to the engine room, in this case in the casemate to the north.

Boiler Room [60B]

The generic Brennan installation drawings (TNA: WO78/4468) contain a plan and section of a standard boiler installation to be accommodated in a boiler house 23ft (7m) long, 18ft (5.5m) wide and 11ft (3.4m) tall with a vaulted roof. The 14ft

(4.3m) long Cornish boilers, each 6ft (1.8m) in diameter, were to be arranged side by side and when encased in their brick flues they occupied the entire width of the boiler room. The injectors and the main steam supply pipe are beneath each boiler at the firebox end in a 2ft 6in (0.75m) deep pit in the floor. The brick flues beneath the boiler rise into a 3ft (0.91m) wide flue chamber that fills the space between the end of the boilers and the end wall of the chamber. This flue chamber connects to a chimney flue which rises outside the boiler house.

Cornish Boilers are the simplest form of flued boiler composed of a long horizontal cylinder with a single large tube running through its centre. This tube transmits the heat from a furnace placed at its end into the water that fills the bottom two thirds of the boiler. The steam produced rises into the top third of the boiler and is drawn off by a steam pipe on the top or at the front of the boiler. For added efficiency a brick flue chamber runs beneath the boiler to a chimney at its far end. This flue draws cold air through the fire improving its combustion. For further efficiency the exhaust gases from the fire were first passed through the central flue and then through further brick chambers surrounding the boiler. These flues then emerged into a brick collecting flue at the front of the boiler and then passed to the chimney (www.wikipedia.org/wikki/cornish boiler page created 25.11.2008 accessed on 1.09.2011). At Cliffe the water supply for these boilers was delivered from the water tanks beneath the parade ground via a 3in suction pipe running underground and almost certainly beneath the floor of the new entrance passage. The suction was supplied by a Grufford exhaust injector driven by the exhaust steam from the engine - a standard fitting for British steam power installations (Beanse 1997, 30). Injector condensers are a form of valve that combined waste steam and cold water, the vacuum created drawing more cold water into the system.

Examination of the former boiler room at Cliffe reveals only fragmentary evidence for this arrangement (Fig 62). No evidence remains in the floor as the 1916 plan and section (TNA: WO78/4963) shows that the work to convert the casemate into a store involved levelling the floor with 1ft of concrete and placing a new drain in the centre. Several features at the west (face wall) end of the casemate can be interpreted as the remains of the boiler flue system. In the south-west corner the former archway taking the shifting passage through the axial casemate wall appears to have been reused for the boiler chimney flue. New brick jambs have reduced the width of the opening although the original arched head of the shifting passage has been retained; beneath are four courses of a sandy-coloured brick and a sandstone lintel, composed of three slabs which extend back into the opening. Both the west jamb of this opening – the only one that can be easily seen – and the lintel appear smoke blackened. Study of the 1916 oil store plan (TNA: WO78/4963) and the surviving fabric show that the flue from this opening follows an upwards inclined course to the east, rising in the thickness of the casemate wall and transitioning through the vault becoming a vertical flue rising up through the traverse on the north side of the former open gun emplacement. This emerges on the roof through a rectangular opening over which are the remains of a small (1m by 1m) brick stack. Beneath a similar opening for a flue in the north-west corner of the casemate are the remains of a pier built in the sandy coloured brick. Against the south wall in the corresponding position is a similar brick pier. These may constitute the remains of the boiler collector flue.

Figure 62: The interior of the former boiler room and oil store looking west. The scar of the removed wall between the ammunition store and the shifting passage is visible on the vault along with the shaft for the ammunition lift to the former open battery. The brick piers beneath the vaulted openings to the blocked shifting passage are the remains of the base and flues for the Cornish boilers. (DP 097540)

The opening to a large brick-lined circular shaft is visible in the apex of the vault offset towards the west wall and immediately to the west of the dark-coloured brick band which marks the position of a removed ammunition store wall (App Fig 6). Its position and the pronounced chamfer to the lip of the shaft suggest that it is the ammunition lift. This is further confirmed by the remains of a ferrous fixing strap for the barrel stave guide that fitted over the shaft mouth; a complete example of this can be seen in the corresponding position beneath the south gun position in the open battery (see Chapter 6). The 1916 oil store drawing (TNA: WO78/4963) confirms that it rises into the northern ammunition passage for the open battery. Considering that the shaft would have been directly over the boiler it seems unusual that it was not blocked at the time of conversion. Beanse (Beanse 1997, 31,46) mentions ventilation fans and shafts in Brennan boiler rooms, particularly in Hong Kong and Malta, and the shaft at Cliffe might have been retained for a similar purpose.

The Willock generic plans (TNA: WO78/4468) suggest that all of the pipework for the boilers (steam, water and drainage) should enter the boiler room below floor level, but later works and flooding have completely obscured the boiler room floor. However in the south wall of the casemate, close to the current south-east corner is a well formed rectangular-shaped opening, presumably leading to the adjacent casemate at floor level. It is possible that this is evidence for the course of the steam supply pipe from the boilers to the engine in the south casemate and the exhaust return to the pump and the ejector condenser. Above this an oval recess with a metal fixing may have held a lamp.

Coal Store [60CS]

The fuel store for the coal-fired boilers was constructed on the north side of the entrance passage which opens into the rear of the boiler casemate, providing a clear route between the store and the boilers (App Fig 6). The construction of the store required the demolition of the north side of the lighting passage for the Laboratory [61] and the removal of an earth traverse and the south wall of the adjacent lamp store [65]. Comparison with the 1899 plan (TNA: WO78/4963; App Fig 1) shows that the 3ft (0.9m) thick traverse wall which formed the north wall of the passage has been replaced by the current 9in thick (0.28m) brick dividing wall. Both the coal store and the passage are beneath a single Fox and Barratt type fire-proof roof and the bulb section iron rafters that run north-south span the 9in thick brick dividing wall. The extensive rebuilding north of the Laboratory is further confirmed by study of the circa 1915 photograph of the parade ground which shows the buildings in the south-west corner of the fort in the background (Fig 49). This photograph shows that the majority of the front wall of the passage and Laboratory, in use as a gun tackle store at this date, has been rebuilt. The porch and hatches shown in the front wall of the Laboratory in the 1899 plan are missing, replaced by a pair of doors leading into the former lighting passage beneath a flat concrete lintel. In front of these doors a lighter coloured patch in the ground may mark the former position of the Laboratory porch.

The entrance to the coal store is through a single doorway opening off the parade ground. The majority of the doorway, other than the lower sections of the brick jambs, survives beneath a two course segmental head and the circa 1915 photograph shows a vertically planked door (Fig 49). Inside there is no evidence for a set back but marks in the render show the position of a timber door-frame. The store has a poured concrete floor and the majority of the walls are roughly finished bare brick, leaving sections of raised mortar and mortar marks on the brick faces; further evidence of this rough finish is visible on the south and west walls and supports its identification as a non-domestic coal store. The north walls incorporate sections of the adjacent lamp store and traverse walls; these walls originally faced back to earth and were waterproofed with Portland cement render. This render has not been removed and serves to highlight the junction between the reused walls and the new construction (Fig 63).

At the western end of the south wall of the coal store a hatch opens into the former lighting passage from where coal could be shovelled down the slope to the boiler casemate at the end of the passage (Fig 63). The floor-level hatch is 1m high and located beneath an iron lintel. On the lighting passage side the hatch was closed by a substantial iron plate (lying on the passage floor at the time of survey) mounted in iron runners flanking the hatch; the one on the west side remains while marks and bolt heads with corresponding spreaders in the coal store show the position of its counterpart. Cut into the brickwork above the lintel and centred to the opening is a deep vertical slot which may show the position of a mechanism to keep the hatch open.

Figure 63: The interior of the coal store with the coal hatch at the base of the left hand wall and the render on the right hand wall marking the line of the original traverse. (DP097545)

Engine Room [60E]

Located in the casemate on the south side of the boiler room is the engine room, identified as such on the 1916 oil store plan (TNA: WO78/4963; App Fig 6).

The Brennan torpedo was powered by a shore-mounted engine, winding in the wires that were contained on the two drums mounted in the torpedo. The majority of installations, including Cliffe, used a twin horizontal cylinder winding engine mounted on a concrete and masonry bed (Beanse 1997, 16). The Willock drawings (TNA: WO78/4468) show that the engine was a fairly conventional small stationary steam engine but with many additions related to the winding and steering gear for the Brennan torpedo; the whole measuring 16⅜ft (4.8m) long. Integral with the basic layout of two cylinders driving a flywheel via piston rods and a crankshaft was a drive for the wire-winding drum, located on either the left or right side of the engine. The steering gear was mounted on a beam suspended over the engine and offset to the drum side, its drive shaft ran inside a hollow pillar at the cylinder end. The pillar was integral with the engine base and supported the front of the steering beam which usually had its rear set into the installation wall. Mounted at the rear of the beam was a dynamometer for recording the wire tension during each run. The whole assembly was operated by one man via a set of valves placed in front of the cylinders (Beanse 1997, 16).

The Willock drawings (TNA: WO78/4468) and the drawings of other installations (TNA: WO78/444) make it clear that the engine and the steering beam should be mounted in alignment with the torpedo launching slipway and its accompanying

pulley beam. At Cliffe this posed particular problems as the topography of the fort placed the engine in the fort basement some 4.5m (15ft) lower than the launching rail on the roof of the torpedo store. The wire run between the engine and the torpedo would have to follow a complex course and it is clear that, like documented examples at Pier Cellars, Plymouth, and Fort Camden, Cork, the wires at Cliffe would have required a system of further pulleys and fairleads to achieve this (Beanse 1997, 40, 45).

Access from the boiler room into the engine room is via the opening in the casemate wall originally provided for the lighting passage. This opening is significantly lower than the vault on both sides and has an elaborate combination of lintels in timber and iron. As the majority of the passage vault has been removed they may be supporting the load from the traverse walls of the open battery above. This short passage then opens out in to the vaulted space of the engine room. Forming the east wall of the room is the base of the 12ft (3.7m) thick traverse wall running at the rear of the open battery. At the base of this wall are two shallow set backs. The one to the north is beneath a segmental head and the massive construction of this four-course head and the closing of the jambs beneath it suggest that it is part of the original construction. The recess to the south is beneath a steel or iron lintel and the jambs are rendered over as is the rear of the set back. Set three courses above this opening is a row of bolts now securing a substantial timber beam to the wall.

The vault and walls of the casemate display the same marks from the removal of the ammunition store walls as the boiler casemate. The circular opening in the crown of the vault that formerly served an ammunition lift has also been retained, presumably for ventilation reasons. It is noticeable that the vault in the south-west corner is extensively repaired. Also visible are four iron straps of unclear function hanging down from the vault and aligned toward the doorway leading into the torpedo store.

The west wall of the casemate has been extensively rebuilt with a broad passage driven through it and the masonry face wall behind (Fig 64). This passage is offset to the north and opens into the torpedo store. The doorway to the torpedo store is beneath a substantial concrete lintel with a metal rail to carry a sliding door mounted above it. At the south end of the face wall a two-course segmental arch is visible in the brickwork. This marks the entrance to the former caponier. The caponier passage was not reused as it would not have aligned with the launching slipway.

The north wall of the engine room displays a series of openings all set below the springing level. In the north-west corner inserted in the wall underneath the vaulted head of the former shifting passage is the largest opening: a rectangular hole with a substantial iron frame which is rebated suggesting that it had some sort of sliding cover. The shaft behind it must give access to the boiler flue which rises in the thickness of this casemate wall and may be a rodding point for the flue chamber. Immediately to the east, but still beneath the former shifting passage vault, is a circular hole, possibly for a pipe. To the east of the position of the former shifting passage is another rectangular opening set within an area of disturbed brickwork that extends up into the vault. This concrete-lined opening slopes upward at an angle around 45 degrees and like its counterpart in the former shifting passage it should meet the boiler flue rising in the thickness of the wall. One of these opening could be the flue for the 'Economic Star' hot water boiler provided for centrally heating the torpedo store (Beanse 1997, 31).

Figure 64: The interior of the Engine Room looking west. The entrance to the Torpedo Store is in the centre of the frame and to its left is the segmental head for the entrance to the caponier. In the vault, and surrounded by light coloured concrete, is the shaft pierced for the driving wire to the north slipway. The projecting iron strap is possibly a support for a pulley wheel. The deep recess at the foot of the wall on the left marks the course of the sea water supply pipes to the surface condenser. On the right the blocked arched headed opening for the shifting passage has a metal framed opening for a flue rodding point inserted in its centre. (DP097535)

The floor of the casemate is obscured by debris and flood water. However a masonry slab thought to be part of the engine bed is visible, centrally-placed in the casemate but offset towards the south wall. Photographs taken in 1992 and 1993 show that to the immediate west of the slab was a cast-iron socket fixed to the floor and aligned with the masonry bed (Beanse 1997, 40; HEA BB93/20794). Careful probing established that this socket is still *in situ* and firmly fixed into the floor. The winding engine was probably mounted on the masonry slab. Plans of the winding engine for the abortive installation in Pembroke (TNA: WO78/444) show that the engine cylinders were mounted on the masonry base with the crank and flywheel and the take-off for the wire-winding drum, on a slightly lower concrete base directly to its rear. The operating valve pedestal and the pillar supporting the steering beam were placed ahead of the cylinders. At Cliffe the cast-iron socket set in the floor is in the correct position to act as the base of this pillar. In virtually all the Brennan installations the steering beam ran back from this pillar to a support set into a structural wall (Beanse 1997, 19). At Cliffe it is possible that the I-section post which is placed beneath the apex of the vault acted as the support for this end of the steering beam. However examination of this post shows no evidence for bolt holes or clamps to fix the end of the steering beam to the post and it is of relatively light section compared to the substantial cast-iron mounting socket at the front of the engine, when the load on the steering beam, which supported two pulley sets, a

spring tensioning device, a dynamometer and the tension of 4000yds (3657.6m) of wire is taken into consideration. In examining the position of this post it is noticeable that the flat-headed recess in the west wall is directly aligned with the socket and engine bed and is provided with a substantial steel or iron lintel which has a row of bolts above it. This seems a more substantial mounting place for the end of the steering beam.

In all the other installations the wire ran directly from the front of the steering beam to the launching slipway. At Cliffe it appears that the position of the socket does not align the front of the beam with the entrance to the torpedo store. However the iron straps hanging down from the vault do align with this opening and this suggests that the wire ran off the end of the beam and was then directed by pulleys suspended from the straps towards the doorway and the passageway beyond. Examination of this passageway shows that its tall 2.8m vault would leave sufficient space for the wires to run above head height. At the torpedo store end the vault ends at the very substantial shaped concrete block that fits into the end of the torpedo handling slot in the roof of the torpedo store. Below this is another concrete block set in the face wall with a cut channel leading into the passage vault. This suggests that the wire ran along the passage up through the channel and then onto a pulley mounted on the four threaded studs set in the face of the concrete block. From there it ran up into the slot, onto the pulley carriage suspended above the slot and then into the torpedo (Fig 65).

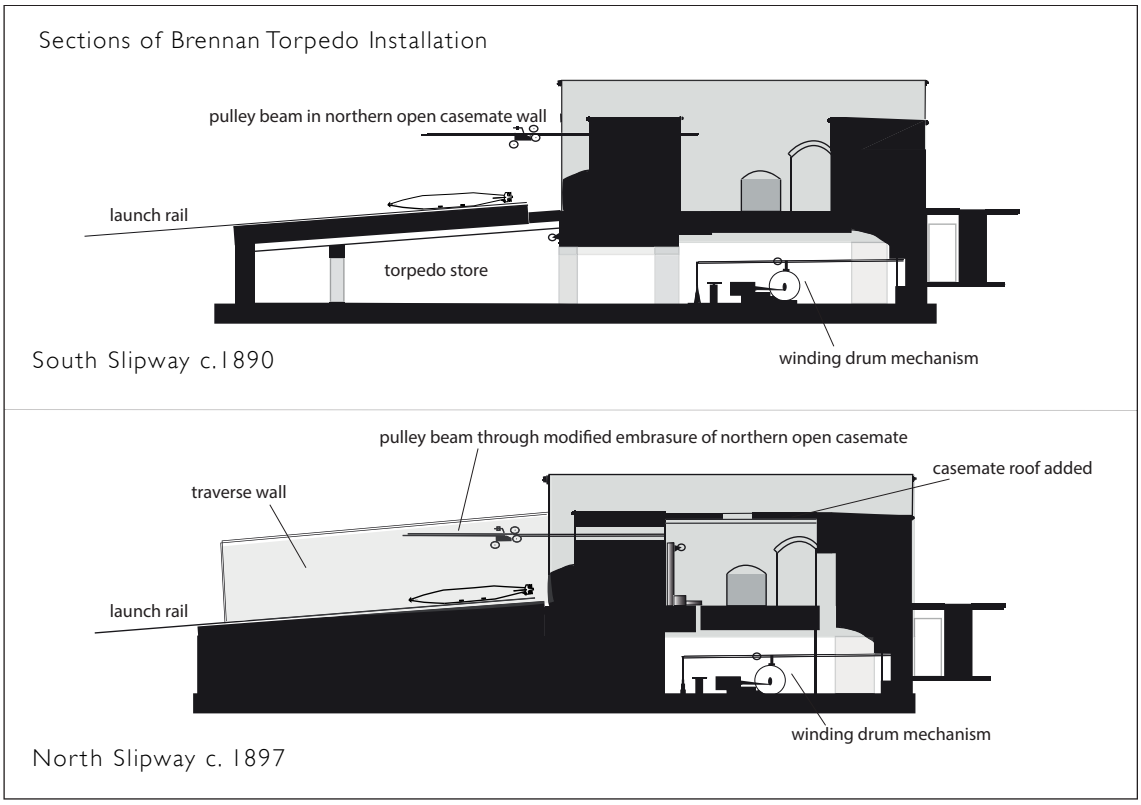

Figure 65: Sections through the south and north slipways based on the survey and dimensions from the 1899 plan (TNA: WO78/4963). The section through the south slipway runs directly east-west but the section through the north slipway is dog-legged to the south to include the wire shaft pierced through the vault and the manhole connecting the engine room to the former open gun position.

The engine bed is offset to the south of the casemate, rather than directly in front of the entrance to the torpedo store, to provide room for the wire winding drum mounted on its north side; there is certainly not enough space on its south side. Associated with the wire drum were mechanisms for exchanging full and empty drums. A system of channels surrounded the engine: the front and rear ones were racks to hold full and empty four-wheeled trolleys, the others allowed movement between racks to facilitate the fitting or removal of the drums to the engine crankshaft, the drums being rolled along the channels (Beanse 1997, 18). At the end of a run the engine would be reversed and the wire on the winding drum wound back on to a transfer drum mounted on a stand next to the engine (Beanse 1997, 32); the offsetting of the engine base would leave plenty of space for this operation. The width of the passage to the torpedo store and its offsetting to the north side suggests that the drums could have been wheeled through the passage to the torpedo store. If the torpedoes were restricted to the south side of the store by the lift mechanism beneath the slot then the north side would be available for the machinery used to rewind the wire drums and the lime tank used for anti corrosion treatment (Beanse 1997, 36). Otherwise the full drums would have to be manhandled through the restricted passages at the rear of the casemates and turned through 90 degrees in the stokehold of the boiler room to be pushed up the access passage.

Torpedo Director Station

Each Brennan installation was provided with one or more Torpedo Director Stations, the observation position that housed the officer steering the torpedo via an electrical telegraph system connect by wires to indicators in the engine room. The principal requirements of these stations were that they were 41ft (12.5m) above mean sea level and as directly in line with the launching slipway as possible (Kitson 1999, 23).

Given the low elevation of Cliffe (14ft, 4.25m) such a position had to be on the roof in order to give sufficient height for the directing officer to see the torpedo's mast and light. A Submarine Mining Officer's position adjacent to the southern 12-pounder gun positions is marked on the 1899 roof plan (TNA: WO78/4963; App Fig 3). This may have been the Director Station as the Brennan torpedo was operated by a detachment of the Royal Engineers Submarine Mining Company from Shornemead Fort (*The Sapper* , September 1904, 59) but it is more likely to have been an additional observation post for the controlled submarine minefield maintained from Shornemead Fort. A letter and plan sent to the Sewer Commissioners at Rochester in October 1888 requests the construction of submarine mining observation stations; these are not identified as such in the text but their form on the submitted plans is unmistakable. They were to be placed in the sea wall near to Cliffe, Shornemead and Coalhouse forts (CKS: NK/AC/1/17) suggesting that a network of advanced observation stations for the minefield south of Cliffe was being established at the same date as the installation of the Brennan torpedo, which was seen as an adjunct to this minefield. It is possible that the mining observation posts had a duel function; by 1905 each Brennan installation should have had two directing positions and several advanced posts linked to the directing officer or the engine room by telegraph or 'loud' telephone (Kitson 1999, 218).

