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# FORT HALSTEAD, DUNTON GREEN, SEVENOAKS, KENT
# A BRIEF ASSESSMENT OF THE ROLE OF FORT HALSTEAD IN BRITAIN'S EARLY ROCKET PROGRAMMES AND THE ATOMIC BOMB PROJECT

Wayne D Cocroft


ARCHAEOLOGICAL
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# FORT HALSTEAD
# DUNTON GREEN, SEVENOAKS
# KENT

## A brief assessment of the role of Fort Halstead in Britain's early rocket programmes and the atomic bomb project

Wayne D Cocroft

NGR: TG 4990 5914

## SUMMARY

The late 19th century Mobilisation Centre, Fort Halstead, is a Scheduled Monument, Kent 303. It fulfilled its original role as a Mobilisation Centre, a store for armaments and tools for the supply of the volunteer force in the event of invasion, for around decade. During the First World War it may have been used as a store before being sold to a private owner in 1921. In the late 1930s, the site was reacquired by the government and became the Projectile Development Establishment, a remote location for the development of unrotated projectiles (rockets). An experimental filling shed associated with this work is the earliest surviving building associated with rocketry in England. In 1947, Fort Halstead was identified as the headquarters for the 'High Explosives Research' team that was responsible for developing Britain's first atomic bomb. A number of purpose-built structures and buildings associated with this work survive. Globally, these represent some of earliest structures associated with the development of nuclear weapons. This report does not discuss other aspects of Fort Halstead's wartime work, nor its later post-war research activities.

## CONTRIBUTORS

Wayne Cocroft compiled this report and Derek Kendall took the ground photography.

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## ARCHIVE LOCATION

Photographs taken for this report are deposited in the National Monuments Record, Swindon.

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## EARLY HISTORY

Fort Halstead (TG 4990 5914) (Figure 1) was one of a series of thirteen 1890s Mobilisation Centres built as part of a scheme known as the London Defence Positions, which was designed to protect the southern and eastern approaches to London (Saunders and Smith 1999, KD203; Hamilton-Baillie 2003, 19-23). Situated about three kilometres to the north of Sevenoaks, it dominates the Darent valley to its east and south. Its main function was as an armament and tool store, which in the event of invasion would be used to equip to local volunteer forces. There were no permanent mounted armaments on the fort, although as a last resort weapons could be mounted on prepared earthen platforms on its outer ramparts. Nor was there a permanent garrison attached to the site and the fort was normally under the supervision of a resident caretaker, who lived in a cottage (A14). If the country was threatened, a series of linking fieldworks might be dug to strengthen this relatively weak chain of forts.

Figure 1: *Fort Halstead, Kent, showing to the bottom the late 19th century Mobilisation Centre and to the top left part of the area occupied by the High Explosives Research team. English Heritage (NMR) MAL71144 5 October 1971 124*

In 1890, the War Office bought 3 acres of land at Halstead, and in the following year another 6¾ acres. Plans for the fort were drawn up by 1894, and construction probably took place between 1895 and 1897 (Griffiths 1984, 4). The London Defence Positions scheme survived for about a decade, but by 1906 plans were put in place to dismantle the system. During the First World War, a laboratory (F14) was built inside the fort, perhaps for ammunition inspection and in 1920 a storehouse was built outside the fort. A year later the fort was sold to a retired army colonel, who lived in the laboratory. The cottages were let, and the remainder of the site was used as a campsite for the Territorial Army, Boy Scouts, Girl Guides, and accommodation for destitute refugees (Griffiths 1984, 3-4).

Figure 2: *Late 19th century Caretaker's Cottage A14 and to the right the Tool Shed A13.* © *Copyright English Heritage DP060532*

The Mobilisation Centre is a Scheduled Monument, adjacent to it are the associated single-storey, brick-built Caretaker's Cottage (A14) and Tool Store (A13) (Figure 2). The fort was entered from the north along a mass concrete causeway that still survives, along with traces of fortress fencing (Figure 3). A dry, concrete lined ditch originally surrounded the Mobilisation Centre. On the eastern side of the inner lip of the ditch, shards of glass are set into the concrete, which may be contemporary with its construction. To the west part of the ditch has been infilled. Past experience of filled hollows in research establishments has shown that they were often convenient dumping grounds for discarded objects, which may now be of historic interest. Within the Mobilisation Centre are many surviving C19th details, including cast iron wall vents, brass light boxes, roof vents, original metal doors, and a cast iron fire hydrant.