Other Brennan installations such as Camden, Cork; Fort Albert, Isle of Wight; and Pier Cellars, Plymouth; had their observation posts placed above the launching slipway. The concrete collar on the roof above Casemate 15, the site of the later rising Brennan observation tower, is offset from the southern launching slipway but as close as it can be while still taking advantage of the slightly higher position on top of the casemated battery. It may be that this later collar is built on the site of an earlier Brennan observation position. The east face of the collar incorporates a gabled wall built on top of the brick parapet wall in layers of poured concrete. Centrally placed in this wall beneath a rounded head is a doorway which would have opened on to the iron landing running just below the inner parapet (Fig 66).

Figure 66: The gable end of what was probably the original Brennan observation position above Casemate 15. The later concrete cone for the rising tower installation appears to have engulfed the earlier handrail stanchions. (bb93_20789)

Inspection of the doorway jambs shows a distinct difference in their colour and consistency compared to the lighter coloured and more aggregate heavy concrete that has been used to build up the cone in several pours. The short and steep upwards slope from the gable doorway into the body of the cone suggests that pronounced differences in floor levels have been accommodated. The submarine mining observation position at Shornemead occupies a corresponding location and was originally a 1.51m deep brick-lined pit with a circular concrete apron at the front. It

is assumed that a timber structure covered the pit leaning against a now demolished rear wall (Barrett 2008, 45). Several Brennan observation posts had a similar design but with armoured sloping roofs of 2in (0.05m) thick steel, which would have required a concrete gable (Kitson 1999, 217; 219).

Dry Guncotton Store [60ST]

The wet guncotton warheads on the torpedoes were detonated by a dry guncotton primer tube and a standard service issue torpedo detonator. Both of these items had to be stored away from other explosives in robust structures well traversed against blast (Beanse 1997, 10). Neither of these items could remain in the torpedo store as this contained the torpedo warheads. An obvious location for explosives storage was the former examination laboratory on the south side of the access passage. As this had been used for examining filled shells it was sufficiently robust and traversed for explosive storage.

On the north side of the entrance passage, adjacent to the coal store, is a small irregularly shaped store which is buried in the rampart at the foot of the traverse wall at the rear of the open battery (App Fig 6). It is connected to the Brennan entrance passage by a narrow passageway. The west wall of this passage is formed by the inner brickwork face of the rampart while the concrete east wall must have been constructed when the north wall of the entrance passage was rebuilt to accommodate the coal store. The irregular shape of the store arises from the requirement to follow the course of the rampart inner wall.

At the north end of the passage is a doorway beneath a timber lintel with a single projecting jamb, built with bull-nosed bricks against the east wall. This opens into a small lobby with rendered walls and a flat concrete ceiling. Through a doorway at the north end of the lobby is a wider chamber. The dividing wall between the lobby and this chamber is a single brick thick and is not keyed into the east and west walls. The lintel has been removed but the remains of a hinge show that the door opened into the chamber closing against the west wall. Inside the chamber the low ceiling is constructed of shuttered poured concrete, reinforced with ferrous joists running approximately north-south. The west wall, the exposed inner wall of the traverse, has been rendered as has the east wall. A portion of the north wall is built of brick but a concrete fillet between it and the roof suggest that it is an earlier wall that has been incorporated into this structure.

The walls and ceiling of the chamber contain a large number of fixings and fittings or marks created by their removal. On the east wall the stubs of three large iron brackets are set in the wall 75cm above ground level. Running along the west wall were two shelves, their presence indicated by pairs of metal bracket stubs set at 1.17m centres. In the ceiling, roughly set down the centre line of the chamber, are three large threaded studs. Holes in the north and south walls indicate the position of further shelves. A series of small wooden plugs running along the passage vault and then the west wall of the lobby and chamber indicate the course of the wiring for electric lighting. Iron straps for electrical cabling are also visible on the west wall. The wiring may have entered the store through a hole just below ceiling height in the east wall.

This store is well protected, buried at the foot of the traverse wall at the rear of the open battery, and with the coal store forming another traverse on its east side. In this context the Royal Navy estimated that 2ft of bagged coal was equivalent to 2in of armoured steel (Brown 1997, 93). It is provided with a shifting lobby which has been divided off from the chamber with non-structural brick walls and is closed off from both the passage and the chamber by doors. The chamber is rendered, a standard requirement for ammunition storage areas, and fitted out with racking that would have accommodated the fuses or the small cylinders containing the primer charges. This may have included racks running down the centre of the room secured to the ceiling by the studs. Rather than magazine lights, the room was probably lit by electricity with lamps in sealed enclosures such as bulkhead lights.

Generator and Accumulator Room [66]

The Brennan torpedo was provided with a shaded electric light mounted on a mast to allow the observing officer to follow its course at night. The light was powered by an accumulator, in this case a Le Clanche cell (an early form of wet battery), located in a special compartment in the torpedo body. After 1896 banks of these cells were also used to provide power for lighting in the Brennan installation (Beanse 1997, 35). By 1901 the same cells also provided power for the back lights in the gun and searchlight rangefinder sights and the telephone system (Linzey 2000, 144). These cells required charging using a steam-driven generator set (a small stationary steam engine attached to a dynamo) (www. wikkipedia.org/wiki/Leclanche C3 A9 cell page created 3.11.2006 accessed 23.09.2011).

A Dynamo [71], Engine House [70], Test House [72] and Accumulator Room [66] are labelled on the 1899 basement plan (TNA: WO78/4963; App Fig 1). All are located on the north and west sides of the parade ground set back into the earth rampart at the foot of the casemates. The Dynamo and Engine House were provided as part of the searchlight installation (see Chapter 11) provided for the minefield, QF guns on the roof and the Brennan installation. They were probably converted from buildings that originally had a different use (see Chapter 6) and were probably rebuilt again for use by the naval signal station established here in the Second World War (see Chapter 12).

The colour of the bricks of the Accumulator Room [66], the rubbed red brick heads to the door and windows, Fox and Barratt-type roof and its location built back into the rampart all suggest that it was constructed as part of the original phase of the fort (see Chapter 6). This building was probably selected due to its close proximity to the entrance passage for the Brennan installation. Its small size suggests that either the cells were stored and maintained in this building and taken to the Dynamo Room for charging or an electrical supply was run from the Engine and Dynamo Room [70, 71] to this building.

The interior of this narrow rectangular building was altered for use as an Accumulator Room by cladding the walls with chemically-resistant white glazed brick; the maintenance of the Le Clanche cells required the handling and storage of ammonium chloride, a strong alkali. Just visible above the current water line

are the edges of the chemically-resistant quarry tiles that covered the floor and were extended up the wall to skirting height to form a tank to contain any chemical spillage. In the single window opening in the south wall a casement frame has been inserted in place of a sash. Cladding the interior with glazed tiles may have decreased the width of the jambs so they could no longer accept a sash frame or, in the event of a spill, reaction and chlorine gas release, a casement window could be opened faster for emergency ventilation.

In the north and west walls there are a variety of timber plugs, iron straps and metal pipe conduits often used for carrying electrical wiring. The largest of these is a 35.5cm diameter ceramic pipe set in the centre of the west wall with a 12 cm (4½in) diameter metal pipe conduit running in its centre. This may be the terminal of an electrical cable run under the rampart from the Engine and Dynamo Room [70, 71]. The multiplicity of plugs and straps suggests the position for a timber backing board and the connecting electrical wiring for charging and test equipment.

Modifications to the Brennan Installation

The Second [northern] Slipway

Additional slipways were installed at Cliffe, Fort Camden, Cork, and Garrison Point, Sheerness (Beanse 1997, 30). The second slipway built between 1896 and 1899 at Garrison Point placed the torpedo on a new bearing allowing it to engage vessels before they reached Garrison Point (Beanse 1997, 45). The reason for the provision of the second slipways at Cliffe and Fort Camden is not known. Beanse has suggested they were a measure to increasing the firing rate, provision of an alternative in case one slip was damaged by enemy action or to increase the target area covered by the installation (Beanse 1997, 45). The date of the installation of the slipway at Camden is described as 'sometime after 1900' (Beanse 1997, 40). At Cliffe the 1897 Ordnance Survey 1:2500 map (surveyed 1895) shows only the single southern slipway labelled 'torpedo slip'(TNA: WO78/5434). The 1909 edition of this 1:2500 map (surveyed in 1907) shows the outlines of both launching slipways (Pattison 1993, 5). This suggests a construction date between 1895 and 1907.

An earlier date for the second slipway is suggested by a letter dated 3 April 1890 from the Royal Engineers' Office at Gravesend to the Secretary of the Sewers Commissioners at Rochester, discussing proposed works by the War Office on the sea wall in the front of Cliffe Fort (CKS: S/NK\AC1\17):

> Sir,
>
> I find that at Cliffe Fort it will be necessary to make a second cut through the glacis of the fort similar to that made for the Railway which was sanctioned by your Commissioners some years ago [and at about the same depth]. Similar measures will be taken to give protection against high tides by measures of planks and I shall be glad if the commissioners would sanction this.
>
> Lt Col R.E
>
> C.R.E Gravesend

This letter is clearly discussing the installation of a second Brennan launching slipway. Though apparently referred to as 'the Railway' for security reasons, this probably refers to the first slipway since the tramway to the pier does not pass through the glacis. The mention of planks confirms that it is the Brennan installation under discussion as both launching slipways are provided with slots to take planks that maintain the integrity of the sea wall in a high tide.

The new and old slips at Fort Camden and Garrison Point clearly differ in construction and design. This differentiation is not as clear at Cliffe where the design and construction of the landward end of both slipways is nearly identical. However, the river end of the south slip has the remains of the original timber rail supports while the north slip has the later steel rail support yokes (Pattison 1993, 6). At Fort Camden the old slip was refurbished with steel yokes 'sometime around 1900' and there are passing references that other slips may have been refurbished in a similar manner (Beanse 1997, 34, 128). A reason for the absence of this work at Cliffe (although we can no longer see the centre section of the south slip) could be that the ramp was no longer in use and this might explain the depiction of only one ramp on the military survey (TNA: WO78/5434).

The alterations for the second slipway were relatively straightforward. If there was an earth traverse on the north side of the torpedo store it was dug out and cut back to a line level with the masonry transition wall between the closed and open batteries. To hold the earth traverse back and, it is suggested, to provide additional protection for the Brennan crew (Beanse 1997, 43), a 1m (3ft) thick, 3m (9ft) high concrete wall was built running parallel to the course of the launching slipways. In plan this side of the store has a truncated wedge shape although the internal space is rectangular in plan (see App Fig 6 and 7), suggesting that a solid wedge of concrete was added between the new wall and the exterior of the store north wall to provide a base for the new slipway. The profile surveyed in 1993 (Pattison 1993, 9) shows that the north slipway rose at virtually the same angle as the south slipway and would terminate at near roof level on the north side of the torpedo store. Examination of this area shows that the new area of slipway is slightly lower than the original and connected to the store roof by a short flight of concrete steps. Two rectangular slots, which could be the bases of rail yokes, are visible in the floor. Beanse (1997, 42) mentions the existence of additional rails running across the roof and connecting the new slipway to the torpedo lift but gives no reference. Smaller slots are visible, close to the top of the traverse wall, the purpose of which is unclear: they could be supports for some form of lightweight shed over the whole installation which otherwise was on display to river traffic passing on the Thames.

The new slipway required a dedicated pulley beam and, in common with the original slipway, this would have been mounted in the concrete block inserted in the former embrasure for the northern gun position of the open battery. Survey of the interior of the gun position reveals a substantial straight-sided opening (0.75m by 0.75m) cut through the top of the cement block in the north-west corner. Both ends of the opening are now blocked with brickwork but it is aligned with the course of the new launching slipway. Inside the gun position, placed in front of the opening, is a substantial concrete pillar which has four studs and a rectangular-shaped rust mark in its east face. The pillar stands on two shallow steps which would allow an average

sized man easy access to the opening from the floor of the gun position. In the floor immediately to the south of the pillar is a slot. Examination shows that this is very carefully shaped, constructed in smooth, hard cement and surrounded by a large patch of replaced brickwork. The pillar and steps may also stand on this brickwork. In the Engine Room below, examination of the corresponding area of the vault also shows disturbed brickwork and rendered repairs, and that the slot is carefully angled to allow a wire taken at nearly right angles from the engine steering beam to rise at an angle of nearly 45 degrees through the vault and emerge at the base of the pillar. Such precision would have been achieved by temporarily dismantling a section of the vault and using timber forming on scaffolds to cast the precise angle. This would allow a wire to run from the torpedo to the engine. Using the concrete steps a crew member could presumably pull the wire from the torpedo via the pulley carriage and beam, through the straight-sided opening, and into the interior of the fort threading it over the pulley which was secured to the four studs in the pillar face, and then down through the slot to the engine and winding drum in the basement (Fig 67).

Figure 67: The opening for the north slipway pulley beam in the concrete block that occupies the embrasure of the former northern open gun position. It is located just below the ceiling with the securing studs for a pulley and the shaft leading down to the Engine Room on its left side. On their right is the short flight of concrete steps for access to the pulley beam. (DP097783)

In the floor at the rear of the former gun position is a rectangular hole pierced through the vault below (App Fig 7). To accommodate it a section of the rear traverse wall has been removed and a set back created with the top of the traverse, at least 1m of brick and concrete, carried over the opening on a substantial wrought-iron lintel fabricated from riveted sections. The hole emerges in the basement through the former light passage vault. Immediately to its west is an I-section steel post placed beneath the apex of the casemate vault (Fig 68). Placing the opening in a set back into the traverse wall of the gun position allowed it to be pierced through the shallower vault of the lighting passage and made sure that it emerged at the rear of the engine room clear of either the steering beam or any wire runs across the vault. Carrying out this work may have weakened the casemate vault (from certain angles the crown of the vault looks like it has dropped slightly) and the steel I-section post immediately to the west of the hole may have been put in place to provide support.

Figure 68: The former lighting passage running at the rear of the Brennan Installation. The Engine Room is in the vaulted casement to the right with the later condenser tank and pumps in the adjacent casemate, the entrance to which is just visible at the end of the passage. The rectangular recess visible in the wall on the left side may be connected with the support for the engine steering beam. The manhole that opens into the former open gun emplacement above is in the cut out section of the lighting passage vault. (DP 097528)

Beanse (1997, 42) has suggested that the substantial lintel over the hole allowed a pulley to be slung for equipment to be winched between the basement and the casemates but there is no sign on the lintel of any bolt holes or other mountings for such a device. It is possible that the hole allowed rapid communication by means of a ladder between the Engine Room and the former gun position above. Quick communication between the two areas would be required when the wire from the torpedo on the new north slip was threaded into the fort (and eventually the winding engine) through the opening in the front of the former gun position and then over the pulleys mounted on the concrete block in its interior. As previously explained the wire for the south slip took a different route, running through the slot in the roof of the torpedo store. Without the hatch, a crew member in the Engine Room wanting to get to the rear of the north slip pulley beam would have to leave the secure and protected Brennan casemates and go outside into a fort that could be under fire from enemy warships. With the hatch he could climb up and down the ladder protected by the traverse of the former open gun position. The opening is provided with a sturdy timber frame set flush with the gun emplacement floor. Presumably this accepted an equally sturdy hatch which could be locked when not in use. As an added security precaution the ladder was probably removed.

The former north gun position is now covered with a roof constructed of lightweight iron beams running east-west with concrete poured over them. The beams sit on

top of the concrete anchor blocks and run back to slots cut in the brickwork of the emplacement walls. A ferrous lintel carries the roof slab over the opening cut for the second pulley beam. Four openings are incorporated into the roof, three with cast in rebates for skylights and the fourth an access hatch set against the north wall making use of the traverse alcove from the original gun emplacement to accept a ladder. This may be part of a route from the observation position on the roof to the Engine Room via the hole at the rear of the former gun emplacement. On the ceiling in the south-west corner of the roof, the mark where the south slipway pulley beam has been removed suggests that this was *in situ* when the roof was poured.

Surface Condensers and Heavier Wires

Starting in 1897 the 0.05in diameter wire used to power the Brennan torpedo was replaced by 0.07in diameter wire. This thicker wire allowed more power to be transmitted to the torpedo and so increase its maximum speed to deal with the increasing speed of new warships (Beanse 1997, 16; Kitson 1999, 232). The work to redesign the torpedo for greater speed and upgrade the pulleys and wire paths was constrained by having to maintain the carefully established dimensions (in particular inside the torpedo) and alignments within the installations (Kitson 1999, 233). When the conversion to 0.07in wire took place more steam was needed to produce the greater engine power required. To increase the rate of steam production surface condensers had to replace the ejector condensers which were fitted as a choke on the exhaust which in turn slows the amount of steam admitted and exhausted from the cylinders and so the work done by the expanding steam (Brown 1997, 68; Beanse 1997, 31).

Ejector condensers had been installed to prevent exhaust steam disclosing the location of an installation by recycling it through the boiler water supply instead of letting it escape to the atmosphere via a stack. The generic plan of the boiler room (TNA: WO78/4468) shows that these condensers sat in a small recess beneath the boilers. Surface condensers were larger and more complex, a circuit of tubes encased in a pressure vessel sitting in a water bath. The vessel acted as a heat exchanger with the now condensed waste steam passing back to the boiler water feed (Brown 1997, 166). In the case of the Brennan installations, and following standard marine practice, the water bath was filled with continually circulated sea water supplied by a steam operated Weir Feed Pump (Beanse 1997, 32; Brown 1997, 166).

The extensive surface condenser installation could not be accommodated in the torpedo store, boiler room or engine room which were already full of equipment. It formed a vital section of the engine and so could not be placed outside the bombproof casemates and it had to be within a reasonable distance for the steam pipe connections. The solution was to place it in a casemate adjacent to the engine room, in Cliffe's case one of the ammunition stores for the now virtually obsolete 9-inch RML in the southern open battery position (App Fig 6).

The casemate selected to accommodate the surface condenser is immediately south of the Engine Room [60c] (Fig 68). It is almost certain that when the Engine Room was constructed the interconnecting shifting and lighting passages between the two casemates were blocked, as leaving the passage open would have been a security risk; an additional safety risk would be that the steering beam, mounted

above the engine, ran across this passage opening at head height. Probably also for security reasons the passages between the condenser casemate and the adjacent No 17 Shell Store [58] were blocked with brick walls constructed, presumably, when the condenser had been finished. Fragmentary evidence for the removal of the original blocking, to gain access from the Engine Room to the condenser casemate, is visible as a short section of springing projecting out of the passage east wall. In the corresponding position in the west wall are patches of brickwork with a lighter coloured mortar which are presumably repairs where the blocking brickwork was removed. Presumably the need for the condenser, which probably needed little attention when the engine was running, other than occasionally oiling the Weir Pump, outweighed the safety hazard of the steering beam running across the passage entrance.

In common with all the modified basement casemates the axial dividing walls of the ammunition stores have been removed, though not as thoroughly as in the adjacent casemates. At the lighting passage (east) end of the casemate its junction with the remains of the partition wall is still visible, covered over with an uneven coat of render. At the west end of the casemate the removal of the corresponding section of partition wall between the ammunition store and the shifting passage is neater with the course of the removed wall detectable as a lighter coloured scar running in the rendered vault. In the crown of the vault the circular opening for the ammunition hoist has been left open. On the north side of the casemate the dividing wall between the former ammunition store and the branch lighting or shifting passage has been left *in situ*, its brickwork visible beneath a thin coat of render. A shallow horizontal slot cut back into the vault may be where the sandstone lintel for the doorway noted in the corner of other ammunition stores has been removed. In this wall are a large number of fixing points, studs and the scar of a large, rectangular structure formerly attached to the wall.

The entrance from the lighting passage into the branch shifting passage has been blocked or extensively rebuilt. Offset to the north side of the blocking is a rendered recess stretching from the floor to the vault. Two steel pipes, cut off just ahead of the point were they angle downwards, project from the centre. Above these are a number of fixing studs. Against the north jamb is a large diameter iron pipe rising from the floor.

Cut into the base of this wall is a channel 1.25 m deep. This channel runs from the torpedo room along the south wall of the engine room then beneath the recess ending in the condenser casemate where it stops mid-way along the north wall. There is a deep hole in the floor at this point close to the north wall although it is not visible due to the water level. To the east three studs are just visible above the water.

The tank for the condenser is contained within the now-sealed former branch shifting passage. In the south-west corner of the engine room part of the shifting passage vault has been reused to create an access hatch into this sealed area. Neatly inserted into the blocking, leaving a patch of reset brickwork to the east of the opening, is the timber frame for the hatch. Looking through this hatch the rendered edges of what is almost certainly a water tank can be seen five or six courses below the opening. Both the river water supply pipes to the tank and the out and return steam pipes to the condenser must have run into this tank through the recess in its

east wall. Presumably some pipes ran into the condenser while another pipe drained the tank and all the condenser pipework ran in the substantial slot running at the base of the relevant walls in the torpedo store, engine room, passage and tank. River water pipes presumably followed the course of the slipway up the glacis and then entered the installation through the torpedo store. The steam pipes ran back from the engine to the boiler room where the condenser drain pipe would connect into the drain pipe from the old ejector condensers. The four studs and the hole in the former ammunition store floor presumably indicate the location of the Weir feed pump which kept the river water continually circulating. It required its own steam supply and this would follow the same route as the engine steam pipes. The construction of the surface condenser is the largest piece of evidence for the conversion to 0.07in wire. All the other modifications were made in the torpedo mechanism or involved areas of the installations that have left only marks such as the pulley system and the steering mechanism (Kitson 1999, 243).

Difficult to associate with any of the standard machinery in the Brennan torpedo casemates is the course of a substantial pipe that ran down the north wall of entrance passage having entered it above the doorway by a hole in the brickwork just below the roof. A series of substantial iron brackets then carried the pipe towards the boiler room where a chiselled out channel and further iron brackets mark its horizontal course along the north wall from the lobby area. The pipe may have then returned north into the hydraulic tower casemate through the now blocked hole in the casemate wall. It had been removed by 1915 since the photograph of the parade ground of that date shows a brickwork patch in the position of the hole into the entrance passage (Fig 49). The pipe is unlikely to have been an exhaust pipe as it would betray the position of the fort. Given the pronounced slope and direction it might be a water supply pipe for either the engine or hydraulics. The likely location of water tanks on the laboratory roof was reused in 1915 to accommodate the recreation hut for the 6-inch gun battery (see Chapter 9).

The Rising Tower

From its inception the arrangements at Cliffe for the direction of the Brennan torpedo must have been unsatisfactory. The specifications for Brennan torpedo installations stated that observing towers for directing the torpedo should be set at a height of 40ft (12.2m) above sea level and that best results were obtained from observation positions located directly behind the launching slipway (Kitson 1999, 243). The problem at Cliffe was that the highest point of the fort roof is only 14ft (4.27m) above sea level. The provision of remote observation stations or the dual use of the posts constructed for the minefield control officers may have partially solved the problem but the post that appears to have been established on the highest point of the fort roof and almost directly behind the slipway was still 25ft (7.6m) too low. Any permanent structure intended to raise the observation position would give away the location of the fort and act as an aiming mark for enemy warships. The alternative solution, used at Plymouth, Cork and Hong Kong, of an observation point established on the higher ground would, in the case of Cliffe, be too far away to see the torpedo.

The design and construction of a rising and retractable tower for the directing station at Cliffe Fort is of uncertain date but appears to have begun as an experimental project at the Brennan torpedo factory in 1895-6 as a one-off after the production run of the Mark 1 0.05in wire torpedoes had finished (Kitson 1999, 216). Other than the note 'site of former rising tower' on the 1916 oil store plan (TNA: WO78/4963) and an oblique reference to `an observation turret' in a newspaper article concerning the accidental sinking by the Cliffe installation of the Ketch W.S. Flower in August 1901 (Beanse 1997, 43) a passing mention in a 1926 letter from Brennan is the only other reference to its existence:

> observing stations; electrical signal transmitting mechanisms [and] a rising bullet proof tower at Cliffe Fort on the Thames that ascended 40ft from the top of the fort so as to get a better command of the river and disappeared in a few seconds. (Brennan to Hoare [Secretary of State for Air] 19 Feb 1926, Kitson 1999, 217)

Brennan's colleague Robert Graham added that the tower was constructed of steel and could be hydraulically extended (Kitson 1999, 217). Kitson (1999, 217) makes the intelligent observation that the tower rose 40ft (12.19m) in total but the exposed section above the casemate roof only need rise 25ft (7.62m). The height of the fort roof, 14ft (4.27m) above sea level, combined with the 25ft (7.62m) projection of the tower, would produce the 40ft (12.19m) required in the Brennan specification as the minimum height.

Hydraulic lifts, presses and cranes were an established technology by the 1890s. Since the 1870s the Royal Navy had used hydraulic machinery to operate the traverse, elevation and ammunition lifts in the gun turrets of major warships (Brown 1997, 60). Machinery such as this would be readily available from Woolwich or Chatham. Hydraulic machinery for operating lifts was also in everyday use, however standard lift machinery would not work at Cliffe Fort. Domestic lifts had the pulleys mounted at the top of the shaft which would leave them projecting above the fort and vulnerable to incoming fire. The same observation applied to the machinery of the shell lifts on major warships. At Cliffe the machinery would have to be installed under cover in the fort and push the tower up rather than pull it via a pulley system. This suggests some form of rising hydraulic platform akin to the telescopic inspection platforms found in garages or telescopic tubes akin to a giant car radio aerial. So far no contemporary analogous installation has been identified and the mechanism at Cliffe, as could be expected from Louis Brennan, was probably unique. The observation position itself may have been similar to the static example installed projecting from the body of the fort at Garrison Point in 1901-2 which was a steel elliptical plan cupola 4ft 6in (1.3m) in diameter, just large enough to house a directing officer (TNA: WO78/4430).

The existing static observation position at Cliffe provided an ideal location for the mechanism of the rising tower. It was already the optimum location (at the head of the slipway) for a director tower and an access route for the directing officer, via the doorway in the east gable and along the walkway, or via the ladders and hatches from the engine room, was already established. Beneath the observation position is the blind Casemate 15 (not used as a gun position) and below this No 15 Shell Store [104] which was probably redundant at this date. The availability of this space

must have been a key consideration in the design and construction of the retracting tower. The casemates provided plenty of room for experimental machinery without compromising the working of the torpedo installation, the vulnerable mechanism (mainly consisting of pipes full of water or oil held at high pressure) would be protected by the casemates against enemy fire and like the rest of the Brennan installation it could be physically isolated from the rest of the fort.

The minimum plant required for the rising tower would be a hydraulic pump, water or oil reservoir, a hydraulic accumulator, operating valves and the operating machinery of the tower. All of this would require its own pumping engine with a supply of motive power. At this date either steam or gas seem the most likely options. This would certainly be a dedicated installation for the operation of the tower machinery. Contemporary plans do not show any other supply of hydraulic power in the fort, such as disappearing gun mounts, and it seems unlikely that steam could be spared from the Brennan boiler room to operate a hydraulic pump given that the boiler plant had just received an extensive upgrade to provide the higher power required by using thicker driving wires for the torpedo. The adaption of the casemates below the observation position could certainly accommodate this equipment and the holes, sockets and a large steel collar suspended from the casemate vault bear witness to its installation. It has not proved possible, however, to gain a clear indication of how the machinery worked or its exact location.

In common with all the basement casemates modified for the Brennan installation the walls of No 15 Shell Store [104] and its associated branch lighting and shifting passage were removed leaving the casemate open from the face wall of the fort to the east wall of the lighting passage. The scars of the former store and passage walls are visible on the vault at the east end of the north wall including one of the blocked passages through the casemate wall found in the corners of several ammunition stores (see Chapter 6).

Pierced through the vault of this casemate are two large holes (App Figs 6 and 7). The hole in the north-west corner is almost square (2.03 by 1.96m), driven through the section of vault over the former shifting passage. In the west (face) wall, beneath the hole, the recess for the ammunition lift for the gun position in Casemate 14 has been blocked leaving the lintel *in situ*. To the north of this blocking is a substantial cast-iron circular mounting for a speaking tube, the other end of which now emerges through the floor of Casemate 15 against the west wall. The north edge of the hole is aligned with the foot of the north wall of the western half of Casemate 15. At the foot of this wall in the basement a shallow (0.5m) set back into the vaulted opening of the now blocked shifting passage has been retained. The floor beneath the hole and indeed the western half of the casemate is obscured by a large mound of (mostly) ashes heaped against the casemate end wall. Around the hole all the exposed edges of the vault brickwork have been rendered over with concrete and on the south and east edges this extends up to the floor level of Casemate 15 above, forming a concrete surround to the hole. At gun floor level and set into a raised lip on the east side of the hole, are two stanchions for a handrail which extends from a recess cut into the brickwork of the north wall. There is no evidence for a similar arrangement on the south side of the hole.

The second hole is circular, driven through the former lighting passage vault; it is

aligned on an east-west axis with the square hole. To form the hole all the brickwork of the passage vault has been dismantled and replaced with cast shuttered concrete, 2m thick. In the north wall of the former passage a section of brickwork between the now blocked passage entrance and the former magazine entrance has been removed and replaced with shuttered concrete keyed into the surrounding wall. The corresponding section of the south wall has been removed entirely and replaced by further shuttered concrete which forms in plan a block which fills the footprint of the former lighting passage. In the floor of the former passage, immediately below the hole in the vault is a pit. This was full of water at the time of survey and was not investigated. A new entrance into the casemate is located immediately to the west of the concrete block, pierced through the casemate wall from the boiler room. In this irregularly vaulted passage the damaged brickwork has been liberally covered with render. A note on the 1916 'Oil Store plan' (TNA: WO78/4963) indicates that it was closed on the store side by a gate.

To the west of the new entrance, the south wall of the casemate contains a number of scars and openings. A 0.6m wide hole has been cut into the wall just above the springing of the vault and runs horizontally into the wall for around 2m towards the boiler room; it appears to be blocked at that end. Evidence for the casemate's former use as a shell store remains in the crown of the vault: a blocked circular ceiling vent is visible and flanking it are two shallow rectangular recesses, the southern one containing a large iron lifting loop.

Above the western half of Casemate 15 is partitioned from the adjoining open battery and casemated battery by brick walls built on its north and south sides, probably to reinforce the vault for the mounting of QF guns on the roof (see Chapter 9). The installation of machinery for the rising tower may explain the inserted tunnel running through the foot of the south wall (Fig 69). The opening has a semicircular arch and leads into a narrow (0.75m) and low (0.78m) vaulted passage that runs parallel to the face wall and emerges into the end of the ammunition supply passage through the north wall. In the walls at both ends of the tunnel disturbed brickwork particularly above the heads suggests that they and the tunnel are a later insertion and so could be associated with the rising tower machinery. Given that this tunnel heads back towards the position of the chimney flue for the main boilers it is reasonable to speculate that it accommodated a connection between the steam plant of the hydraulic pump and the existing boiler flue. Unfortunately the end of the ammunition passage was altered during the work to rebuild the boiler room as an oil store.

A number of slots and holes that either accommodated substantial timber, such as joists, or acted as the mountings for machinery, are cut into the walls of the western half of Casemate 15. In the west wall, 1.65m from the ground, are eight pairs of rectangular holes regularly spaced at 0.88m centres and below these at the south end of the wall are a pair of horizontal slots 0.12m by 0.02m set at 0.77m from the floor. At the north end of this wall immediately below the springing point is a recess 0.33m square and 0.25m deep; set at the same height in the north wall close to the corner are two further rectangular holes. In the south wall above the entrance to the passage are three pairs of regularly spaced (0.88m centres) rectangular holes placed at the same height as those in the west wall. The coincidence of these holes suggests a mezzanine at this end of the casemate.

Figure 69: The southern wall of Casemate 15 showing the low tunnel that may have been inserted to enable the installation of the machinery for the rising tower. (DP097642)

The floor of this half of Casemate 15, in the area not covered by the concrete surrounding the holes, is composed of loose earth and rubble over the exposed brickwork vault of the casemate below. Close to the west wall and running parallel to it are three regularly-spaced dwarf walls, each three courses of bricks high. The two westernmost walls flank the opening to the passage in the foot of the south wall, at their north end they are incorporated into the concrete surround of the rectangular hole. The easternmost walls run over the concrete plug that seals the vent visible in the crown of the vault in the basement casement. The possible function of these walls is unclear. The partial rebuilding of the fireplace and vent in the north wall may be a result of the insertion of the wall in the western half of the casemate or damage caused by the piercing of the vault.

The circular hole is set centrally in the floor of the east half of the casement, opening into the east end of the former No 15 Shell Store [104] below (Fig 70). The extent of the shuttered concrete replacing the dismantled brick vault can be clearly seen. Set in the edge around the circumference of the hole are regularly-spaced, small (0.15m) slots to accept wrought-iron L-shaped brackets, some of which remain in place. The surviving examples have a bolt hole tapped in the upward facing section of the 'L'.

Directly above this hole is another circular opening 2.0m in diameter pierced through the vault. This aperture has been formed in the same manner as the one in

the floor, with a large section of the brick vault dismantled and replaced by shuttered concrete. An iron frame is incorporated in the concrete, surrounding the hole. Attached to the frame, seemingly by welding, is a rivetted iron cylinder forming a collar around the hole and projecting downwards into the casemate. This collar has been constructed from bent and formed plates with flanges of I-section beam riveted to the top and bottom. In the underside of the bottom flange are regularly spaced studs. In the body of the collar are six narrow slot-like openings running between the flanges. Each slot is flanked by bolt holes at the top and bottom. The collar has an internal diameter of 1.8m.

Figure 70: The interior of Casemate 15 looking west with the iron collar for the rising tower set in the vault. The corresponding hole visible in the floor opens into the former lighting passage and casemate below. On the right hand side of the photograph is the corner of the brick wall inserted to support the 6-pounder gun battery on the roof. The arched doorway on the left hand side of the picture leads to the former open gun positions. (DP097638)

The hole emerges on the fort roof in a near circular collar of poured concrete (Fig 71; App Fig 8) over the assumed position of the original static director post (see chapter 9). The shaft in the centre of the collar has parallel sides but the exterior of the collar is cone-shaped rising from a broad base on the roof of the fort. Inside the cone prominent horizontal marks show several sequential pours of concrete. On the east side of the cone the poured concrete has engulfed the rear of the gable end for the original observation position, two handrail stanchions, a wiring conduit and the flue pipe for the casemate ventilator. In common with the hole in the floor of the casemate below, it has L-shaped brackets or the shallow marks indicating their positions set around the circumference. Their possible mechanical function would be to secure guide rails for the tower against the sides of the hole but this would have left more extensive witness marks and nothing of this nature is visible in either hole. However the lightweight nature of these brackets and their counterparts below suggests that they are later additions to secure boards covering the holes.

The end of the Brennan Torpedo

The Brennan torpedo was declared obsolete in 1906 and it can be assumed that the installations were dismantled after this date. On 29 July 1907 the MP for Gravesend, Sir Gilbert Parker, asked a question to the Secretary to the Admiralty about the state of the Thames defences including if the use of the Brennan torpedo at Cliffe Fort had been 'practically abandoned'. As befits a matter 'of interest in the defence of the United Kingdom' he did not receive a direct reply (Anon 1907, 179:474). Certainly no further documentary evidence for use or the existence of the Brennan installations other than the annotations 'boiler room' and 'rising tower' on the 1916 oil store plans has come to light (TNA: WO78/4963). Other than the converted boiler room, the former Brennan casemates do not appear to have been reused and are remarkably undisturbed with no further inserted walls and items such as the engine bed and securing bolts for pulleys easily detectable. Given the large amount of valuable scrap metal in the pipework and boilers in the installation it is not surprising that few clues other than structural modifications and marks where the fittings have been removed remain. This appears to be the case in the other installations, although Cliffe is in the minority that retain at least a section of their launching slipways in context with torpedo stores and the engine room.

Figure 71: The interior of the collar for the rising tower looking north. The horizontal marks in the sides of the cone mark successive pours of concrete. The steeply sloped ramp between the interior of the cone and the opening in the gable end of the earlier observation position can be seen on the right hand side of the picture. The rod set in the centre is thought to be a mounting for a Second World War light machine gun sitting on an inserted timber floor. (DP097558)

11. SUBMARINE MINING AND DEFENCE ELECTRIC LIGHTS (DEL)

The 1860 Royal Commission report had recommended a floating barrier across the Thames between Coalhouse Point and Cliffe Creek in time of war (Smith 2002, 22). However experience of the American Civil War (1861-1865) and subsequent technical developments in explosives and electricity suggested a new method, a controlled minefield (then know as torpedoes), to restrict passage along the Thames.

In a controlled minefield the mines were moored in position, connected to the shore by electrical cable and exploded by means of an electric battery housed in the test room on shore. These electro-contact mines could be fired by two methods, either an observer on shore pressing a key when a hostile ship was passing over a mine or by the circuit closer method whereby a mine on being struck by a ship automatically exploded – providing the shore main switch was in the closed position. The electrical cables for the purposes of firing were laid on the river bottom and connected into permanent waterproof junction boxes. Each minefield was provided with several firing points each with rangefinders, firing keys and diagrams showing the position of the mines and fixed reference marks on the shoreline. The firing was done by an observer known as the Submarine Mining Officer (SMO) (Baker Brown 1910, 35).

A letter from the Chief Royal Engineer Gravesend to the Inspector of Fortifications dated 12 August 1873 shows that such a scheme had been under consideration since April 1869 when charts had been prepared for proposed 'torpedo' (minefield) sites along the Thames. Discussion of water tanks for storing electrical cable and the location in the Thames forts of firing points and stores shows that the scheme was under active consideration. The conclusion was that Coalhouse Fort, at the centre of the area, seemed to be the best positioned as the firing and observation point (TNA: WO30108/233). However, the scheme was eventually carried out with Shornemead Fort adopted as a Submarine Mining Establishment and commissioned in 1878 at a cost of £3393 (TNA: T1/16171). The minefield formed the foundation of an integrated defence scheme to restrict an attacking warship's passage around Hope Point. This scheme included the heavy guns of the forts, augmented in the late-19th century with searchlights and quick-firing gun batteries, and later enhanced by the installation of the Brennan torpedo battery at Cliffe.

Remaining fragmentary physical evidence within Cliffe Fort and some documentary evidence suggest that the fort accommodated a directing position and the attendant electrical supply system, eventually including searchlights, for the operation of part of the extensive controlled minefield that would be laid from the establishment at Shornemead in the event of war.

Engine House and Dynamo [70, 71] Test Room [72]

The Engine House, Dynamo and Test Room are located at the north-east corner of the fort, set into the earth rampart and placed between the two entrances to the basement (see Chapter 6). The construction of the buildings, particularly the use of the rampart wall as the rear wall and their presence on the outline 1891 drainage plan (TNA: WO78/3427), suggests that they are either original buildings or early

additions to the fort as does the close resemblance of the front wall of the Test Room to those in the barrack and service ranges

Test Room [72]

The brick-built north, east and west walls of the rectangular plan building are 4ft (1.25m) thick, while the front (south) is a conventional 9in (0.28m) wall with one doorway and one window (App Fig 1). Both openings have segmental arched heads as in the domestic ranges, but in yellow stock brick rather than the rubbed reds of these ranges. This difference may suggest lower status as a store or technical building, or may imply construction shortly after the completion of the main gorge buildings. Internally the walls are of bare brick with traces of whitewash and blue paint, and the roof is of Fox and Barrett-type construction, the beams sitting on sandstone pads. The roof is distinguished by having three jack arches, the only examples in the 19th-century buildings in the fort. This construction would have produced a load bearing roof, either for a structure on the top of this building or to support a thick bombproof layer. The current roughly-formed concrete-slab roof is a later addition and stops short of the wall faces (Fig 72).

Figure 72: The interior of the Test Room [72] showing the vaulted roof and the various marks on the walls showing the positions of the connection boards and benches. (DP 097565)

The location of the building in the rampart and its thick walls and jack-arch roof suggests that it was provided with greater protection than the surrounding buildings. This would accord with the description of the test house at the East Glacis at St

Mawes Castle, Falmouth, which was constructed under cover for 'the purposes of concealment and protection against enemy gunfire...' (Linzey 2000, 220). This was because the Test Room contained numerous batteries (supplying the current to detonate the mines) along with the terminals from the wiring running out to the moored mines and the test instruments for checking the electrical connections. A hit on the Test Room would disable a section of the minefield. At Cliffe confirmation of the presence of batteries, which at this date would be wet cells filled with a strong acid or alkali, is provided by a band of bitumen at skirting level suggesting that the floor was originally tanked with this chemically-resistant substance. A slight north-south slope and a drain in the foot of the wall in the south-east corner suggests that the floor was designed so that chemical spills could be flushed away.