Beyond the fort a map reproduced in Neill Griffiths' typescript history (1984) shows trench works to the south of the fort. It is not clear if the entrenchments were dug in the 1890s, or if they marked a line to be dug in the event of hostilities. The scheme was partially revived during the First World War and some trenches were dug. A cropmark has been plotted to the southwest of the fort (TQ45NE21), this may represent the line of a trench or an earlier feature. There is also a linear earthwork above Pilgrims Way, leading to the North Kent Business Park, this may represent a former hedgeline.

Figure 3: *The main entrance to the Mobilisation Centre, to the left are traces of the fortress fencing and to the right part of the rampart has been removed to create a separate pedestrian entrance. © English Heritage DP060613*

## 1930S ROCKET RESEARCH

In 1936, British interest in rocketry revived and the Committee for Imperial Defence entrusted Alywn Crow of the Armament Research Department with developing rockets for anti-aircraft defence, long range attack, air combat and assisted take-off units (Crow 1947, 511). Initial work began in the Ballistics Branch at the Royal Arsenal Woolwich, under Dr H J Poole. But due to safety concerns a remoter site was sought. Writing in 1949, Poole commented that his preference was for the new establishment to have been located adjacent to an explosives filling factory or firing range. 'This was also turned down in favour of a completely unsuitable site at Fort Halstead. In the end, as you know, a rocket station was built at Halstead and never used…' (The National Archives (TNA): Public Record Office (PRO) AVIA37/357 E2 letter 21 Jan 1949).

In 1938, under the directorship of Alwyn Crow, Fort Halstead became the separate Projectile Development Establishment (Griffiths 1984, 1-2). Construction work began almost immediately, and by the end of the war there were around eighty buildings, comprising specialist explosives filling sheds, a large laboratory, workshops, administration buildings, and welfare facilities, such as a canteen. In addition the establishment was equipped air raid shelters and to the north a housing estate for the War Department police (TNA: PRO AVIA 22/2304).

Figure 4: *Experimental filling shed F11 erected in 1938 for filling cordite rocket motors.* © *English Heritage DP060536*

One of the earliest buildings (Figure 4) constructed for the new establishment in the old fort was an experimental filling shed (F11), a design drawing dated February 1938 calls it simply 'New Building', and it was later known as 'Poole's Folly' (Griffiths 1984, 4). An early suggestion for the assembly of a 9 foot rocket involved closing the end of a rocket tube that would then be filled with a molten, sticky cement into which a cordite charge would be pushed. This sturdy double storey structure is concrete framed with brick infill laid to English bond with a 6 inch (15cm) sloping reinforced concrete roof. In the southern half of the building are four bays (Figure 5) standing the full height of the building and tall enough to accommodate a vertical rocket casing. In the rear of the bays are pipes that may represent heating and or hydraulic pipes associated with the filling process. On the east side of the building a covered, metal-framed walkway gives access to the upper storey. On its rear wall are two ground level doors and two upper blocked doorways,

which probably gave access to emergency escape ways. There is some doubt if this building was ever used for its intended function (Griffiths 1984, 4). Nevertheless, this modest building represents the earliest surviving purpose-built rocket related building in England and Britain's first steps to manufacture modern missiles. It is directly associated with this pioneering work by Sir Alwyn Crow that led to Unrotated Projectiles (rockets), which were widely used for anti-aircraft defence, coastal bombardment, and air-to-surface attacks, notably during the D-Day operations.

Figure 5: *Experimental filling shed F11, showing the vertical filling bays. © English Heritage DP060548*

In 1940, while building work was underway parts of the Armament Research and Armament Design departments occupied the nearby Halstead Place and its grounds. At this time the country was also threatened with invasion and other sections were moved to Aberporth in mid-Wales. As construction work was completed and the risk of invasion receded, different departments and sections began to occupy the newly completed buildings. By 1941, the headquarters for the rocket work was moved back to Fort Halstead, which also included a small experimental explosives filling area to the west of the fort (Clive1997, 18-19). Aberporth was also retained and developed into an important coastal missile range.

## FORT HALSTEAD AND HIGH EXPLOSIVES RESEARCH

At the end of hostilities in 1945 armaments research continued on a reduced level. Halstead Place was also retained and used for the evaluation of German technical equipment and translation of captured documents, assisted by nearly 200 prisoners of war (TNA: PRO AVIA22/2554). A German high speed wind tunnel was also brought to Fort Halstead, and later installed, although it is believed that it has recently been removed (TNA: PRO DEFE 15/70, 6). Research into solid propellants continued at least into the early 1950s, when a former employee recollects working on 3 inch air to ground, and 2 inch air to air missiles in Block D8 (pers. comm. David Brighton).