Fragmentary evidence for the probable wiring runs from the moored mines are visible at the top of the rear (north) wall of the Test Room where two ceramic pipes emerge in the ceiling close to an iron pipe (0.30m in diameter) or conduit which has been cut back flush with the wall. Beneath them are numerous missing headers and marks which suggest the positions of sockets for timber mounting boards for instruments and a substantial test bench running the length of the room; in the east wall similar features suggest the same arrangement. Baker Brown (1910, 40) states that the firing keys for the mines were placed on their own table separate from the test equipment, with the batteries on stands placed around the room and the connecting leads fastened round the walls as required. In the west wall three ceramic pipes - one large pipe (0.19m in diameter) with a pair of smaller pipes (0.10m in diameter) immediately to the south - all end flush with the wall surface as they emerge into the room. Closers in the brickwork on the north side of the larger pipe suggest that it may have been inserted during construction, but on its south side the thick mortar course around the smaller pipes has obscured the surrounding brickwork and suggests that these smaller pipes are later insertions. These pipes or conduits emerge in the adjacent Dynamo and Engine House [70, 71].

Dynamo and Engine House [70,71]

The Dynamo and Engine House [70 and 71] (Fig 73) is immediately west of the Test Room and has seen considerable alteration. The 1891 plan (TNA: WO78/3427) and the 1897 Ordnance Survey 1:2500 map (surveyed 1895) show a different outline for the buildings to that on the 1899 plan (TNA: WO78/4963). On the earlier plans the front wall is set further back leaving a pronounced step between it and the adjacent building. Examination of the buildings shows that their north wall, which is built back to the earth rampart, is rendered on its south face and this extends, along with a plaster beading at dado rail height, on to the northern halves of the east and west walls, suggesting that all three are contemporary. The southern halves of these walls are not rendered and study of the brickwork shows keyed-in joints between the two halves suggesting that this brickwork is a later extension to the south. The associated south (front) wall has been removed completely and replaced by a new wall of steel posts and brick panels set further to the south to increase the size of the building. It is thought this wall dates from the Second World War (see chapter 12). The witness mark for the position of the earlier front wall (which is shown on the 1899 plan; App Fig 1) can be clearly seen in the southern half of the east wall.

Figure 73: The interior of the Engine and Dynamo House [70, 71]. The later (presumed Second World War) steel-beam and ribbed-section roof can be clearly seen. The black stripe running across the roof indicates the position of the former dividing wall between the Engine and Dynamo Rooms. The corner of the engine base can just be seen to the right of the picture. (DP 097558)

This physical evidence and comparison with the plan and section of this building on the 1899 plan (TNA: WO78/4963; App Fig 1) with the plan and section of an engine, dynamo and test house for the submarine mining section at St Mawes Castle built in 1901 (TNA: WO78/4095) suggests that the buildings may be the fragmentary remains of a steam engine house built circa 1890, converted to an oil engine house circa 1899, and finally to a diesel generator house circa 1941 (see Chapter 12).

The Royal Engineer and Royal Artillery Committee account of the experiments with searchlights conducted at the Thames forts on 29 and 30 October 1890 mentions that Cliffe was provided with a permanent steam engine and dynamo set (TNA: WO33/396). Initially this was to charge the wet batteries kept in the Test Room. The steam engine house for the same duties at St Mawes Castle, Falmouth is described in contemporary accounts as a timber shed (Linzey 2000, 220) and it is possible that the north wall and the northern sections of the east and west walls of the buildings at Cliffe could be the remains of a traverse around a similar structure erected and then extended and incorporated into a later brick-built engine house.

In 1896 a new steam engine house for the submarine mining section at St Mawes Castle was constructed of brick and concrete. Its conversion for two Hornsby Ackroyd oil engines in 1901 is detailed in plan TNA:WO78/4095 (Linzey 2000, 254). This plan shows a building bearing a close resemblance to the one detailed on the 1899 plans and sections (TNA: WO78/4963) of Cliffe Fort. Both single storey

buildings are shown as heavily traversed, rectangular in plan with thick walls and thick (3ft, 0.90m) concrete roofs. The front walls have a single wide entrance for a pair of doors and openings for 6ft (2m) high casement windows with opening toplights. Immediately adjacent to both is a Test Room, and in the case of St Mawes, with a connecting internal doorway. Internally both buildings have an I-section steel beam running on the longitudinal axis (in the case of the Cliffe building this is east-west) placed hard against the soffit of the concrete roof. Both beams are displaced towards the rear of the building acting more as a partition than as a structural member. The St Mawes plan shows that the narrow bay created by this beam housed three dynamos, partitioned from the engines in the rest of the building by timber screens. On the 1899 drawings (TNA: WO78/4963; App Fig 1) of Cliffe this I-beam (which is still *in situ*), and a brick wall beneath it, which would form the same narrow bay as at St Mawes, is shown in section but not in plan. In plan, a brick wall with a sliding timber door midway along its length, is shown running north-south and creating a small dynamo room at the building's west end.

Examination of the buildings at Cliffe reveals evidence for the course of both walls; the course of the foot of the longitudinal east-west wall is shown by a presumably earlier mounting plinth of blue engineering brick and concrete (perhaps for a steam engine) which has been cut back on its south side to align with the south edge of the I-beam above. It is also noticeable that the sections of wall covered in render and the beading at dado level extend to just past this line, perhaps evidence of a clean room for the dynamos and the position of a timber partition. Close to the north-east corner of the building are the cut back and rendered over remains of the north-south wall shown on the 1899 plan. It may be that the section shows the oil engine arrangement while the plan shows the earlier steam engine arrangement.

In section both the buildings at Cliffe and St Mawes are depicted with large Stones-type rotating vents rising through the roof slab. At Cliffe these emerged in front of two rectangular structures on the Engine Room roof. These are not on the St Mawes plan and study of the oil engine maintenance diagram in the Coalhouse Fort record book (TNA: WO192/48) suggests that the Cliffe tanks would have been reservoirs for cooling water. The current concrete and steel trough roof has no evidence for any of these fittings and is probably a replacement for the roof shown in the 1899 section (TNA: WO78/4963).

Both the St Mawes and Cliffe engine rooms are shown with cylindrical steel oil tanks sitting on concrete and steel rail platforms against the front wall. Both were also provided with an oil store and at Cliffe this was built outside the fort against the face wall of the north-east bastion. It is shown on the 1899 plan (TNA: WO78/4963; App Fig 1; Fig 74) but not on the 1897 Ordnance Survey 1:2500 map; the 1908 edition of this map gives an indication that it was partially buried in the glacis. It is still *in situ* and any earth covering has been removed revealing a rectangular plan building with thick brick walls (shown as 2ft [0.60m] on the plan) in an irregular English garden wall bond. The building has a thick 0.90m (3ft) oversailing concrete slab roof, no windows and a single entrance in its south wall, the wall nearest to the fort entrance. The interior was not accessable at the time of survey. The building is pulling away from the face wall of the fort leaving a gap 0.30m wide in places. Examination of the

1899 plan shows that the store has its own rear wall and the north and south walls extend beyond this to butt against the fort, presumably to carry the heavy slab roof to a junction with the face wall of the fort. A pipe can be seen protruding through this wall, although the 1899 plan does not show any supply pipe to the engine room. The building appears to have been constructed before 1903 as a tell-tale on the crack between the face wall of the fort and the concrete roof carries that date. A similar building was constructed at Shornemead by 1901 and stored oil in bottles or barrels (Smith 2007, 82).

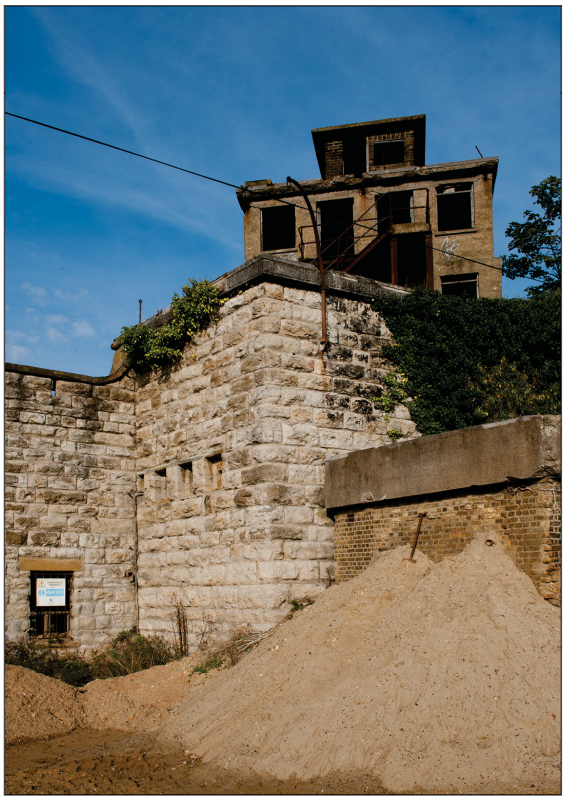

Figure 74: The external oil store located outside the north-east bastion. (DP097698)

A drawing dated 1916 shows the conversion of the casemate housing the former Brennan boiler room [60b] into an oil store (TNA: WO78/4963). This might have been intended to replace the oil store outside the fort [105] due to its vulnerable position. In the former boiler room casemate the majority of the work was concentrated on the floor but due to flooding this was not visible at the time of survey. Examination of the walls of this casemate shows that the work in these areas conforms to the 1916 plan and section (TNA: WO78/4963). At its west end the brick-built mountings required for the Cornish boilers have been removed leaving only short brick piers at the foot of each wall, as detailed on the conversion plan. At the east end of the casemate a Fletton-brick partition wall 9in (0.28m) thick, rising from floor to vault and incorporating a centrally placed doorway for a pair of doors has been inserted, separating the body of the casemate from the former circulating and stoke hole area. On the roof the remains of a short brick stack, for mounting the Stones type ventilator which is shown in section over the former boiler flue, is still *in situ*. The 1916 plan and section show that the floor of the boiler room was levelled with concrete but incorporated a shallow slope into a centrally-placed drain. The

cylindrical oil tanks were located in rows sitting on supports made from concrete and tramway lines. A 1in diameter feed pipe ran under the floor presumably reusing the course of the water feed pipes to the Brennan boilers, and after running beneath the parade ground emerged at the Dynamo and Engine House [70, 71].

Submarine Mining Observation Posts

The 1899 roof plan (TNA: WO78/4963; App Fig 3) shows a Submarine Mining Officer (SMO) position adjacent to a DRF (depression range finder) position on the fort roof above casemates 9 and 10. This SMO is incorporated in the wing walls of the A group of the quick-firing battery and may be a replacement for an earlier position (see below). The plan shows a levelled quadrant (labelled as 43ft [13.10m] above the fort datum) set in the apron in front of the SMO, probably the mount for the slate table for the rangefinder and minefield indicator board. Circles in each corner of the SMO suggest supports for a roof; the SMO position at Shornemead is thought to have had a steel roof (Barratt 2008, 12). The SMO position at Cliffe was incorporated into a larger battery commander's position when the barbettes for 6-inch guns were added to the roof in 1913 (see Chapter 9). No indication is given on the plan or by examination of the fort as to the wiring run between this position and the Test Room.

Evidence of an earlier network of observation stations is provided by a letter and plan sent by the Chief Royal Engineer, Gravesend to the Sewer Commissioners at Rochester in October 1888. This requests permission to construct what the plan titled 'Proposed Observing Stations for Thames Defences' in the sea walls near to Cliffe, Shornemead and Coalhouse Forts (CKS: NK/AC/1/17). The plan shows these to be SMO posts with the characteristic levelled slate shelf for the mounting of the depression range finder telescope inside. The slate in these particular posts is 5ft (1.5m) higher than specification and Victor Smith (pers comm) suggests that this is to place the observation aperture above the high water level in front of the sea wall. The observer may have been provided with a timber stage on which to stand. The use of the label 'observing arc' on the drawing confirms that these positions were for use with submarine minefield depression range finders (V Smith pers comm).

The plans submitted to the Sewer Commissioners contain no indications as to the post's location. A rapid reconnaissance of the shoreline and study of the 1897 and 1908 Ordnance Survey 1:2500 maps has revealed no further information. If they were built then the posts were almost certainly destroyed by later flood defence works. On the shoreline just above the highwater mark to the north of Cliffe Fort, now in the sheltered area formed by the aggregate unloading pier, are large fragments of brick wall which could be related to these posts though there is no evidence for a substantial slate shelf. These remains may have been identified by the North Kent Rapid Coastal Zone Assessment Phase II (Wessex Archaeology 2005) as Kent HER TQ 77 NW 1124 (Fig 75).

Responsibility for Submarine Mining was transferred from the Royal Engineers to the Royal Navy under the terms of the 1906 Owen Review (TNA: CAB16/1). Baker Brown (1910, 106) alludes to various submarine mining establishments, mainly in

the British Empire, being taken over by the Royal Marines as a temporary measure. This might explain the recording in the 1911 census return of a detachment of Royal Marines at Cliffe Fort (www.1911census.co.uk 1911 transcript details for Cliffe Fort, Cliffe at Hoo, Kent accessed on 13/12/2010).

Figure 75: The possible remains of either a brick-built Submarine Mining Observation Post or a fixed-beam searchlight position on the shoreline to the north of the fort. (DP 097726)

The observation minefields were rapidly reinstated in the First World War and the Thames minefield extended between Cliffe and Coalhouse in conjunction with a boom (Smith 2002, 39). In the absence of any readily available information on the minefield it is assumed that it followed the principles laid down by its late 19th-century predecessor. Observation and firing points could have been established at both Cliffe and Coalhouse, utilising the command and control facilities already established for the examination batteries. The only impediment to this would be inter-service rivalry as the minefields were now controlled by the Royal Navy and the forts by the Royal Garrison Artillery. The minefield control position at Cliffe may have been located in the ground floor of the Battery Observation Post where the presence of a large slot in the east wall close to the floor may be the entry and exit point for cable runs (see Chapter 9).

Defence Electric Lights

Defence Electric Lights (DEL) were co-located with controlled minefield establishments because the mines had to be fired by a shore-based observer who needed to see the target at night. In conjunction with the QF batteries (see Chapter 9) the lights also acted against 'countermining, creeping and sweeping', all tactics successively employed by the Royal Navy in the exercises of the 1880s (Baker Brown 1910, 74; Brown 1997, 84). No available source is absolutely clear on when the Defence Electric Light (DEL) was adopted for land-based use. Baker Brown (1910, 74) states that experiments were made as early as 1871 and 'practical steps' by the 1880s. By 'about 1890' some 50 lights, many of low power, had been provided at the various ports. Brown (1997, 84) suggests that widespread installation of the DELs commenced in the later 1880s after a series of exercises had allowed the Royal Navy to demonstrate to the Royal Engineers that their minefields could be breached by attacks at night.

There is little available documentary evidence concerning the installation of DELs at the forts on the Thames. The plan entitled 'Thames Defences Cliffe Fort, Site Plan' (TNA: WO78/4963), which dates to the late 1880s or early 1890s (it includes the Brennan torpedo slipway) shows the arcs for the 12.5, 11 and 9-inch RMLs and 12-pounder QF guns but no searchlight arcs. The Royal Artillery and Royal Engineers Committee report on the searchlight experiments held at the 'three Thames Forts' on 29 and 30 October (TNA: WO33/396) states that Cliffe Fort had a permanent (steam) engine and 'appliance' (dynamo?), the light being temporarily sited some 150 yards (137.16m) from the fort between it and the cement works. Shornemead also had a permanent engine although this was out of action and replaced by a 'steam sapper' (military traction engine). A similar arrangement was made for Coalhouse which did not have a permanent engine.

A version of the 1897 Ordnance Survey 1:2500 military map dated 1904 (TNA: WO78/5125) showing the searchlight and gun arcs for Cliffe, Coalhouse and Hope Point batteries, shows two searchlights towards the southern end of the fort. Both the lights at Cliffe are noted as having fixed 30 degree arcs, the standard configuration for lights used in conjunction with minefields (Linzey 2000, 201). It is also notable that they are numbered in sequence as numbers 3 and 4 with the lights at Hope Point (1 and 2) and Coalhouse (5 and 6). This suggests that all the lights were under a single command, probably based at Coalhouse.

The approved Defence Electric Lights return for March 1918 lists three searchlights at Cliffe: No 1 searchlight, a 90cm concentrated moving beam, and No 2 and 3 searchlights, 120cm concentrated moving beams, all powered from the engine room in Cliffe Fort (Dobinson 2000, 247). Another annotated copy of the 1897 Ordnance Survey 1:2500 map (TNA: WO78/4963) shows the Defence Electric Light Emplacements at Cliffe Fort on 26 November 1918. These are still numbered 1, 2 and 3 (Dobinson 2000, 247). At Cliffe, No 3 is shown at the south-west corner of the fort on top of the glacis. No 2 is on the glacis about where the masonry wall marks the transition from the open to casemate battery, and No 1 on the glacis in front of Casemate 5 or 6. A table drawn on the top of the map lists the length, height, width, construction and personnel for each emplacement. No 1 is a timber building 9ft 6in

(2.89m) by 9ft 2in (2.79m) with a roofing felt, 'Rubberoid' and timber roof, a wooden floor and room for one man. Emplacement 2 is virtually identical to 1 other than for a concrete floor. Emplacement 3 has a steel roof and a concrete floor but otherwise is similar to its counterparts. The fire command chart for Coalhouse included in the *Fort Record Book 1911-1943* notes that all three lights mounted at Cliffe are 3in traversing beams (TNA: WO19/248). This suggests that the fixed lights initially provided for use with the submarine minefield were replaced by concentrated traversing beams for use with the 6-inch battery. This work was carried out at Pendennis Castle in the early 1900s, shortly after the mounting of 6-inch BL guns, as the lights for use with the 6-inch guns needed to be parallel with the water and in positions where they would not be obstructed by smoke from gun fire (Linzey 2000, 239).

The 1918 plan (TNA: WO78/4963) is referenced as the source of information for the annotations on a 1:2500 plan of both Coalhouse and Cliffe forts dated by its annotations to 1936. The presence of only one Brennan slipway at Cliffe suggests that the 1895 Ordnance Survey was used as a base map (TNA: WO78/5134). On this plan all of the mounting and DEL information for both forts on the 1918 plan has been transcribed and then subsequently struck out and the word 'withdrawn' appended to each block of text. This suggests the two forts were finally decommissioned as coastal artillery stations by 1936; subsequently Coalhouse would be recommissioned in 1940 as an Emergency Battery and Cliffe Fort, after its sale to the Alpha Cement Company, would become a base for the Royal Navy Auxiliary Patrol Service (see Chapter 12).

12. CLIFFE FORT 1919 - 1970

The only documentary sources identified that indicate when Cliffe Fort was disarmed and decommissioned as a coastal defence establishment are an index plan to the Thames defences (TNA: WO78/5134) dated to 1936 by its catalogue description and the last known armament return for Cliffe Fort dated 12 November 1927. This armament return, which lists two 6-inch guns at Cliffe, is part of a national survey preliminary to the decommissioning of selected coastal defence establishments that began in the late 1920s (Dobinson 2000, 145, 220). The comprehensively annotated 1936 plan uses the Ordnance Survey 1:2500 confidential military survey undertaken in 1895 as a base. It records details of the two 4-inch QF guns installed at Cliffe in 1918 and the accompanying searchlights as well as other relevant technical information appended in table form, the majority of information being taken from a plan dated 1918 (TNA: WO78/4963). The tabulated information and all of the annotations have been struck out and the phrase 'withdrawn' added as a suffix to each block of information. The last annotation date on the plan is 1936 (hence the catalogue description) and the most probable occasion for this wholescale amendment would be when Cliffe was decommissioned as a coastal artillery station. This work was probably undertaken prior to the fort's sale, suggesting it could have taken place sometime between 1936 and the outbreak of the Second World War.

It is clear from an aerial photograph taken in 1941 (Fig 76) that Cliffe Fort had not been used as a coastal battery for some time. In the Thames, immediately to the north-west of the fort, is a substantial pier with three large cranes, presumably constructed by the Alpha Cement Company. Ground photographs taken in 1993 show a structure of cross-braced reinforced concrete posts (HEA AA9302488) which would have interupted the fort's field of fire. To the rear (east) of the fort the ditch and fence in advance of the gorge face were breached by a new bridge for a tramway connecting the pier to the company's works to the east. This tramway ran right across the entrance to the fort clipping the glacis in the process before following the former military road. Its course is still in use as the route of a conveyor belt for moving sand and aggregate unloaded at the modern, smaller, successor to the concrete pier.

Figure 76: Cliffe Fort on an extract from an aerial photograph taken in 1941. The areas with white highlights may indicate construction work. RAF 26/ UK/1455 2045 14-March-1941 Historic England (HEA) RAF Photography

Given the effort made in 1914 to rearm Cliffe and provide cross-fire with Coalhouse, it is interesting that it was not rearmed with large calibre weapons in July 1940 when 5.5-inch guns were installed at Coalhouse as an emergency close defence battery (TNA: WO192/48). Another two 5.5-inch guns were installed at Shornemead in a new barbette battery to the north of the fort. By 1942 the batteries at Coalhouse and Shornemead were listed as part-time close defence batteries (Gander 1979, 142). This work was probably not carried out at Cliffe because of the Alpha Cement Company's pier with its large cranes which are likely to have interferred with the sighting and firing of any large calibre weapons on the roof of the fort. As noted by earlier surveys (see Chapter 5) Cliffe's low-lying position made the construction of an alternative barbette battery on the fort's flanks impractical.

An important source of information about the fort for this period is a three minute segment on the work of the Royal Navy Auxiliary Patrol (RNAP) on the Thames in a British Pathe newsreel (number 1310.28) entitled *Right Turn* issued to cinemas on 22 September 1941 (www.britishpathe.com accessed 4/12/2011). The demands of wartime censorship and the practice of holding back items to fill gaps in newsreels may mean that the film was made some considerable time before its release. A 15 second shot of Cliffe Fort shows a scene, presumably staged, of a naval gun crew manning a 6-pounder gun emplaced in the northern 6-inch barbette. The individual frames of this sequence provide a wealth of detail for both the gun mounting and the Battery Observation Post (BOP) in the background.

Signal Station

The only documentary evidence for the existence of a signal station is a naval signal dated 3 July 1945: Signal 3906/102/8/45 3.07.45 'Establishment 132 Signal Station Cliffe Fort category B will be reduced [closed] on July 5 1945' (TNA: ADM1/18577). Details of the signal station's role and equipment have not come to light but the 1941 Pathe newsreel concerning the work of the Thames RNAP records evidence for its existence in the background of the footage close to the BOP. To its north is a mast with a single cross tree and visible flag halyards. On its west side, facing towards the river, is a sandbagged emplacement with a cylindrical object mounted on the top which could be a searchlight or signal light. Immediately to the left of this but still in the emplacement is what looks like a ship's deck ventilator but could be, given its small size, a loud hailer or foghorn. Mounted between the emplacement and the barbette is a short mast with a weather vane on the top. The area of the sandbagged emplacement is now heavily overgrown but a substantial rectangular-shaped concrete slab with threaded studs set at each corner, presumably for the mast base, is still *in situ* on the parapet of the north-east bastion. All of this equipment was standard issue for a naval signal station. Port War Signal Stations, somewhat larger establishments, were equipped to signal ships by wireless telegraphy (radio), semaphore via aldis lamp, flag signals hoisted up a mast, signal guns, flares and loud hailers (Linzey 2000, 145). The evidence from the newsreel suggests that Cliffe was equipped to signal by flags run up the mast, light and probably loud hailer. Very close examination of the Pathe newsreel reveals possible telephone lines or radio aerials running from behind the BOP to a post located in the glacis at the front of the fort. A heavily overgrown telegraph pole is still *in situ*.

A black-painted rectangular-plan hut built on the roof of the ablutions and kitchen block with its east wall hard against the gorge parapet wall is visible on both the 1941 aerial photograph (RAF 26/UK/1455/2045 14-March-1941) and a photograph taken from the centre of the parade ground looking east and reproduced undated may be further evidence of the signal station (Cherry 1991, 34). The condition of the fort and the buildings suggest that this photograph may have been taken soon after the withdrawal of the Royal Navy around 1945. The photograph shows a building that resembles a sectional timber hut, gabled north-south, with a brick stack at the south end. The hut floor sits on large joists running across the roof of the ablutions block and the west wall has three irregularly-spaced windows with opening top lights. Given the hut's situation it is very likely that these were the only windows in the building. There is no doorway in this wall and as the visible gable contains a stack the entrance must have been in the north gable, hard against the arched opening into Casemate 1. This casemate may have provided an elaborate combined porch and blast-proof wall for the hut entrance. The small number and irregular spacing of the windows in this hut, rather than the larger number of regularly-spaced windows found in huts used as living accommodation, and its location which uses the casemate and parapet walls as blast proofing, suggests that the hut had a technical use; blast walls and the absence of windows are often associated with measures to protect sensitive signalling equipment such as teleprinters (Monckton *et al* 2010, 144).

The former position of the hut on the roof of the kitchen and ablutions is marked by shrubs and weeds growing in the troughs left by the removed joists (Fig 77). Large sections of corrugated iron, which may have been part of the roof covering, can be found in various places in the fort. A column of missing headers in the parapet wall may indicate the position of the brick stack. A number of steel conduits or pipes inserted in the wall in the north-east corner could be evidence for the route of telephone wires or similar connections to the hut.

Immediately to the east of the hut position is an area of disturbed brickwork, including patches of a cream-coloured brick in the parapet wall, surmounted by a stub of corrugated asbestos roofing set into the wall by enlarging the slot provided for the sandstone slabs of the *chemin de ronde*. Below is a raised concrete floor slab with a scar for a brick-thick (0.12m) dividing wall running north-south. Comparison with the post-war, possibly *circa* 1945 photograph (Cherry 1991, 34) shows a distinctive brick structure in this position, rectangular in plan, with no door or windows in the visible walls and with what appear to be vents placed just below the eaves. Built against its west wall is a brick structure of low height, flat roofed and with similar vents below the eaves. The appearance of this building suggests some type of equipment building like a battery room rather than any domestic use.

XDO Post

The Royal Marines' XDO (Extended Defence Officers) controlled the close inshore observation minefields, nets, booms and similar obstacles to navigation, induction loops (a means of detecting submarines by magnetic effect), the local defence of their naval installation and liaised with the other services concerning wider defence of the

locality (www.pillbox-study-group.org.uk/exdopostpage.htm accessed 14/12/2011). During the Second World War XDO posts were established at Coalhouse and Holehaven (Smith 2002, 43). The argument for the presence of an XDO post at Cliffe is circumstantial. In a web article Peter Cobb (www.pillbox-study-group.org.uk/exdopostpage.htm accessed 14/12/2011) states that XDO posts were established in groups of three or four to ensure that their functions would still be carried out if one or more posts were captured or destroyed. In the case of the Thames he suggests that the three mutually supporting posts would have been Coalhouse, Holehaven and Cliffe. This is an understandable conclusion, particularly as Cliffe Fort was a naval establishment in the Second World War and would have required an XDO officer to coordinate its local defence making the accommodation of the duties of minefield control a straightforward matter. The extensive ground laid observation minefield of the 19th century (see Chapter 9) had observation posts at all three forts, both for rangefinding purposes and because of the technical limitations of the electrical equipment then in use. The same arguments can be applied to the Second World War minefield and it is conceivable that the purpose-built reinforced concrete XDO position at Coalhouse Fort would not have been able to supervise the full extent of a minefield extending around Hope Point (Smith 2002, 43).

Cobb (www.pillbox-study-group.org.uk/exdopostpage.htm accessed 14/12/2011) suggests that the XDO post at Cliffe was initially located in the disused Battery Observation Post (BOP) which was subsequently modified by the addition of a small watch position on the roof for the minefield control. In this way it would resemble the purpose-built tower XDO positions, such as that at Coalhouse, which had three storeys, with the watch position on the roof, communications and chart room below and crew mess room on the ground floor. The purpose-built towers were hardened against attack with thick concrete walls and observation slits rather than windows. The addition of the small brick-built watch position to the Cliffe BOP would produce this three storey arrangement.

Examination of the BOP shows a number of modifications and additions from the Second World War. The most prominent is the look-out post on the roof of the BOP mentioned above. This is visible, lacking a roof or window frames, in the background of the 1941 Pathe newsreel (www.britishpathe.com accessed 4/12/2011). It survives *in situ*, a virtually square plan single-storey brick building, laid in stretcher bond, which distinguishes it from the cast concrete of the BOP. The brick may be salvaged from the interior of the fort. The structure has an oversailing concrete slab roof and the east, west and south walls have a large centrally-placed window beneath a soldier course head. Close examination of the newsreel shows that the heads of each opening are formed from steel joists now concealed by the current brick soldier-course heads. The doorway in the north wall was reached from the first floor landing of the BOP by a ladder secured to the wall, indicated by a missing section of the BOP roof and the remains of a securing bracket. At the top of the ladder the roof around the entrance has a concrete parapet with two handrail stanchions and on the east side of the lookout post is a low concrete platform. These features may be later additions as they cannot be seen on the 1941 newsreel.

The BOP also shows evidence of modification. The ground floor south wall of the

Figure 77: Former position of the possible signals hut on the roof of the entrance range. (DP097582)

BOP was reverse engineered replacing the window and door visible on the 1941 newsreel footage with the current single window opening. This work essentially returned the wall to the general appearance it had *circa* 1915 (Fig 54). Examination of the wall shows that the section containing the door and window openings was removed leaving narrow panels of original material at the corners. To fill the gap a new panel incorporating a sill and set backs for a casement window frame was poured *in situ*. On the exterior the work was made good with a thin coat of concrete render. A similar coat was also applied to the tops of the lean-to gables and a layer of concrete was poured over the timber suspended floor in this structure with the date 21/3/41 scratched in the floor surface.

Superficially this work would have re-equipped the BOP to act as an XDO post. The new position on the roof provided the additional storey and the rebuilding of the west wall and the refurbishment of the lean-to structure would have created a crew mess room with an added degree of protection against blast, though not the level of protection seen in other XDO posts. What throws doubt on this interpretation is the omission of some features which seem characteristic of all other XDO posts. Communication between the chart room and the observation post was usually internal with a hatch in the chart room roof. At Cliffe access to the observation post is via an external ladder. The chart room and the observation room should be connected by wiring conduits for telephones and firing circuits, with further conduits connecting the XDO to the minefield. These were not seen at Cliffe although, for health and safety reasons, the upper storeys of the BOP could not be inspected. An alternative interpretation of the position is as a Mine Watchers Post (one of the duties

of the RNAP, see below); the large windows matching those of the example shown in *20th Century Defences of Britain* (Lowry 1995, 74; 77). It may have been an ancillary lookout to the large and well protected XDO post at Coalhouse

Royal Naval Auxiliary Patrol London (RNAP)

Shortly after the outbreak of the Second World War, Cliffe Fort was described as 'an old abandoned fort now the property of the Alpha Cement Company' (TNA: WO199/2478). By August 1940 it was reported as in use as a base for the London section of the Royal Navy Auxiliary Patrol Service (RNAP) (TNA: WO192/48). Documentary and physical evidence suggets that Cliffe Fort rapidly became a hub of naval activity on this section of the Thames. Along with the small craft of the RNAP, the fort accommodated a naval signal station which remained in use until July 1945 (TNA: ADM1/18577). It is suggested that an XDO (Extended Defence Officer) post or more probably a mine watching post was also present at the fort (www.pillbox-study-group.org.uk/exdopostpage.htm accessed 14/12/2011), although no reference has been found in primary documents.

Some of the first references to the use of Cliffe Fort as a base for the RNAP London division come from a letter dated 18 September 1940 from Flag Officer in Charge, London to Commander in Chief Eastern Command discussing Cliffe Fort:

> I am using part of it as accommodation for a section of the Thames Auxiliary Patrol. I understand from your BGS that it occupies an important position on the flank of your defensive line. I would ask that should you consider it desirable to requisition this fort so as to put it in a state of defence, you would allow the Auxiliary Patrol to continue use of their accommodation. Further, if I can get two 6 pdr guns as I hope to, perhaps you could provide crews to man them. The guns would be sited to cover the river. (TNA: WO192/2478).

An update to the *Coalhouse Fort Record Book*, which was probably made after the 5.5-inch guns had been installed in July 1940, reported that Cliffe Fort was dismantled as a CA (Coast Artillery) Station and had become RNAP base armed with two 6-pounder guns (TNA: WO192/48).

Cliffe was one of five RNAP anchorages on the Thames, the others being Dagenham, Tilbury, Greenhithe and Holehaven (Smith 2002, 43). The duties of the Thames Auxiliary Patrol are outlined within a letter written on 21 November 1941 by Flag Officer in Charge London to Commander-in-Chief Nore justifying the current number of craft allocated to RNAP London (TNA: ADM 116/4581):

> The London RNAP auxiliary patrol consists of the vessels shown in the first column below:
>
> 5 small tugs (withdrawn from commercial use as being too old and broken down)

6 ex Belgian drifters

35 Motor patrol boats

9 small speed boats

3 open motor boats

If the RN Auxiliary Patrol is relieved of the responsibility of meeting an attack by air-borne troops landing in the river, their remaining duties are as follows:

1) Control of shipping mainly the duties of the Naval Control Officer and to inform merchant ships of enemy minelaying and the location of prohibited anchorages

2) Collecting reports throughout the night from 66 mine watching barges and other craft, supporting their personnel and replacing barges whose sinkers have dragged.

3) Minewatching in areas where there is no shore lookout

4) Serving three floating anti aircraft batteries off Blythe Sands

5) One craft permanently allocated for Naval Control Service Officer Gravesend

6) One craft permanently allocated for Degaussing Range

7) One craft for Bomb Safety Officer [bomb disposal] when required

8) Substitute craft for Boarding Officer or Naval Control Service London when required

9) Co-operation with the army in exercises and placing their defensive wiring [barbed wire?]

10) Enforcing admiralty orders in ships in the river

11) Taking kite balloons [a type of small barrage balloon] to and from ships passing Tilbury. 44 balloons have been handled in one day.

12) Training midshipmen RNR from Greenwich

Additionally odd jobs and harbour service craft duties

(TNA: ADM 116/4581)

A report earlier the same year by the Flag Officer London notes that the tugs equipped with 6-pounder guns and the launches armed with Hotchkiss .303 machine guns patrol an area extending from Dagenham to the convoy (assembly) point at Southend and the Yantlet Beacon (TNA: WO199/2479).

By 1942 Cliffe had become an important anchorage for the RNAP. A list of this date shows that the following vessels were located at Cliffe (www. naval-history.net/xDK WW2-420-40RN Ships 2Home.htm accessed 7/2/2011):

Naval Auxiliary Boats - MARGARETTA, NARWALE, PRIDE OF SHEPPEY, SAMAKI, SHEEMAUN, VALTERRY, WESTCLIFFE BELLE, WINDELF, WINONA, ZELEA

Tugs - DIDO, MAUD

Motor Fishing Vessels – Belgian: RENAISSANCE (P.1), ZEE MEEUW (P.7), CLARA SIMONNE (P.10)

A strong argument for the selection of Cliffe as a base must have been the substantial pier and cranes constructed in front of the fort by the Alpha Cement Company. The 1941 aerial photograph (Fig 76) shows no new building or works associated with this pier but a1946 photograph (RAF CPE/UK/1789/4038 11-Oct-1946) shows two large hut-like buildings at the shore end of the pier, just infringing onto the glacis at the north-east corner of the Fort. These could well have provided shore facilities for the RNAP craft based at Cliffe. The larger craft, the tugs and fishing boats could have accommodated their crews but the crews of the patrol boats might have required shore accommodation whilst moored here. Also apparent on this photograph are moorings upstream of the pier and directly in front of the fort.

The physical evidence for the presence of the RNAP at Cliffe Fort is fragmentary. The clearest piece is the lettering A P (Auxiliary Patrol) on the surviving right-hand leaf of the front door to the fort (Fig 78). The door retains patches of battleship grey paint which may denote naval ownership. The casemates of the fort provided near ideal storage for fuel and ammunition. Supplied in drums and boxes, it only required stacking in protected areas. The removal and reversing of doorframes in the ammunition stores towards the northern end of the fort may be evidence of their use as storage at this time. The presence of Belgian fishing boat crews may explain the French notice 'Defense d'afficher' in No 10 Shell Store [98]. This shell store also has a concrete ramp constructed across the threshold and the end of the branch lighting passage has been broken through to provide a direct route between the lighting passage and the store. Other former shell and cartridge stores [92, 96] exhibit one or both of these features, possible evidence of use by the RNAP.

Though the obvious location for ammunition storage for the 6-pounders and their counterparts on the vessels of the RNAP would be the existing facilities in the basement, two examples of what could be Igloo Sheds can be found in the fort. Igloo Sheds were 14-gauge corrugated iron sheeting bent into a semicircle and supplied in 2 to 4ft sections that could be bolted together to form a structure resembling an Anderson shelter and used for the storage of small arms ammunition or pyrotechnics (Francis 1996, 209). One possible example is in a barrack room [45] while the adjacent barrack room [46] has the door jambs partially removed, the threshold widened and a ramp provided perhaps to allow bulky items such as ammunition crates to be stored inside. The other example is in the basement below Casemate 15 where the mechanism for the Brennan rising tower had been. This example is directly below the hole in the floor left by the removal of the rising tower suggesting that later visitors to the fort may have dropped it there. However it is sitting on a pile of ashes and the specification for Igloo construction does specify this material as a suitable base.

Figure 78: The right-hand leaf of the front doors to the fort. Evidence for the occupation of the fort by the Royal Naval Auxiliary Patrol is provided by the letters 'A P' on a background of flaking naval grey paint. (DP097676)

Local Defence Weapons and their Mountings

The 'Minutes of the Conference on Defence of the Thames' dated 30 August 1940 make two references to the armament of Cliffe Fort (TNA: WO199/2478) :

> Thames Auxilliary Patrol [TAP] has also been issued with 16 MMGs..... 4 at Cliffe Fort – 1 manned by TAP [the Auxiliary Patrol] , 3 to be manned under arrangements made by XII Corps

and in relation to Sector E:

> the majority of these craft are armed only with one .303 Hotchkiss and therefore their attacking power is small. Two 6 pdr and two .303 Hotchkiss have been asked for to be mounted at the Auxiliary Patrol Section Headquarters at Cliffe Fort (TNA: WO199/2478)

Correspondence from 1941 (TNA: WO199/2479) suggest that MMG is an abbreviation for Maxim Machine Gun, typical of the old weapons reissued as emergency supplies after the evacuation from Dunkirk in June 1940.

The combined naval units would have been responsible for their own local defence but the strategic position occupied by Cliffe both on the shoreline and on the flank of the stop line which ran across the Hoo Peninsula (Truscoe 2014) led to discussions in 1940 for the establishment of a Home Guard presence at the fort (TNA: WO199/2478). It would appear that the Home Guard was involved with the defence

of the fort for a very limited period. On 10 September 1940 the 'Minutes of the Conference on Defence of the Thames' refers to arrangements for the Home Guard to man the 3 MMG (Maxim Machine Guns) at Cliffe Fort (TNA: WO199/2478). This request seems not to have succeeded as on 25 December 1940 the same meeting reported that:

> Cliffe Fort – There are no Home Guard now available to man the defences in Cliffe Fort. This leaves one sec. of MMGs only manned by naval ratings (TNA: WO199/2478)

By 1941 Cliffe Fort was identified by the Flag Officer in Charge, London as a Vulnerable Point which required a defence plan. A report on the Thames Waterway Defences (TNA: WO199/2479) noted that Cliffe Fort would be defended by the RNVR (Royal Naval Volunteer Reserve), which could equally well describe the RNAP or the signal station crew, with 6 MMGs and the 'doubtful' aid of the Home Guard within 2 or 3 hours or possibly the regular troops of 11 Battalion The Gloucester Regiment. It would take under command any Defensively Equipped Merchant Ship (usually mounting a 12-pounder gun) if it was temporarily moored near the fort (TNA: WO199/2479). As the war progressed and regular troops were withdrawn to fight overseas it is probable that the reinforcement of Cliffe Fort, during an enemy attack, would be entirely in the hands of the Home Guard.

The March 1941 aerial photograph (Fig 76) shows recent works in the north-east corner of the fort's parade ground, identifiable by extensive patches of white possibly the result of freshly poured concrete or trodden-in chalk and sand of surrounding the area. A large patch near the entrance of the fort and along the road suggests recent vehicle traffic. Further patches are visible on the fort roof surrounding the Battery Observation Post (see Chapter 9).There are further white marks at parade ground level, around the entrance to the Cook House [78], Latrine [79] and Ablutions [80] and the Engine House [71] and Dynamo [70] buildings in the rampart to the north. Smaller patches on the roof of the south-west bastion and in the glacis in front of the 6-inch battery suggest the location of machine gun emplacements or weapons pits.