In January 1947, the British cabinet took the decision to proceed with the development of an atomic bomb and in May the task was given to William Penney, Chief Superintendent Armaments Research (CSAR) who was based at Fort Halstead (Gowing 1974, 442). Penney was a physicist and had been a leading member of the wartime British Mission to the United States Manhattan Project that was responsible for creating the first atomic bombs. He played a prominent role in the project, and in addition to his scientific contributions also sat on the Target Committee, which discussed which Japanese cities should be attacked, and flew with the mission that dropped the bomb on Nagasaki to film its results (Norris *et al* 1994, 19).

To mask its true purpose the atomic work the project was codenamed High Explosives Research (HER) and to accommodate Penney's team a fenced enclave was created within the Fort Halstead, centred on the Mobilisation Centre and a group of buildings to its immediate north. Within these structures were housed electronics, engineering, mathematics and theoretical physics departments (Hughes nd, 25-26). The enclave comprised the structures of the 19th century fort, a number of wartime buildings, and some purpose built structures. William Penney's main office remained in the late 1930s CSAR Headquarters Offices building, which was located just inside the main gate. By the end of 1950, the atomic bomb project dominated work at Fort Halstead with nearly 600 of the 997 posts allocated to HER (TNA: PRO ES1/246, note 1.12.50). The link between this project and the fort was a closely guarded secret, to the extent that even within government all orders were routed through the largely civil Atomic Energy Research Establishment (AERE) Harwell, Oxfordshire, until 1949 (Gowing 1974, 130, 452). Although, an astute foreign intelligent agent may have made the connection after the investigative journalist Chapman Pincher wrote an article for the Daily Express in 1947 entitled *Dr Penney plans new weapons in 1807 invasion fort* (Griffiths 1984, 2). Although, correct in linking Penney with the work, he misquoted the date of the fort.

No easily identifiable documents have been found in the National Archives database relating to the early atomic bomb work at Fort Halstead. There is, however, the possibility that documents or references may lie in related series, but these are not readily locatable from document title searches. Given this dearth of accessible official documents one of the few sources of information on early years of the British bomb project is Brian

Cathcart's *Test of Greatness* (1994). In addition to using the available official and published sources, he made extensive use of interviews with former scientists to compile an account of the late 1940s research work. This supplements Margaret Gowing's (1974) earlier official history of the British atomic energy, which explains the political and administrative of the project, as well as offering personal insights into many of the leading figures.

The principal task of Penney's team was the development of the ball of conventional high explosives that would produce the implosion wave, which in turn would act on the plutonium core to create the nuclear explosion. The main conventional explosives work was carried out at the Royal Arsenal, Woolwich, under Ernest Mott, and test assembly and firings at the AWRE's Foulness, Essex, range (Cocroft and Newsome 2009). One of the main responsibilities of the scientists and engineers at Fort Halstead was the development of the electronic detonators, which were required to work simultaneously in order to detonate the bomb's 32 explosive lenses (Cathcart 1994, 69). Leonard Tyte was in charge of electronics and high speed measurements, with responsibility of the two areas split between John Challens and Ieuan Maddock (Hughes nd, 26). Challens who arrived at Fort Halstead in January 1948 led the electronics team, assisted by Bernard Hillam, and in May they were joined by Edward Howse (Cathcart 1994, 66). Development of the detonators was undertaken out at Fort Halstead, while their manufacture was carried out in the former wartime Radio Production Unit on Ha Ha Road, Woolwich Common (TNA: PRO ES1/1420 letter 24 1 55; ES1/691 letter 31 5 1956; AB 16/1890 letter 7/12/1956). The reliability of the detonators was crucial to bomb's design and under the leadership of Ieuan Maddock probably many hundreds were tested at Fort Halstead (Cathcart 1994, 71). More were also tested in combination with the explosives lenses at Foulness. During these early years another regular visitor was Klaus Fuchs, an émigré German scientist who had worked on the United State's Manhattan Project. After his return to the United Kingdom he went to work at the AERE Harwell, but was frequent visitor to Fort Halstead as a lecturer and to pass on knowledge he acquired in the United States (Cathcart 1994, 103-4). In 1950, he was revealed as a Soviet spy.