The photograph may show the positions of two of the MMGs. The first is a white near circular feature on the roof of the south-west bastion possibly a sandbagged emplacement of the correct size for a MMG. Investigation of this area of the roof revealed a slight depression surrounded by a ring of lighter coloured roof covering. The presence of the MMG here may explain the neat removal of the stack and fireplace from the Canteen [20] and stores [18, 19] below as this would open up the arc of fire for this position. A second is at the entrance to the cement company's pier, a strategic location, to deal with potential enemy landing parties. The 1941 aerial photograph seems to show a similar shaped emplacement to the one on the roof of the south-west bastion in this position. A third position may have been located on the roof of the south-east bastion [37] which had already been modified for a similar if not identical weapon in the First World War. The fourth seems to have been emplaced in Casemate 2. Examination of the shield in this casemate shows that its embrasure has been modified. The brick wall, which had sealed the embrasure from the inside, (see chapter 9) has been cut away to form a slot similar in size to those found in contemporary pillboxes mounting MMGs. The MMG could

have been mounted on the shelf formed by the concrete fill between the outer and inner iron shields. A ceramic pipe has been inserted over the loophole probably to vent the smoke and steam produced when the MMG was fired for long periods. Casemate 2 is divided by a Fletton brick wall, which follows the course of the 19th-century removable timber partition. This may be related to its modification, sealing it off from the body of the fort and containing any grenade explosion. The glacis in front of this position may have been reshaped to provide a field of fire from this embrasure which also covers the entry on to the pier. The .303 Hotchkiss machine gun was a smaller and more portable weapon than the MMG. Large numbers had been produced as the secondary armament of the tanks used in the First World War. A likely mounting for one of these weapons is the steel pole set in the centre of the disused collar for the rising Brennan control station (see Fig 71).

Evidence for the location and mounting of the 6-pounders can be seen in the 1941 Pathe newsreel (www.britishpathe.com accessed 4/12/2011) concerning the operations of the RNAP on the Thames. The section about Cliffe shows the roof of the fort with a 6-pounder mounted in the northern former 6-inch gun barbette being brought into action by a gun crew. The weapon is almost certainly a Mark II 6-pounder gun which entered service with the Royal Navy in 1890 as a shipboard anti-torpedo boat weapon. After the First World War the gun was considered obsolete for combat but many were brought back into active service in the Second World War, some for coastal defence (//en.wikipedia/wiki/6 pounder gun accessed 11/12/2012). The example shown at Cliffe has a narrow curved shield and is mounted on an elastic frame mounting bolted to the top of the barbette. Further study of the newsreel shows that the barbette, apron and visible sections of the parapet are painted black. The shell locker recessed into the base of the barbette has a single timber door, a crude replacement for the pair of steel doors that should be in this position. Inside the locker stacked boxes of what is presumably ammunition can be seen.

Survey of this area revealed that the two 6-pounders requested in 1940 were supplied and mounted on nearly identical concrete blocks constructed in the gun pit in the former 6-inch gun barbettes (Fig 79; App Fig 8). These brick and concrete blocks measure 2.27m square and 1.22m high and sit on the base of each pit obscuring the original holdfast. They are carefully placed, being offset towards the front apron of the barbette, the east edge of each block forming a level surface with the walkway around the gun pit. The other edges of the block do not run to the sides of the pit. On the top of each block is a square patch of concrete set back from the block edge leaving a pronounced rebate. Set around the centre point of the patch are two distinct alignments of threaded studs suggesting two phases of 6-pounder mounting. The position for a pedestal mount is indicated by eight studs with hexagonal bolts, forming an outer ring, and the mark for a 6ft (1.83m) diameter plate. The position of the elastic frame is suggested by a rectangle measuring 0.57m by 0.33m, delineated by six studs all carefully set in poured lead, all within the 6ft (1.83m) diameter ring.

Placed between the two barbettes is a small building of very similar appearance to the Second World War addition to the top of the BOP. It is square in plan with 9in

Figure 79: Concrete block inserted to modify the 6-inch gun emplacements during the Second World War. (DP097671)

(0.28m) brick walls in a mixture of reused fort bricks and Flettons laid in stretcher bond, covered in a thin exterior coat of cement render, all beneath an oversailing concrete slab roof. There are large rectangular openings occupying the majority of each wall, all beneath soldier course heads. In the east and west wall a brick mullion divides the opening into two windows each with timber casement frames with sliding lights; an intact but unglazed example survives in the east wall. In the north and south walls the openings accommodated a window and door combination. The interior of the building has roughly rendered walls and evidence for a suspended timber floor, but in the north-west corner are two dwarf walls intended to support a sturdier floor in this area. Above this corner is a hole through the roof slab surrounded by a non-ferrous plate which appears to be the mounting for a piece of equipment. The building's location and construction suggest that it was intended as a shelter for the crews manning the 6-pounders located in the former 6-inch gun barbettes. A telephone insulator bracket on the north-east corner of the exterior of this building, the hole in the roof and associated non ferrous plate may simply be the course of a telephone line connecting the shelter to higher command. However the use of a carefully set non-ferrous plate and the strengthened floor suggests the location of some other type of equipment.

Adaption of the Domestic Ranges

It is reasonable to assume that the Royal Navy units that are thought to have been accommodated in the fort: RNAP, signal station and the XDO office (if such a position existed) shared the domestic accommodation. The officer's mess

accommodation with its superior facilities, particularly smaller heated rooms, appears to have been refurbished at this date and could have been used as living accommodation by all ranks of the small permanent naval staff. The barrack rooms shown no evidence of refurbishment but they would still have been weatherproof and with the fireplaces still in place they would be available as temporary shore quarters for the RNAP crews.

Construction work in the north-east corner of the fort is clearly visible in both the 1941 aerial photograph (RAF 26/UK/1455/2045 14-Mar-1941) and on the undated photograph taken from the centre of the parade ground looking east (Cherry 1991, 34). The focus of the wartime rebuilding work was the East Gorge Range which on the 1899 record plan (TNA: WO78/4963; App Fig 1) comprised, from south to north, the Guardhouse, Cells, Cook House, Latrines and Ablutions. Beyond the Ablutions was the entrance [81] to the ammunition stores and light passage which ran beneath the rampart and the casemates. To the west was the Gyn and Tackle Store [73] (see Chapter 8). The 1941 aerial photograph shows that this had been demolished and the entire area levelled. Survey shows that the whole west wall of the range was demolished except for small sections in the north-east corner at the junction of the Ablutions with the ammunition stores passage (Fig 80). The demolition work left the Fox and Barratt-type roof and the brick dividing walls between the various rooms intact. Examination of the undated photograph (Cherry 1991, 34) suggests that the protruding joists of the roof were used to secure handrail stanchions around the black hut on top of the roof.

Figure 80: The north end of the East range. In the foreground are the remains of the Guard House and the cell block. Beyond them are the Ablutions and Latrines with their new front wall and the heavily weathered modesty wall in front. On the right hand side of the picture, the lighter coloured patch on the parapet wall is the position of the brick outbuilding to the demolished timber hut which extended from here to the left hand side of the frame. (DP097523)

The Ablutions and Cook House were extensively rebuilt. In the case of the Ablutions, survey shows that the rebuild included internal alterations. These suggest that both this room and the adjoining cook house might have been recast as a gas decontamination area, which were provided for military and civil personnel likely to be exposed to high concentrations of gas by remaining at their posts (McCutcheon 2007, 107) though there is little definitive evidence. The majority of RAF stations were provided with decontamination facilities (Francis 1996, 186) but similar information about naval facilities is not readily available. Large areas of rebuilding work have used a soft sandy yellow brick which has weathered markedly in the external walls, possibly an interior facing brick supplied under wartime material restrictions.

Survey shows that the Guard Room [75] had two small rooms inserted beneath the remains of the Fox and Barratt-type roof. At the south end a new wall was built parallel to, and 2.6m from, the original wall, forming a narrow room. This was lit by an equally narrow window in the west wall, the concrete sill of which is still in situ amongst a heap of bricks and corrugated iron (possibly the remains of the roof) which now marks its position. At the north end of the Guard Room another room built in the sandy coloured brick and measuring 0.95m by 1.42m was created against the end of the cell block [76, 77] after the connecting door from the Guard Room to the Cells had been bricked up. The remaining fragments in this room shows that it was a toilet, the base of the bowl (labelled J Duckett & Sons) is still in situ. The centre section of the Guard Room is open although the window in the gorge wall is now bricked up and painted over. The front wall of the cell block has been reinstated with a 9in (0.28m) brick wall butted against the original partition walls and with a much larger window than the original cell window. The western cell has been reused as a cloakroom and for the course of the water and drainage pipes running into the adjacent new WC. The east cell appears to be unaltered except for the addition of electric lighting and may have been retained for its original purpose. These alterations are clearly visible on the undated photograph of the fort (Cherry 1991, 34).

The entire front wall of the Cook House [78] was removed and a new entrance to the cell block knocked through a former fireplace in the south wall. The window in the gorge wall has been blocked with Fletton bricks except for a centrally-placed hole for a 0.2m diameter pipe which protrudes through to the outside of the fort. In the north wall all the flues, hot boxes and mountings for the cooking range were blocked or removed and a new hole broken through at the top of the wall into the ceramic flue for the cooking range. At the foot of this wall a pen was constructed out of poured concrete shuttered with corrugated iron sheeting. This pen measures 3.0m by 5.0m and has its west wall sitting on the footings of the original front wall. The pen can be clearly seen on the undated post-war photograph (Cherry 1991, 34) which shows that the only original opening in the pen was in the east wall, a small rectangular hole at floor level.

The Cook House may have been modified to house a hot water boiler for the adjacent Ablutions/suggested decontamination area. Its position is indicated by the stove flue protruding through the gorge window and the pair of Fletton brick walls below it which must have supported the boiler attached to the flue. Four cut-off ends of what

are presumably hot water pipes can be seen just beneath the ceiling in the north-east corner and these run back into the ablution room. Below this a pair of iron brackets have been inserted into the stack and these have a further pair of Fletton brick walls below them which may have supported water tanks for the boiler supply. Presumably the coal for the boiler was kept in the concrete pen, as the hole in its east wall is immediately opposite the boiler position.

The entire front wall of the Ablutions [80] and Latrines [79], other than the section of ablution wall running from the north jamb of the doorway to the entrance to the ammunition passage wall, has been demolished and replaced by a new wall. In the remaining section the height of the doorway has been reduced by inserting a concrete slab lintel beneath three courses of sandy coloured bricks. Depressions for lifting rings in its surface and a rebate around the edge suggest that it may be a reused drain cover. On the north side of this doorway three new windows are set low in the wall beneath further concrete lintels, each window measuring 0.60m wide and 0.70m high. The windows are set flush with the external wall and internally this has formed a 0.50m deep concrete sill running beneath them as a shelf. To the south of the Ablutions doorway, the front wall, and that of the latrines, was completely demolished and has been replaced by a new wall in a sandy coloured brick laid in English bond but built on a line slightly to the east of the original wall. In this wall are two doorways beneath concrete lintels, both opening into the latrine. Marks show the position of timber frames. In front of the doorways and parallel to the front wall, at a distance of 1.50m, is a 1.75m high modesty wall built of sandy yellow brick - now very heavily weathered. Comparison with the 1899 plan (TNA: WO78/4963; App Fig 1) shows that it uses the foundations of the east wall of the demolished Gyn and Tackle Shed [73] as a footing.

Both the Ablutions and Latrines [79, 80] are entered via lobbies. The ablutions room has a small lobby 1.35m by 2.20m with the two doorways placed virtually opposite each other. The latrine has two lobbies. The larger one, for the north doorway, measures 2.48m by 3.20m. The exterior doorway is flanked by shallow walls whilst the interior doorway is offset to the south. The southern lobby is simply a corridor formed by the walls of the north lobby and the original south wall of the latrine. This lobby was closed off from the body of the latrine by a door set in a sturdy timber frame, the removal of which has left a deep vertical scar in the rendered finish of the wall. It is notable that the lobbies do not rise to the full height of the rooms and have secondary ceilings of the same hard plaster as the redrawn ceilings. All the lobby walls are built in the sandy yellow brick.

The interior of both rooms has been comprehensively refinished. Both have had the 19th-century fittings stripped out and the walls rendered in a fine grained cement finish. This finish extends over the walls, modesty walls, stall partitions and into the jambs and sills of the windows. The concrete covering of the floor, where visible, has been extended up to a junction with the cement finish at the level of the skirting. The sash windows indicated on the 1899 plan (TNA: WO78/4963) have been replaced by casement windows set in splayed jambs filling the space left by the removal of the sash boxes. The ceilings have been underdrawn with a modern hard plaster and, presumably, new laths.

The Ablution and Latrines were interconnected by a doorway inserted in the east end of their shared wall, now infilled with breeze block. Internally the ablutions room has had three shower stalls constructed in the north-east corner, partitioned from the rest of the room by a brick2m long modesty wall which has the mountings for sinks on its western face. The latrines have three new stalls in the south-east corner and the ceramic splashback for stalls in the north east corner with a modesty wall on their west side (Fig 81). Water supply pipework runs at ceiling level from the south wall of the latrines suggesting that it originates from the hot water boiler in the former kitchen and crosses the latrines at this level emerging in the ablutions room where one branch feeds the showers. The others rise through the roof in the north-east corner and may emerge in the store in the corner of the north-east bastion which has fittings for a water tank and its supply pipes.

Figure 81: Sketch survey of the rebuilt northern end of the entrance range based on field measurements and the 1899 basement plan (TNA: WO78/4963). The possible Second World War additions and alterations are shown in light grey.

Gas Decontamination?

Several features of this remodelling suggest that these rooms may have been modified to provide a gas decontamination facility (though a later origin through the activities of the Blue Circle Sailing Club cannot be ruled out, see below). The most apparent are the lobbies which, with their sets of doors and secondary ceilings, could

have formed gas-tight air locks; similarly replacing sash windows with casement windows would provide a better gas proof seal. The fine-grained render covering both rooms may be the granolithic cement finish recommended in the ARP manual, so that no exposed brickwork or other porous surfaces are left to absorb mustard gas. This would also account for the refinishing of the ceilings in hard plaster (McCutcheon 2007, 107). The stalls, plumbing and fittings are arranged against the walls and leave large open areas, which were recommended for decontamination and first aid work, in the centre of the rooms. A block of showers is provided rather than baths; the decontamination procedure recommends washing down in warm water showers, moving progressively from one to the next as the contamination was washed off. The washing procedure required a large amount of water which may explain the adjacent boiler.

Study of the ARP manual for gas decontamination (McCutcheon 2007, 107) suggests the possible nature of the procedure at Cliffe. The modesty wall may have formed a protected area where contaminated clothing could be discarded before entering the ablutions room air lock. Once through this all other clothing would have been discarded in bins in the north-west corner of the room. The low set slot-like windows may have formed chutes for contaminated clothes bins placed against the outside wall. These bins could also accept clothing discarded behind the modesty wall. Similar sized openings for this purpose are present in RAF decontamination buildings (Francis 1996, 187). Eyes and faces could be washed out in the sinks and then the whole body washed down in the showers in the north-east corner. Once dried off, personnel could have passed through the connecting doorway into the latrines where fresh clothes were available. The open centres of the room may have provided space for minor first aid treatment and donning clean clothing. The large lobby in the latrines may have been provided as a first aid room accessible from both clean and dirty sides the shallow walls with an oilskin tarpaulin forming a secondary airlock (McCutcheon 2007, 107).

Engine House and Dynamo [70, 71]

These buildings are thought to have been constructed for use with the 19th century submarine minefield and then modified to accommodate the power equipment for the electric searchlights installed in the fort in the 1890s (see Chapters 9, 11 and 12). Survey suggests that they were further modified during the Second World War. Comparison with the 1899 plans (TNA: WO78/4963; App Fig 1) shows that the south wall of both buildings, the concrete roof, internal walls and the associated vents and oil tanks shown on these plans were dismantled leaving only the north wall (a wall that dates from the construction of the fort in 1873) and the late 19th-century end walls. This work has left a vertical mark in the east wall at its junction with the dismantled south wall. All of the remaining walls have been repaired in a mixture of bricks including some sandy yellow bricks, similar to those in the modesty wall outside the Ablutions and Latrines [79 and 80].

The concrete roof shown on the 1899 plan (TNA: WO78/4963; App Fig 2) has been replaced by pressed steel troughing supporting a concrete slab. The 1.5ft (0.45m) wide steel trough sections are riveted together with the troughs running north-south.

They sit on the rebuilt top courses of the north, east and west walls. The trough sections are bolted to the I-section beam, running east-west, which is supported by three irregularly-spaced posts of the same section, all of which are thought to date from the late-19th century. The 1899 plan shows that they formed the internal division between the engine and dynamo rooms (see chapter 9). The troughing ends at an L-shaped plate running behind, and bolted to, a steel plate fascia running east-west, the whole forming the wall plate for the steel posts framing the south wall. A 1ft (0.3m) thick concrete slab has been poured over the top surface of the troughing with its edges set back from the brick and steel work forming a pronounced rebate.

The south wall is divided into nine irregular bays by I-section steel posts measuring 0.10m by 0.20m. These posts are set in the concrete floor and bolted to the steel wall plate running beneath the troughing. The post at the north end has been cut off leaving its top still bolted in place. The bays have been filled with brick salvaged from the interior of the fort laid in stretcher bond. Window openings in the second, fourth and sixth bays are formed by omitting brickwork in favour of tall openings (1.94m). Study of the undated post-war photograph (Cherry 1991, 34) shows they contained casement windows with top opening lights. The same photograph shows a door in the bay at the north end. Investigation revealed that there might have been a pair of doors using the cut off post as the dividing jamb between the doors. A mark running at 1.45m (halfway up the wall) and an associated single surviving angled-bracket suggest that a light porch-type roof ran along this wall.

Internally the building is now undivided with only the stub of the former brick partition wall between the 1899 Dynamo and Engine Rooms visible in the north wall. A band of black bitumous paint continues the line of this wall across the soffit of the troughing suggesting that a later north-south partition wall of light materials has also been removed. This wall would have divided the building into two unequally sized compartments. In the roof of both compartments and set close to the front wall, is a small hole cut through the troughing and concrete. Inside the building both of these small holes are surrounded by a distinctive steel mounting plate bolted to the troughing. Cut through the steel plate around the circumference of the holes are three elongated slots.

Given that the previous use of this building as an engine and dynamo house for submarine mining (see chapter 11) had connected it to junction boxes for the fort's electrical circuits and to a fuel supply pipe from the former Brennan boiler room [60b] it seems reasonable to assume that it continued in use as a generator house. The two small holes in the roof suggest the position of exhaust stacks for diesel generator sets, probably the emergency power supply for the signal station. These generators should have a trunked air intake and the course of this may be indicated by the scars and bracket on the south wall. Alternatively the tall window openings may have performed the same function in a less sophisticated manner. The rebuilt roof is characteristic of buildings constructed in the early years of the Second World War, requiring protection from bomb blast such as magazines and equipment workshops (Brown and Williams 2001, 35). Confirmation of a building's use as a generator house is usually provided by mounting studs and conduits in the floor but in this case the floor is obscured by water and silt.

The adjacent building [72], labelled as Test Room on the 1899 plan (TNA: WO78/4963; App Fig 1) has a concrete slab roof similar in appearance to that on the Engine House/Dynamo [70 and 71] but no discernable internal alterations. It may well have continued in the role for which it was constructed: the storage of wet cell batteries. On the exterior of the building, below the sill of the window on the east side of the south wall, are the remains of three dwarf walls (1.0m high) built of brick with cement render. These run north-south and divide an area extending from the north jamb of the doorway to the projecting traverse wall at the north end of the building into two compartments. Running across the top of these is the broken remains of a thin concrete slab that would have formed a roof over the compartments. The arrangement is visible on the post-war photograph (Cherry 1991, 35). An obvious use, other than as coal bunkers or for fire fighting equipment, which might explain the painting of the compartments and surrounding wall in light coloured paint, is difficult to ascribe.

Second World War alterations to casemates

The post-war photograph (Cherry 1991, 35) shows that the brick-built stair constructed in the late 1890s, when the access to the ammunition stores was altered (see Chapter 9), was provided with handrails set in piers. This suggests that during the Second World War it was the main access route between the buildings at parade ground level and the hut at roof level. Survey of this area shows the footings for these piers remain on the west side of the stair. At the head of the stair, on its east side, sections of concrete kerb now severely disrupted by tree roots, are the probable remains of a parapet to the walkway which may be visible on the post-war photograph in front of Casemate 2.

The group of casemates (1, 2 ,3, and 5) at the top of the stairs were presumably reused for similar functions to those they had performed in the First World War, as war shelters and battery offices for the 6-inch gun battery on the roof. Curiously the end walls of casemates 3 and 4 have been demolished and this is evident on the post-war photograph (Cherry 1991, 35). Similarly Casemate 2 has had its end wall either reconstructed or inserted. This 9in (0.28m) thick wall is built in Fletton brick in stretcher bond in the position originally occupied by the timber end wall to the living casemate. It has a doorway at its west end beneath a brick soldier course head and to the east two high set and small (0.35m by 0.60m) window openings with concrete sills and lintels. Pintles on the side of each window suggest that shutters were provided. Aligned pairs of holes in the sills and lintels and indicate that each window opening was barred or grilled. At the top of the wall are two pierced red-brick air vents. At the base of the wall beneath the west window opening are two holes for small pipes.

Inside the casemate, the floor has been levelled with concrete. A Fletton brick wall mostly composed of stretchers has been constructed in the position of the timber partition wall that formerly divided the living casemate from the gun position. Access to the gun position was via a doorway in the east end of the wall, now blocked with concrete bricks. The 6m long vaulted room created by this work has no heating, due to the earlier demolition of the fireplace to provide a connecting doorway

into Casemate 3. The walls have been painted black above the vault springing and possibly pale green below. Timber batons, probably to carry electrical cabling, run over the vault from the east wall and eventually to the location of a light switch to the west of the doorway. This small room was probably created when the gun position half of Casemate 2 was converted into a machine gun position. The lack of heating and the small windows with bars or grilles suggest that it was used as a store.

Study of the 1941 aerial photograph (RAF 26/UK/1455 2045 14-Mar-1941; Fig 76) suggests that the officers' quarters [37, 38, 39, 40, 41, 42 and 43] and associated kitchens and stores [31, 32, 33, 34, 35 and 36] were refurbished at the same time to provide the living quarters for the station personnel. The large amount of white showing on the roof of this area in the photograph suggests it was recovered or extensively repaired. The single-storey officers' quarters [38, 39, 40, 41] in the south-east corner would have made ideal accommodation for the small number of naval staff as each room was finished to a higher standard than the barracks with plastered walls and ceilings, and all were heated. All the rooms in this area, the officers' mess [37], three officers' bedrooms [38, 39, 40] and the commanding officer's quarters [41,43] have evidence for repairs and redecorating. In the officers' mess patches of green paint and repairs to the plaster using modern gypsum rather than horse hair can be seen and the ceiling retains patches of blue paint. Similar green paint can be seen on walls of the commanding officer's quarters, over an earlier red brown scheme. These quarters also have alterations to the fireplace for an economy grate, repairs in cement render to a window jamb in the north wall and patch repairs to the ceilings. Similar repairs and paint schemes can be seen in the adjoining rooms [38, 39 and 40].

The west (front) wall of the officers' pantry, stores and kitchen range has been demolished. The officers' kitchen has a concrete-lined inspection pit set in the floor with corresponding bolts for lifting tackle set into the roof suggesting use as a garage. The retention of camouflage nets may also explain the purpose of three ring bolts set in the east wall at the end of the first floor hospital quarters. Doubt about the date of demolition is raised by the rough nature of the work compared to the ablutions and latrines and the retention of fittings and fixtures in the relatively undisturbed rooms.

Similar repairs and redecoration are not evident in the barracks and the hospital rooms above them but the robbed out walls of the hospital may have provided the reused bricks found in the walls of the new observation huts for the signal station. On the ground floor there is fragmentary evidence for the further use of two rooms. One barrack room [45] has the remaining patches of a coat of naval grey paint on the walls, along with repairs to the glazing bars of the gorge window frame and its reglazing with wire reinforced obscured glass. The coal store [44] also has a wash of grey paint and signs of successive repainting of the walls to indicate divisions for different types of coal or different rooms or owners, perhaps the signal station and the RNAP.

After the Second World War

It is not clear when Cliffe Fort was closed as a naval establishment and handed back to its owners the Alpha Cement Company. The signal instructing the naval signal

station to close is dated 5 July 1945 (TNA: ADM1/18577) and presumably the naval presence at the fort was terminated as quickly as possible after this date. The various service histories of vessels used by the RNAP, notably the 'Sheemaun' which still survives and was allocated to Cliffe Fort for its entire wartime service, indicates that by November 1945 most were handed back to their civilian owners, suggesting that the RNAP has been disbanded by this date (www.rnpatrolservice.org.uk/forum accessed 20/02/2012).

Cliffe Fort was within the boundaries of the Alpha Works, a part of the Associated Portland Cement Manufacturers (APCM), which was founded in 1900. The kilns and processing machinery of the Alpha Cement Works (it may be that the 1940 reference to the Alpha Cement Company has confused Company and Works) were located to the east of Cliffe Fort. The clay quarry for the works extended to the south of Salt Lane and by the 1950s it was becoming exhausted. After being abandoned the workings quickly flooded, which is how they remain today, as quarrying had exceeded the depth of the water table. The Alpha Works did open new quarries to the north of Salt Lane but due to their impending exhaustion the works closed in 1967. They were replaced in 1971 by the new Blue Circle Works at Northfleet, so called because, by the 1970s, the Associated Portland Cement Manufacturers (APCM) were known by their trade mark as Blue Circle Cement (www.wikkipedia.org/wiki/Cliffe, Kent accessed 20/02/2012).

The Blue Circle Sailing Club, founded in 1956, uses the original flooded workings as a marina (www.bluecirclesailingclub.co.uk accessed 28/02/2012). At one point the club used Cliffe Fort as a club house and boat store. Older club members recall that the main club room, toilets and showers were in the east range; the site of the former Ablutions, Latrines, Cook House, Cells and Guard House (Sue Roberts pers comm). Within the Latrines and Ablutions there are signs of subsequent modernisation in the bathroom fittings, some tilling and the painting of the walls in various colours; peach, blue and white predominating. The latrine side has also been labelled with a painted sign as 'Male'. It is possible that the extensive rebuilding of the latrines and ablution area dates from this period, although the sailing club's occupation of the fort appears to have been minimal with a low impact on the fort's fabric. The club moved into new premises in 1967, which coincided with the closure of the Alpha Works and the sale of the site by Blue Circle Cement.

In 1970 the Blue Circle Cement Company sold the site to the Marinex Gravel Company as a handling quay for sand and gravel dredged from the Thames(www.wikkipedia.org/wiki/Cliffe, Kent accessed 20/02/2012). Brett Aggregates, the successors to Marinex, continue to use the jetty and the area outside Cliffe Fort for the same purpose.

Cliffe Fort became a Scheduled Ancient Monument (County Number KE 269) on 1 July 1971 (Department of the Environment 1978, 111).

13. DISCUSSION AND CONCLUSIONS

The Thames Forts

Due to the delay in construction caused by the debate over the mounting of Montcreiff disappearing guns, Cliffe, Coalhouse and Shornemead Forts were completed around 1875 and were the ultimate development in the United Kingdom of casemated-battery coastal forts designed under the provisions of the 1860 Royal Commission. Unlike other Royal Commission forts they did not pass through an intermediate stage of large calibre, usually 68-pounder, smooth bore weapons or the smaller calibres of Rifled Muzzle Loaders, 7-inch being the most common, served by central magazines. Instead all three forts were completed with large calibre 9, 11 and 12.5-inch RMLs mounted either in purpose-built casemates behind composite iron shields, which are still *in situ* at all three forts, or in open battery. All the guns were served by shell and cartridge stores dispersed in the basement and connected to the gun floor by lifts.

Of the three contemporary forts, Coalhouse, Shornemead and Cliffe, it is only at Cliffe that the appearance of this ultimate design of casemated battery fort with ammunition stores in the basement can be seen and understood clearly, albeit with modifications of the 1880s that converted five casemated gun positions to traverses by filling them with concrete. This work also involved the movement of one 12.5-inch RML to a new casemate and the probable rearrangement of racer rails to change the arc of fire of the three 11-inch RMLs in the western casemates. This appears to be the only major modification to the casemated battery at Cliffe, other than the eventual removal of the RMLs. Shornemead, however, has been mostly demolished leaving only the face wall of the battery and the ammunition stores in the now sealed basement. Coalhouse Fort, which had a long military career (1875-1956), was reworked on several occasions to accommodate new weapons. This has left a legacy, as with many of the Royal Commission forts, of accretions of concrete structures such as new gun positions, searchlight and observation positions and the major modifications required for items such as shell lifts for the roof-mounted breech-loading guns. These lifts, introduced in the 1890s, were pierced through casemate roofs and required fundamental reordering of shell and cartridge stores to accommodate them.

Basement

The basement of Cliffe Fort was completed by 1870, sometime before the battery above, and benefitted from the re-examination of ammunition supply arrangements, mainly a change from central magazines to dispersed shell and cartridge stores, that had been conducted at Woolwich in the 1860s. Despite this the basement underwent a major reordering probably shortly after completion of the fort. It appears that the original basement lighting scheme and, in particular, the provision of lights to the shifting passage at the front of the fort, was inadequate and major modifications were made, both to the passages and stores, to provided new segregated lighting passages for the shifting passage. That this work was done before the removal of RML guns in the 1880s and early 1890s, in favour of traverses and the Brennan torpedo

installation respectively, is shown by the care taken to retain the same number of shell and cartridge stores as originally intended. The current state of the majority of the basement is largely as this work left it, although with an additional entrance in the north-east corner dating from the installation of quick-firing guns on the fort roof in the 1890s.

Rooftop batteries

Although the roof of Cliffe Fort was successively modified, from the late 1880s onwards, first to accommodate a possible 3 or 6-pounder, rapidly replaced with a 12-pounder, quick-firing gun battery and finally two 6-inch guns in barbettes, this has had little material effect on the casemates or the basement, particularly when compared to Coalhouse Fort. For reasons that cannot be fully explained, none of the rooftop batteries at Cliffe were provided with modern shell lifts so the associated modifications to the fabric of the casemates and basement shell and cartridge stores to accommodate them did not take place. This means that other than superficial, but no less interesting, modifications to the casemates to equip them as war shelters for the 6-inch battery personnel, the casemates and basement are fundamentally as they were on the withdrawal of the RML guns at the beginning of the 20th century and include racer rails in several of the casemates.

The rooftop batteries, in particular the two gun 6-inch battery *en barbette*, are of interest in themselves. Cliffe Fort was decommissioned as a costal battery in the period between 1927 and 1936. Unlike other Royal Commission forts, such as Coalhouse, it was not rearmed as an emergency battery during the Second World War and the barbette gun positions were not modified with concrete gun houses or to accept non-standard emergency weapons, such as the 5.5-inch guns at Coalhouse. The rooftop batteries at Cliffe are in much the same condition, other than minor Second World War modifications for mounting 6-pounder guns, as they were at the end of the First World War and this includes a co-located Battery Observation Post and Electric Light Director Position. Although superficially of standard design, the 6-inch battery at Cliffe has some important deviations from the specification for this type of battery. As previously mentioned it has no shell and cartridge lifts, and as these are not indicated on the available contemporary plan for the work, this seems to have been deliberate, and it consisted of only two guns as compared to the four at Coalhouse. Further documentary sources suggest that the battery at Cliffe was conceived solely as an examination battery covering the examination ground around Hope Point. In itself the construction of a specialist examination battery is unusual; usually an existing battery such as the one at Coalhouse, was designated for this role.

Submarine Minefields and Brennan Torpedo

Of particular interest is the association of Cliffe Fort with the successive generations of tethered minefields laid in the Thames, referred to as Submarine Mining, and their fascinating offshoot, the Brennan Torpedo. Located in the basement and former open battery position in the south-west corner of Cliffe Fort, the Brennan Torpedo installation was almost certainly decommissioned by 1907 and was certainly dismantled by the First World War; a plan of 1915 shows the conversion

of the empty boiler room in the installation into an oil store. However the other parts of the installation, mostly accommodated in basement casemates formerly used as ammunition stores, were never reused and retain enough physical evidence to allow this very complex installation and its development, from commissioning circa 1895 to stand down circa 1906, to be understood. The major components of the installation (slipways, torpedo store, engine room, boiler room and director) still survive to a level where their interconnection can be understood. Minor components such as the coal store, guncotton store and the accumulator store are also extant and can be understood in context with the main features of the Brennan installation.

The installation also shows several phases of modifications to the machinery of the torpedo and its deployment. The surface condenser, accommodated in the casemate adjacent to the engine room, is evidence for an upgrade in Brennan technology, the increase in driving wire size from 0.05in to 0.07in in 1897. Modifications to the open battery position above the casemates used for the Brennan installation show how the new pulley beam and wire run for the second slipway, thought to date from the late 1890s, was accommodated within the existing installation. The final modification to the installation is also the most enigmatic. Enough documentary evidence survives to confirm that a rising observation tower for the officer directing the torpedo existed at Cliffe. Evidence for the tower and its machinery exists on the roof, casemate and basement levels of Cliffe Fort, but given the unique approach of Louis Brennan to engineering design, no clear understanding of how the mechanism functioned or what it looked like has yet been reached.

The provision of a tethered submarine minefield extending around Hope Point and downstream to Shornemead was one of the key recommendations of the appendix to the 1860 Royal Commission report that dealt with the defence of the upper Thames. Ultimately the Submarine Mining Establishment would be based at Shornemead Fort but documentary sources and physical evidence shows that observation posts and firing positions were established at Cliffe Fort, part of the network maintained and controlled from Shornemead and which probably included similar test and observation facilities at Coalhouse Fort. Correspondence and plans submitted to the Thames Sewers Commissioners between 1888 and 1891 discuss the construction of observation and firing posts for the minefield on the riverbank at Shornemead, Cliffe and Coalhouse. Within Cliffe Fort evidence survives suggesting that the fort housed a position for the control of the submarine minefield is provided by the survival of a Test Room in the north-east corner of the fort. This small but bombproof structure acted as the battery room (the mines were electrically fired) and firing point for a section of the minefield. The building is largely unaltered and conforms to period accounts of these rooms with an acid-proof floor and witness marks for the test boards, the firing keys for the mines, on the walls. Next door to this building is the site of the engine and electrical generator set that was provided to charge the batteries. Features in the circa 1914 Battery Observation Post suggest that the role of Cliffe Fort as part of the control for the Thames minefield continued into the First World War and a brick-built observation post on the BOP roof suggests that this role may have continued into the Second World War.

Royal Naval Auxillary Patrol

In common with many 19th-century military structures Cliffe Fort played a secondary, although important, role in the Second World War. Its principal role was to provide accommodation for the Royal Navy Auxiliary Patrol that provided small craft to patrol the Thames, watch for mines, direct shipping and provide a defence with light weapons against enemy aircraft. Cliffe Fort appears to have provided mooring, stores, accommodation and a command centre. Though documentary evidence for the activities of the RNAP at the fort is sparse, the appearance of the fort in a 1941 British Pathe newsreel item on the Thames patrol is informative. Some physical evidence survives and some of it, such as the modifications to mount 6-pounder guns in the 6-inch gun barbettes and the brick-built shelters on the roof, is elucidated by the newsreel. What may be another major modification associated with the RNAP, the rebuilding of the north-east corner of the gorge range to provide a possible gas decontamination facility and ablutions, cannot with absolute certainty be distinguished from washing facilities that may have been installed by the Blue Circle Sailing Club, the fort's tenants in the 1950s and 1960s.

Outstanding questions

The majority of outstanding questions regarding the fort's history are very specific and arise due to its current physical condition. The dense undergrowth on the glacis and face walls and the flooding of the basement and parade ground may obscure a great deal of evidence, though some of the vegetation may be protecting parts of the structure from the impacts of the weather.

Brennan Torpedo

Undergrowth obscures parts of the Brennan torpedo installation including the roof of the torpedo store, the traverse wall to its north and the section of launching rails running down the glacis of the fort. It may be masking more evidence for the mechanism that hoisted the torpedo out of the store and the course of the wire runs between the torpedo, pulley beams and the engine room. Evidence for the remains of the remote-control release mechanism for each torpedo slipway may survive. The *Phase II Kent Rapid Coastal Zone Survey* (Wessex Archaeology 2005) recorded the position, to the south of the fort, of the foundations of what is assumed to be the jetty for recovering test-fired Brennan torpedoes, but further work would be required to be certain. It is possible that small stretches of the tramway, that connected the jetty to the fort, may survive beneath the present piles of aggregate and scrub to the south of the fort.

Dense vegetation in the area of the transition between the open and casemate batteries may obscure some evidence for the searchlight position probably provided for the Brennan torpedo director. However given the lightweight construction (timber and roofing felt) of the other searchlight emplacements, it is unlikely that substantial evidence of these has survived. Fragmentary evidence for the routes for electrical cables from the engine and dynamo house to the emplacements, in the form of ceramic pipes, has been noted inside the fort but no substantial evidence has

been found for either these cables, or their counterparts that connected the director position in the fort to the submarine minefield in the river.

The flooding within the fort may obscure other important evidence such as the water tanks beneath the north-east corner of the parade ground which might reveal additional evidence for the water supply arrangement for the Brennan torpedo installation's steam engine. Though not visible due to flooding, the floors in the Brennan torpedo casemates, particularly the engine casemate and the torpedo store, may contain evidence allowing confirmation of the location of the engine bed and possibly the handling arrangements for the wire drums and the torpedoes.

It is certain that the rising observation tower for the Brennan torpedo directing officer existed but the physical remains in Cliffe Fort and the documents do not provide any conclusive evidence as to the nature and function of the mechanism. Without contemporary examples of similar types of machinery, almost certainly hydraulic, it is very unlikely that further detailed study of the remaining fabric at Cliffe Fort will reveal the exact nature of the machinery used.

The glacis

Undergrowth in front of the casemated battery and the glacis may obscure the method used for sealing the embrasures made redundant by the construction of the internal concrete traverses in the 1890s. The lower height of the earth glacis at Cliffe compared to that at Coalhouse suggests that different methods were used at each fort. Outside each embrasure, in the earth glacis, there is the suggestion of earthworks either forming traverses to each open embrasure or as evidence of trenches and weapon pits dating from the First and Second World Wars. These could only be surveyed with substantial undergrowth clearance, though any future clearance in this area should bear in mind that Ordnance Survey map depictions of the fort in 1895 and 1907 suggest that shrubs and small trees grew on the glacis, perhaps as part of a camouflage scheme.

Submarine minefield

The high water level also obscures the floors of the Engine and Dynamo house, with any attendant mounting studs or plinths for successive engine and generator sets, and the floors of the Test House and the Accumulator Room. Bricks and rubble obscure the interior of the Laboratory.

Safe access to the upper floors of the Battery Observation Post (BOP) for the 6-inch guns may provide information as to the later modifications of the BOP, both for continued use as a director post and for its suggested uses as either an XDO post controlling the moored minefield or as a minewatching post.

Observation posts outside the fort

As previoulsy discussed, it is unlikely that any feature between the fort glacis and the shoreline, other than the Brennan slipways, would have survived subsequent works

for reinforcing and remodelling the flood defences along this stretch of the Thames. To the south of the fort, the rapid coastal survey (Wessex Archaeology 2005) and the authors of this report both noted piles of bricks and disturbed concrete bases that may be the remains of observation posts for submarine mining or the horizontal position rangefinder and these may justify further investigation.

Ammunition supply

Within the parade ground the Gyn and Tackle Store and the well head are not visible due to the water level. Depictions on the 1897 and 1908 Ordnance Survey 1:2500 scale maps and the 1899 plan (TNA: WO78/4963; App Fig 1) suggest that a raised kerb or possibly a low wall ran around the south and west perimeters of the parade ground. A high water level in the basement obscures any details on the floors of the shell and cartridge stores and the shifting and lighting passages, in particular evidence for any timber secondary flooring or lining to the walls of the stores, which according to contemporary regulations should be present, but which has left very little evidence for its existence at Cliffe. Similarly, the absence of evidence for any lift machinery to supply ammunition to the 6-inch guns, mounted on the fort roof between 1914 and 1927, is noteworthy. It is unlikely that the fabric of the fort can provided any further evidence for the reason for this omission. The reasons for this unusual absence in a 6-inch gun installation are likely to reside in the documentary sources.