A notable feature of the development of the Mark 1 bomb was the close co-operation with the intended service user, the RAF, and the HER team. Shortly after the decision was taken to proceed with the project in summer 1947, the then Squadron Leader John Rowlands was selected to head the RAF team that was to participate in the development of the atomic bomb. His principal task was to ensure that it developed to the Air Ministry's Operational Requirement 1001 (Wynn 1994, 29-31). He was also required to understand the science and engineering of the bomb, and to prepare the necessary procedures and regulations for storing, servicing and operating the weapon. The RAF team comprised Rowlands and a further nine serving RAF officers all with strong backgrounds in mathematics, science, and engineering. Once at Fort Halstead the RAF contingent was closely integrated with the HER team. Rowlands headed one group that was responsible for weapon assembly, which also included Squadron Leaders Brown,

Mitchell and Skelley, and Flight Lieutenant Blythe. While, Wing Commander Hunter-Toddy joined the mathematics team, Squadron leaders Betts and Pulvermacher went to electronics, and Flight Lieutenant Mercer to explosives (Hughes nd, 28-29). A general duties officer was also assigned to team to look after operational matters (Rowlands 1990, 14).

Both to ensure the secrecy of the work and safety of the surrounding buildings the mobilisation centre was used for the testing of the bomb's electronic detonators. Within its bounds the casemates (F4 and F8) and existing buildings were also adapted for use as workshops and stores. While in the eastern half (Figure 6) of the centre a number of purpose built structures were constructed to support the work of William Penney's atomic bomb team. The principal buildings are the bomb chamber (F16) (Figure 7), detonation chamber (F17) (Figure 8) and a recording laboratory (F18), other smaller buildings in the fort may also have been associated with this work.

Figure 6: *The eastern side of the Mobilisation Centre showing the buildings built for the High Explosives Research team, a scene little changed from the late 1940s. To the left is the Bomb Chamber F16, in the middle ground the Recording Laboratory F18 and to the left rear the Detonation Chamber F17. © English Heritage DP060587*

Figure 7: *Bomb chamber F16 designed in July 1947. © English Heritage DP060586*

Figure 8: *Detonation Chamber F17 designed in August 1947. © English Heritage DP060573*

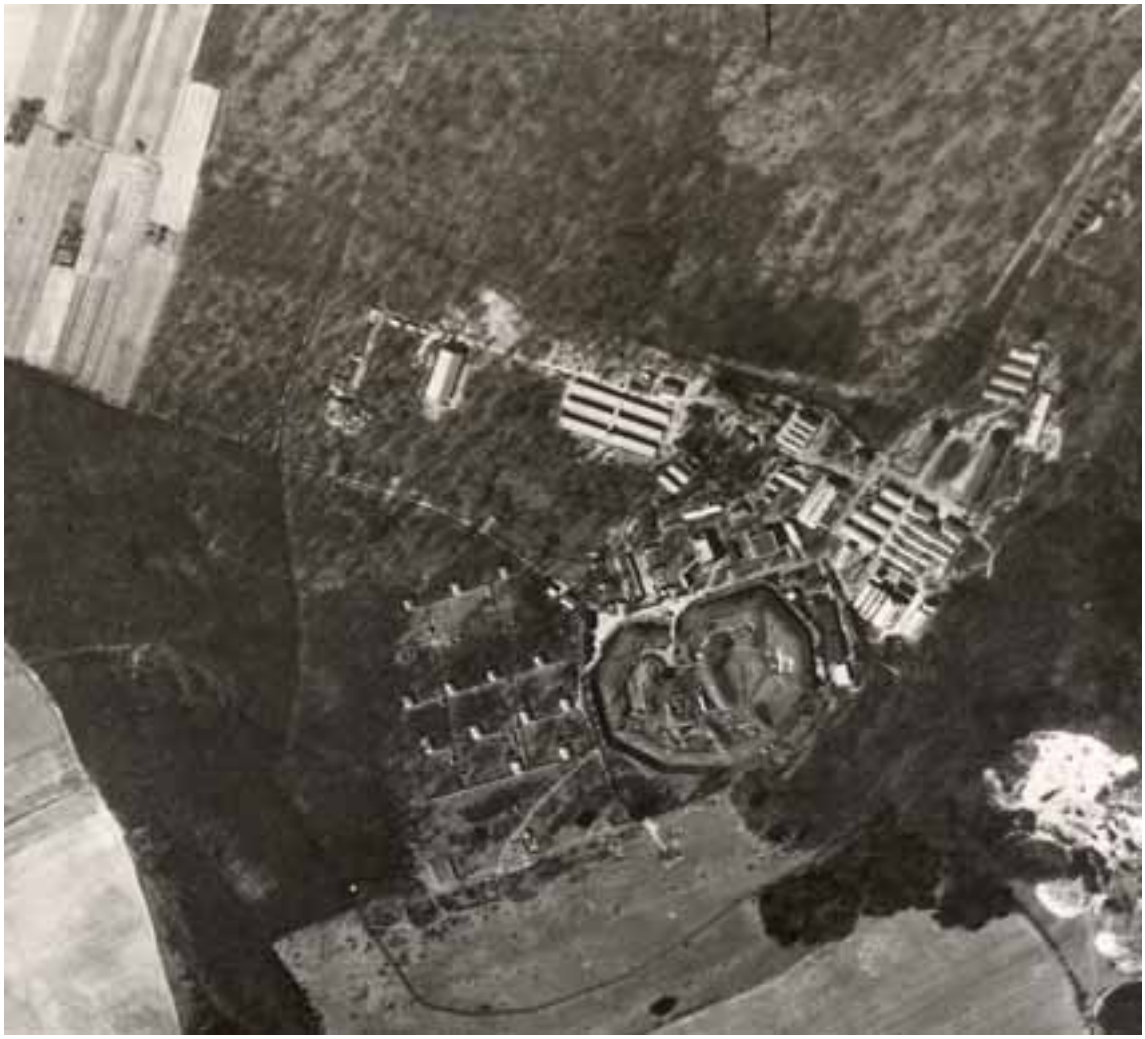

Figure 9: *Fort Halstead in April 1947 shortly before it was identified as the headquarters for the High Explosives Research team. English Heritage (NMR) RAF Photography RAF/CPE/UK 1982 11-APR--1947 1110*

The urgency and importance of the work at Fort Halstead is reflected in the preparation of a design drawing for the Bomb Chamber (F16) in July 1947, only two months after the formation of the High Explosives Research (HER) team. This has an E-shaped internal ground plan, with a single armoured chamber for the detonation of explosives devices. A month later the design was prepared for the more elaborate Detonation Laboratory (F17). This comprises an armoured bursting chamber with camera rooms to either side. The bursting chamber was divided into two parts, described as 'large' and 'small' and each equipped with armoured glass windows for the observation of experiments. Explosions were recorded using an angled mirror and Cordin high speed camera. Trials were overseen from a first floor control room, below which was a photographic dark room. Adjacent to these structures a new recording laboratory was added in 1948