Documentary evidence

It is unlikely, given the detailed research on the history of the Thames defences undertaken by various individuals for over thirty years, that any completely new documentary sources for Cliffe Fort will now come to light. It is of course possible that plans have survived in private hands or that the successors to Blue Circle Cement unknowingly retain the conveyance paper work for the sale of Cliffe Fort in the late 1930s. It is unlikely that any directly relevant 19th-century or Second World War documents remain to be discovered in The National Archives. The records relating to the Royal Naval Auxiliary Patrol Service may, after diligent research work, produce further relevant information on either Cliffe Fort, the signal station or the Thames patrol. Although, as these subjects are not clearly indexed (naval papers tend to be organised by command structure and not subject) the information is spread across many Admiralty file series, and discovering it would require time and patience. Research into the social history of the fort may also have its benefits.

14. CLIFFE FORT'S SIGNIFICANCE IN THE NATIONAL CONTEXT

Cliffe Fort is one of what are often described as the Palmerston Forts, a group of mainly coast defence batteries built in the mid-19th century. These were built after the 'Three Panics', a term summing up a period of strategic reassessment, public anxiety concerning the intentions of the new French Third Empire and political campaigning (led by Lord Palmerston) on the subject of defence. They were built at considerable cost and incorporated the latest thinking in both the science of fortification, heavily influenced by the recent experience of the American Civil War (1861-1865), and developments in technology and materials produced by what was then the world's leading industrial nation. Such an expensive, ordered and carefully-planned land-based defence infrastructure programme of this magnitude and cost has only one subsequent peacetime equivalent; the development of the United Kingdom's strategic nuclear deterrent in the 1950s and 60s.

The fort, along with its contemporaries Shornemead and Coalhouse, is the last of the coastal forts with casemated batteries and iron shields to be completed in the United Kingdom as a result of the recommendations of the 1860 Royal Commission, the committee of inquiry created mostly in response to Lord Palmerston's campaign. Unlike earlier forts it was built from the outset as a casemated work for the mounting of large calibre, 9-inch and above, RMLs with dispersed ammunition stores in the basement connected to the gun floor above by winches and lift shafts. Later forts would mount smaller numbers of large guns, eventually breech loaders, in concrete and earthwork positions instead of iron-shielded casemated batteries.

Cliffe Fort ceased to be a costal battery on the recommendation of the 1906 Owen Committee report and was subsequently used for a variety of ancillary functions. These ancillary functions, such as a First World War examination battery or as a base for the Royal Naval Auxiliary Patrol service during the Second World War, had far less of an impact on the 19th-century fabric of the fort than if it had continued to be a coast defence battery rebuilt for modern weapons or enhanced to meet new threats such as aircraft. This has left some areas of Cliffe Fort, notably the basement and the south-west casemates, in a condition or configuration dating from the removal of the RML guns at the end of the 19th century. The northern end of the roof was modified, at the outbreak of the First World War, for two 6-inch guns mounted *en barbette* as an examination battery. However, even this work had little effect on the casemates and basement beneath and the closure of this battery in the late 1920s or 1930s has left it almost in the condition it would have been in during the First World War.

Brennan Torpedo

A major element contributing to the fort's significance is the survival of its Brennan torpedo installation. Of the five Brennan installations constructed in the British Isles: Fort Albert, Isle of Wight; Garrison Point, Sheerness; Pier Cellars, Plymouth; Fort Camden, Cork and Cliffe Fort, two, Fort Albert and Garrison Point, have been damaged to such an extent that the remaining physical evidence for the Brennan

installation is now fragmentary at best. Of the remaining installations both Fort Camden and Pier Cellars retain, according to the Palmerston Forts Society website (www.palmerstonfortssociety.org.uk accessed 29/03/2012), their major structures; the torpedo store, boiler and engine room and some evidence for the launching ramp. Photographs of Fort Camden suggest that the machinery rooms may retain some of the Brennan fittings and fixtures such as a pulley beam and large sections of the engine bed. However it appears that only a short section of one of the two launching slipways originally built at Fort Camden survives. As Pier Cellars is inside an active Royal Navy base details about its condition are not readily available but some photographs on the website and Beanse's account (1997, 123) suggest that all the machinery rooms are still present although reused for other purposes, and a section of the single slipway ramp survives.

Cliffe retains all its machinery rooms; boiler, engine and torpedo store, in relatively good condition although with little evidence for the torpedo's operating machinery. One slipway is in good condition, retaining the steel stirrups for mounting the launch rails, the other is partially demolished and backfilled for flood defence although the shore line section survives to show the relationship between the machinery rooms in the fort and the slipway. The good condition of the machinery rooms and the survival of the slipways can be attributed to the decommissioning of the Brennan torpedo coinciding with the decline of Cliffe Fort as a coastal defence battery. Once the machinery was removed this area of the fort was practically abandoned, other than the conversion of the boiler room to a store. This decline has left the ancillary buildings (the coal store, guncotton store, accumulator store and the surface condenser room) intact and in context with the machinery rooms of the installation. In many ways this is the most significant feature of the Brennan installation at Cliffe Fort. Some of these structures may remain at Fort Camden and almost certainly at Pier Cellars but the design of these stations was more dispersed and both were adapted for other uses after the torpedoes were removed. What has no equivalent in any other Brennan installation is the evidence for the observation post that rose through the roof of Cliffe Fort. Unfortunately the details of its machinery and exact appearance are still unknown. Additionally incorporated within the protective concrete cone around the top of the shaft for the rising observation post, are the probable remains of the earlier fixed observer post for the directing officer. Fragments of a fixed director post remain at Garrison Point but the corresponding positions for Fort Camden and Pier Cellars are not thought to have survived (Beanse 1997, 41). None of the stations appear to have retained their shoreline ancillary observation posts although there is some very fragmentary evidence at Cliffe that requires further investigation. Similarly only Pier Cellars retains a recognisable searchlight position, converted to a small store, although evidence for a searchlight position at Cliffe may remain beneath undergrowth on the face wall of the fort.

Submarine Minefield

The other significant group of features is the Test Room, the battery store and control room for a section of moored submarine minefield to be laid in the Thames, in the event of war, from the 1870s onwards. These rooms would have been present in all Submarine Mining Establishments and in forts equipped with observer and

firing positions for submarine mine fields. Information on the survival of such rooms has proved hard to establish. There are no visible above ground remains of the demolished submarine mining establishment at Shornemead, there should be one at Coalhouse Fort but it is not indicated on any available plans and an example on the East Glacis at Falmouth was demolished in 1941 (Linzey 2000, 220). One is indicated on a 1890s plan of the Submarine Mining block at Landguard Fort, Felixstowe (TNA: WORK43/434) but this has gone through several uses since the cessation of submarine mining (it is now part of the museum). The virtual abandonment of large areas of Cliffe Fort before the First World War and the subsequent low impact use of the fort in that war and the Second World War may have ensured that the Test Room here has retained significant features, such as the floor and evidence for the cable runs on the walls, lost in rooms in other establishments which were adapted for other uses.

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16. ARCHIVE REFERENCES

Documents Relating to Cliffe Fort

The National Archives, Public Record Office, Kew

WO78/3427 Cliffe Fort: Plan of Fort showing Drainage.

Drainage plan dated 1891 with skeleton outline of major buildings and annotations dated 1893.

WO78/4963 Thames Defences: Cliffe Fort Plans and Sections 1899-1918.

This portfolio contains two groups of drawings: a series of plans from the 1890s concerning water supply and drainage and a set of plans and charts from 1918 concerning the armament of the fort's rooftop barbette battery and its accompanying searchlights.

Thames Defences: Cliffe Fort plan No 2 of Magazine, Drains etc dated 22/6/1899 and signed by the CRE Gravesend. Scale 15ft to 1in

Thames Defences: Cliffe Fort plan No 3 of Gun Floor dated 22/6/1899 and signed by the CRE Gravesend. Scale 15ft to 1in, annotations in red ink from 1901 to 1915.

Thames Defences: Cliffe Fort plan No 4 Top of Roof dated 22/6/1899 and signed by the CRE Gravesend. Scale 15ft to 1in, annotations in red ink from 1901 to 1915.

Thames Defences: Cliffe Fort plan No 5 Sections dated 22/6/1899 and signed by the CRE Gravesend. Scale 10ft to 1in

[Plan No 1, presumably of the foundations and earthworks, is missing]

Thames Defences: Cliffe Fort Proposed Emplacements for two 6 inch BL (struck out in favour of) 4 inch QF Guns on Top of Fort, dated 9 May 1913. Includes plan and sections at differing scales, work for 4-inch QF annotated in pencil, red and blue ink.

Chatham Sub District Gravesend Division Cliffe Fort, Record Plan of Oil Store Dated February 1916 includes plan and sections at various scales. Evidence of the former Brennan Installation in the form of annotations: former engine room, boiler room and site of former rising tower.

Chatham and District Gravesend Division DEL Emplacements 1, 2 and 3 accommodation for DEL personnel dated 26/11/18. 1:2500 1895 survey annotated in black ink with table of heights and construction materials for each DEL position.

Admiralty Chart: Broadness to Mucking Light, Gravesend Lower Hope Reach. Drawn 1887 with last amendments dated February 1907. Annotations for DEL and 4-inch QF ranges (in green pencil) dated 26/11/18.

Thames Defence: Cliffe Fort Site Plan. An annotated OS 1:10,000 1895 survey marked with the respective range arcs for the 12.5-inch, 11-inch, 9-inch and 12-pounder QF guns. Not dated but the weapons listed suggest a date in the early 1890s.

Untitled: Location map for water supply plan dated June 1893.

Two pieces of foolscap paper with sight diagrams showing the elevation of the fort from the low water mark to the top of the roof with spot heights for major features such as the glacis. Both dated 26 November 1918

WO78/5134 Sheerness, Medway, Thames and Harwich Area: Thames Defences: Index Plans, 8 sheets 1936.

Sheet 4 OS 1:2500 (1895 survey) annotated in red with armament and DEL installations for Cliffe and Coalhouse Forts. Presumed earlier annotation for ELD siting [sic] done in blue ink. Note against Cliffe annotations that information derived from plan dated November 1918 (this may be the plan in WO78/4963). All annotations struck out and word *Withdrawn* added in brackets.

WO78/5434 Chatham, Redham Mead: Dockyard, Fort(s) Cliffe, Horstead, Lyton and Darland 1879 -1897.

A collection of plans and maps relating to the above named. The Cliffe map is the 1895 1:2500 Ordnance Survey military map. Annotations suggest that this map was prepared for the discussions concerning the construction of the second Hope Point Battery circa 1905.

WO78/2601 Thames Defences: 1 August 1887

Contains plans of partitions, window frames and iron loopholed shields that were used in all of the Thames forts. The plans suggest that major construction features of the three forts may have been based on a shared standard plan.

WO30/106 National Defence: From Works Dept to CRE Gravesend September 1867 to August 1871.

Holographs of letters received by the CRE Gravesend; they are fully indexed with many discussing the construction of Cliffe, Coalhouse and Shornemead Forts along with the completion of the rebuilding at New Tavern Fort in some detail. This volume and its three counterparts were preserved as Capt (acting Lt Col) Charles Gordon (later Gordon of Khartoum) was the CRE Gravesend between these dates and several letters are signed by him. When Gordon left the post in 1871 the letters cease.

WO30/107 General: From Works Dept to CRE Gravesend January- October 1870

See previous

WO30/108 National Defence: To Works Dept from CRE Gravesend (press copies) November 1869 – October 1870

See previous

WO30/109 General: to Works Dept from CRE Gravesend (press copies) November 1869 onwards

See previous

Library of the Royal School of Military Engineering, Chatham:

GRA/0/9 Gravesend Order Book from January 1866 to December 1878

A small leather bound notebook containing a running list of the orders of the day issued by the CRE Gravesend. Few orders relate directly to Cliffe but useful for the names and tenures of officers and sappers and incidentals such as the legal case against the cement works.

GRA/0/9 Cliffe Fort Correspondence File

Contains recent correspondence related to Cliffe Fort and a newspaper cutting dated 1980. Of most interest is a correspondence dated September 1980 between Major A Nutter late R.A and the respective librarians of the SME and the Royal Artillery Institute concerning documents relating to Cliffe Fort. The file ends with an unequivocal letter dated 10 September 1980 stating that neither institution holds any primary material later than 1869 concerning Cliffe Fort.

Centre for Kentish Studies, Maidstone

CKS/NK/A/C/1/17 Correspondence between the Thames Sewer Commissioners and the CRE Gravesend concerning the sea walls in front of the forts in the river below Gravesend (includes Cliffe Fort) 1888-1889

The correspondence concerns alterations to the sea walls at Cliffe, Coalhouse and Shornemead. The two letters dated October 1888 discuss the construction of Submarine Mining Observation posts for which drawings are appended. The name or function of these posts is not mentioned in either the letters or drawings but the drawings are unmistakably of the standard design for this type of observation post. The letters dated 1889 and 1890 concern alterations to the sea wall in front of Cliffe Fort. The reason for these alterations only becomes clear in the last latter dated 3 April 1890 when oblique references are made to a 'railway' passing through the fort glacis and sea wall. This along with other incidental details in the earlier letters is taken as a deliberately obscure reference to the installation of the then top secret Brennan torpedo installation at Cliffe Fort.

Other relevant National Archive holdings

WO78/4468 Plymouth: Plans and Sections of Launching Way for Torpedoes dated 31 July 1888

This bundle contains the set of four drawings considered by Alex Beanse to be the generic instructions for assembling a Brennan Torpedo Installation. The drawings related to the design of the rooms in the installation are titled *Design for Machinery Rooms No 1* and *Design for Machinery Rooms No 2*. The No 1drawing is held to be the progenitor of the Torpedo Store erected at Cliffe. The bundle also contains similar drawings for boiler and steam engine installation. All these drawings are signed by Captain Willock Royal Engineers and dated 30/4/1888. Plymouth was the last UK installation to be completed in 1891 or 1892 (Beanse, 1997, 49) and this may explain why the bundle of generic Brennan installation drawings came to be indexed under the above title.

WO369/3 Royal Artillery and Royal Engineers Works Committee. Minutes 81-112 1886-1887

Item 45: 13 December 1886 Reconstruction of the Casemated Forts on the Thames and Medway

Initial proposals including major reconstruction with chilled iron shields and the rebuilding of Coalhouse Fort to take large calibre breach loading guns.

Item 62: 11 April 1887 Revision of Armaments: Thames and Medway

Discussion of strengthening Cliffe with new shields and traverses and an observation station situated on higher ground, construction of a new disappearing battery at Coalhouse and the mounting of quick-firing guns and machine guns at the Thames forts to cover the minefield.

WO396/4 Royal Artillery and Royal Engineers Works Committee. Reports 81-112 1888-1889

Report 102, 1st April 1889 Revision of armaments: Thames and Medway

This report continues the discussions begun in Item 45 (WO369/3) on the proposals for removing some of the existing armament from the Thames and Medway forts and installing concrete traverses. It also discusses the provision of quick-firing 6 pdr guns.

WO78/4369 Thames Defences: Shornmead [sic] Fort 31 December 1888, Coalhouse Fort 1 June 1887 at 10in to 1ft.

Original document unfit for production during visit to The National Archives. Extracts included by Victor Smith in 2007 archaeological desk study on Shornemead Fort. Plan shows this fort before modifications to the glacis and the demolition of the caponiers.

WO 192/48 Coalhouse Fort, Tilbury: Record Book 1911-1943

WO 332/53 Chatham Eastern Defences: Cliffe and Shorne Coalhouse Fort; tenants 1860 Jan 01-1863 December 31

MPHH 1/171 Thames Defences: Coalhouse Fort Plans and Sections 1899 – 1918.

A portfolio of record drawings of similar date and appearance to those for Cliffe Fort in WO78/ 4963

ADM1/18577 Reduction of Bases: Nore Command 1945

CAB13/5 Home Ports Defence Committee: memoranda for committees 101 – 162 December 1929 – March 1934

CAB 16/1 Report on the Committee on Armaments of Home Ports, 1905, categorising fortifications according to class of threat

WO 78/5132 Sheerness, Harwich and Felixstowe: Admiralty Charts showing defences: Thames Defences: Coalhouse Q.F. Battery

WO 78/5134 Sheerness, Medway, Thames and Harwich Area: Thames Defences: Index Plans

WO 78/4431 Thames Defences: Plans of Thames and Medway Garrison Defences.

WO 78/4529 Thames Defences Shornmead Fort, Plan of Terre Plein 1929

WO 33/254 Table of annual return of Approved Armaments 1902

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WO33/311 Thames District Defence Scheme 1904

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WO33/671 Eastern Coast Defence Scheme, Thames and Medway pt 1 1914

WO33/1349 Interim defence scheme for Thames and Medway 1934

WO199/624 Defence of certain areas: Thames August 1940 – May 1942

WO199/1163 Fixed defences: Thames and Medway September 1941 – September 1944

WO199/2478 Thames and Medway Defences August 1940 – June 1941

WO199/2479 Thames and Medway Defences January 1941 – July 1944

17. METHODOLOGY

Fieldwork

Standard survey methodologies were adapted due to the conditions within the fort (see below). Due to restrictions in time and resources a measured survey of the whole fort was not feasible. An alternative approach was adopted in order to increase the speed and safety with which the survey could be undertaken. The majority of the survey involved description (using a basic recording form) and photography of the interior and exterior of the fort without measured survey. A set of plans from 1899 (TNA: WO78/4963) were used as a basis for identifying changes to the structure and graphical survey was used to record any differences from the 1899 plans. Electronic measured survey was restricted to the roof area and small areas of detail on the parade ground and the glacis. The edges of the roof were not recorded due to health and safety issues.

GNSS using VRS

The two Total Station theodolite stations and some small areas of details within the fort and on the glacis were surveyed using a Trimble R8 survey grade GNSS receiver working in Real Time Kinematic mode (RTK). The position of each point was adjusted in real time to the National Grid Transformation OSTN02 via the Trimble VRS Now Network RTK delivery service. This uses the Ordnance Survey's GNSS correction network (OSNet) and gives a stated accuracy of 10-15mm per point.

Total Station

Most of the detail was surveyed using a Trimble 5600 Total Station theodolite by taking radiating readings from two stations which formed a baseline. The data was transformed to Ordnance Survey National Grid by adjusting the positions of both stations to the National Grid Transformation OSTN02 by use of a Trimble R8 survey grade GNSS receiver. The survey data was downloaded into Korec's Geosite software to process the field codes and the data transferred to AutoCad software.

Graphical Techniques

Details of internal alterations not shown on the 1899 plan (TNA: WO78/4963) were supplied using standard graphical techniques. The 1899 plan was used to fix the details but the results are diagrams and should not be considered metrically accurate as the copies of the plans obtained from The National Archives were distorted. The details were drawn up in MicroStation and then transferred to Adobe Illustrator for completion.

Publication

The measured plan of the roof was completed at 1: 1000 scale using digital drawing techniques in AutoCad/Adobe CS2 software. Additional report illustrations were prepared using Adobe CS2 software. The report was prepared for publication using Adobe InDesign software.

Archive

The survey data has been archived in compliance with Historic England RADF guidelines and deposited at the Historic England Archive.

Limiting factors

Flooding

The entire ground floor of the fort, including the parade ground, is flooded to approximately 0.5m. Consequently structural details below this level were not recorded during the survey. Areas of deeper water were identified in the gorge and barracks ranges, where suspended wooden floors have been removed, and in a number of specific locations relating to the installation of the Brennan torpedo: in the floor of the basement below the position of the rising observation tower, in the floor where the surface condenser was located and where the pipe ducts ran in the floor from the surface condenser, through the engine room, to the torpedo store. Other hazards may exist which were not noted during the survey. It should be noted that the water level within the fort changes with the tides with the result that new features may be revealed at exceptionally low tides.

Vegetation

Dense vegetation on the glacis at the front of the fort restricted survey in these areas by potentially obscuring important evidence and also masking potential hazards, particularly in the area where the Brennan torpedo store is located. In addition to the flooding, vegetation also impeded survey in the parade ground, potentially obscuring important evidence and hazards.

Unsafe structures

Special care was taken on the second floor of the barrack range where collapse, and some areas of purposeful demolition, has led to holes in the floor and walls. However the condition of the structure itself only restricted access to the roof of the barrack range and to the upper floors of the observation tower on the roof of the fort.

Lighting

In the area of the Brennan torpedo installation and the rest of the ammunition stores a lack of natural light may have impeded the observations of the survey team.

Protected Species

The presence of bats in some areas of the fort had an impact on the survey. These areas were surveyed rapidly in the presence of a licensed expert and small details may have been missed. Some evidence of water voles was noted within the parade ground and access through these areas was kept to a minimum.

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