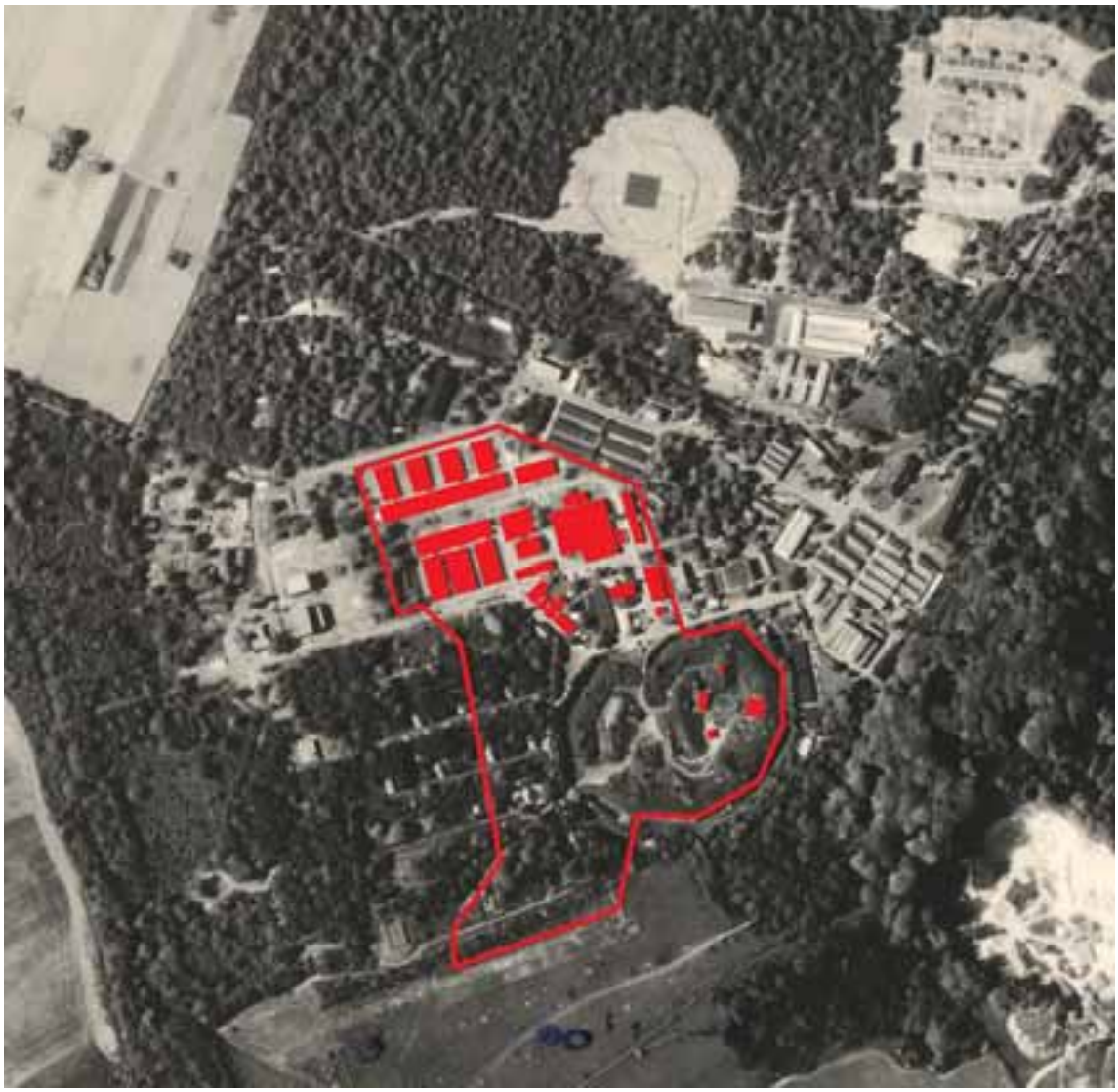

Figure 10: *Fort Halstead in July 1952, the red line denotes the main area occupied by the High Explosives Research team, buildings added to this area since 1947 are shown in red. English Heritage (NMR) RAF Photography RAF 540/731 15-MAY-1952 4075*

It was probably also in the late 1940s that the breach was made in the south west side of the Mobilisation Centre's moat to facilitate access to the wartime explosives filling sheds. This might suggest that were being used by the HER team for the assembly of trial devices.

Also associated with the HER team and the early bomb work are the group of buildings immediately to the north of the Mobilisation Centre. Two historic air photographs, one taken just before Fort Halstead was identified as the headquarters for the project and the other just before the first detonation of a live atomic bomb (RAF/CPE/UK 1982 11-APR-1947 1110 and RAF 540/731 4075 15-MAY-1952) (Figures 9 & 10) may be used to

identify buildings constructed during this critical period in the late 1940s. The boundary of the area occupied by Penney's team is taken from Clive (1997).

Figure 11: *Laboratory Q13 built about 1939, in the foreground is one of the trees from the original planting scheme.* To the left is A12. © *English Heritage DP060621*

Immediately to the east of the HER area, and apparently outside its boundary, is building (Q13) (Figure 11) that was originally designed as a chemical laboratory and was later used as the headquarters stores (Clive 1997). It is a well proportioned double storey brick building, and typical of many 1930s buildings is lit by horizontal glazed bands. It was originally glazed with metal Crittall-type windows that have recently been replaced with double glazing. The metal railings around its flat roof give the impression of a ship's deck. The building is entered from the south through a porch and well finished oak doors, above the first floor window surround is emphasised by horizontally projecting bricks. Internally, is an impressive staircase lit to the east by a full height window. A surviving drawing of December 1939 confirms its construction to the original development phase of the Armament Research Department. Externally, the road, now Penney Road, was tree lined, reflecting a concern for the working environment also found on many contemporary airfields. To its south west is the associated wartime A12, a well built brick bungalow-like building, with a pitched tile roof. To its east is a modern extension.

Also constructed during the war to the west of Q13 was a single storey brick building with a flat concrete roof (Q1), also known as Block 'O' and Block 3 (Figure 12). Associated with this building to the east and west were six small experimental buildings. It was the area surrounding Q1 that was developed for the HER team. To the west

standard concrete framed and asbestos roofed Ministry of Supply hutting was erected for office accommodation. Immediately to the west of Q1three now demolished huts, Q17, Q18, and Q19 housed the team's drawing offices. To the north of Q14 hut H6 remains and is now used as a café.

Figure 12: *Wartime building Q1 later incorporated into the HER enclave. (C) English Heritage DP060615*

The most distinctive building in this area is Q14 (Figure 13), unfortunately, no original building drawings for it survive on site, although air photographs confirm that it was built between 1946 and 1952. A plaque on its wall also states that 'In this building a group of scientists led by the then Dr W G Penney worked on United Kingdom atomic warheads during the period 1946 to 1952' (Figure 14). A member of the HER team recalls that this structure was colloquially known as the 'RAF building' and illustrates the role the RAF played in the project (pers. comm. Colin Hughes). It was a purpose-built structure designed for the assembly of the prototype warhead and its ballistic casing, and was central to Rowlands' task 'to see that everything we were making could be put together in one case' (Wynn 1994, 39). This building was the only place where a complete model was assembled, and certainly the one location where all the HER components were brought together along with the ballistic casing produced at the Royal Aircraft Establishment Farnborough (Rowlands 1990, 15). In this building inert model wooden replicas were used instead of the live explosive components. Work on the live explosive lenses was undertaken in another specially constructed building at AWRE Foulness, Essex (Cocroft and Newsome 2009, 13-15).

Figure 13: *Building Q14, to the right is its former main entrance and to the left the plant room marks the position of the entry into the workshop. This building was specially designed for the assembly of Britain's first the prototype atomic bomb. © English Heritage DP060631*

The architecture of Q14 directly reflects its very specialised and highly classified functions. The building is brick clad and laid to stretcher bond, but it is unclear if it is supported on a steel or reinforced concrete frame. It is topped by a flat concrete roof. Although, some steel framing was visible in the ground floor workshop area, it was unclear if this was structural, or if it was there to carry the travelling crane. Originally, the lower two storeys formed a large double storey workshop with a travelling crane above. In keeping with the highly secretive work carried on in this building, its east elevation facing out from the HER area, was blank except for the top floor office windows. In recent years the workshop has been converted into office accommodation, with the insertion of a false ceiling. On the west and north elevations the original double height windows have been partly infilled in brick and on the east elevation windows and a door have been inserted into the originally blank lower part of this elevation. Another feature of the highly sensitive work that was undertaken in this building was the way that access into it was carefully controlled. The main entrance is in the centre of the south elevation through an undistinguished double door, to its east more recent brickwork marks the position of another similar sized door opening. The only entry into the workshop area appears to have been from a single bay width entrance at the south end of the east elevation. Although blocked and partly covered by a brick plant room, a surviving wall light and metal covering, perhaps for a roller door, mark its position. On the second floor above the workshop is a suite of offices lit by windows on all elevations. To the northwest of

Q14 is a large stores building Q4, also erected between 1946 and 1952, and immediately to the north a standard Ministry of supply hut H6.

Many aspects of the manufacture and testing of Blue Danube trials rounds still remain imperfectly understood. As mentioned, responsibility for the development of the bomb's casing lay with the Royal Aircraft Establishment (RAE), Farnborough, while HER, and the RAF team, was responsible for its internal devices. Most of the casings were manufactured by Hudswell Clarke and Co Ltd, Leeds, while the Percival Aircraft, Luton (Gowing 1974, 179) also played an important part in the design of the sphere that contained the high explosives and fissile components. Some of its internal electronic components were manufactured at HER's Woolwich Common factory, while others were probably produced by a number of private companies. The discovery in 2009 at the former Royal Ordnance Factory at Elstow, Bedfordshire, of a concrete dummy mimicking the high explosive elements of the bomb, may suggest it was also involved in the early phases of the project. Given its proximity to Luton it may have been used for the trial assembly of the core's metal casing.


Figure 14: *Plaque on the side of building Q14 commemorating its association with William Penney and the HER team. © English Heritage DP060630*

To prove the design of the casing, in the late 1940s and early 1950s RAE began a series of ballistic trials over Orford Ness, Suffolk, with aircraft based at RAF Martlesham Heath (Cocroft and Alexander 2009, 15-20). From here the aircraft probably flew to the nearby

RAF Woodbridge, where a special three-crane gantry had been designed for assembling the inert trials rounds (pers. comm. Colin Hughes). The bomb casing measured 7.3m in length and for ease of handling it was split into three sections a nose, centre section, and tail. Woodbridge had originally been constructed as a wartime emergency landing airfield, and was equipped with a 2743m runway, which the modified Lincoln aircraft were able to make full use of to take off with the large trials rounds.

It is, however, not known where the trial devices were assembled prior to being taken to Woodbridge. One possibility is that they were assembled in Q14, with the large store Q4 being used to hold the bulky casings. Alternatively, they may have been assembled in at as yet undocumented location. Although, for the early trials work AWRE Aldermaston and Burghfield may be ruled out as assembly sites, as at both sites construction work wasn't completed until the early 1950s.

At Fort Halstead, other new work in the late 1940s included more offices, stores, workshops and other buildings to the north. Also to the north a large clearing was created in the woods for a large square surface surrounded by an octagonal fence, which may suggest a fenced firing area. Outside the establishment an additional housing estate was built to the west of the existing wartime War Department Constabulary housing. In the village of Otford, to the east of Fort Halstead, extra housing was built for the establishment (Cathcart 1994, 72).

In the run up to Hurricane trial in October 1952, when Britain exploded her first atomic bomb on the Mont Bello Islands, Australia, members of Fort Halstead's RAF contingent, Wing Commander Rowlands and Squadron Leader Mitchell, were entrusted with transporting the radioactive components by air from the United Kingdom. In the final hours before the trial, Rowlands and Mitchell, and William Moyce from the HER team, were responsible for the final assembly of the test device (Rowlands 1990, 16-17). It was successfully detonated on Friday 3 October 1952. In August 1953, Rowlands went on to become the commanding officer of the Bomber Command Armament School at RAF Wittering, the first RAF station to receive atomic weapons (Wynn 1994, 92). Atomic weapons related work remained at Fort Halstead until 1955, when the last members of staff were transferred to new Atomic Weapons Research Establishment (AWRE) Aldermaston, Berkshire (TNA: PRO ES1/246).

## SUMMARY

The Mobilisation Centre is one of thirteen such structures built in the 1890s to guard London from possible landward attacks. They reflect then current political fears about possible invasion, which was represented in popular literature, such as William le Queux's *The Great War in England in 1897*. Although, there have been later additions to the fort, due to its long service in government hands many original 19th century features survive in its casemates, including cast iron wall vents, brass light boxes, roof vents, original metal doors, and on the surface a cast iron fire hydrant.

The 1938 experimental rocket filling building (F11) is the earliest surviving purpose-built rocket related building in England. It reflects Britain's first steps to manufacture modern missiles, but also demonstrates the country's modest entry into this field when compared to contemporary German work at Peenemunde.

In the eastern part of the Mobilisation Centre are a small group of buildings built in the late 1940s specifically to support the atomic bomb work of William Penney's team. One of the principal tasks of the Fort Halstead teams was the development of the electronic circuitry to detonate the conventional explosives lenses that surrounded the bomb's fissile core. At the centre of project was the purpose designed building Q14. As the bomb project developed it was the single place where the highly classified components were brought to for assembly by the specially picked RAF team under Squadron Leader Rowlands. It architecture directly reflects its secretive and specialised function. Its ground floor presenting blank faces to those outside the HER team, and was lit by windows facing into the HER enclave. Access to the building was carefully controlled and internally was large double storey assembly floor for the assembly of the prototype 7.3m long Blue Danube bomb.

The occupation of Fort Halstead by the High Explosives Research team under William Penney took place during the crucial period during which the UK developed its own atomic bomb. Its detonation on Monte Bello Islands, Australia, in October 1952, was a significant national turning point in post-war history. It represented a technological achievement for British scientists and engineers, with enduring political repercussions for the United Kingdom's relationship with United States and the rest of the world, and how the country continued to perceive itself as a member of the 'top table'. These structures, along with a handful of buildings at Foulness, Essex, are amongst the earliest buildings in England associated with the development of the country's first atomic bomb. Internationally, they also represent very early survivals of structures associated with the pioneering stages of atomic weapons technology. At this date only the United States and Soviet Russia, were in advance of the United Kingdom in this field.

## METHODOLOGY

This account is based on three brief escorted field visits to Fort Halstead conducted over a number of years. The sparse secondary literature and a selected number of documents at the National Archives have been reviewed. Historic air photographs were also consulted. Selected buildings in the former HER area were photographically recorded in May 2008 and copies of these are available from the NMR.

# SOURCES

The National Archives, Kew, on-line catalogue lists 52 files with Fort Halstead in their titles, of these 40 relate to its post-war history. None, however, shed much light on the work carried out by the High Explosives Research team. The site's estates department holds most of the original building plans on aperture cards. Drawings of the late 1940s buildings inside the fort survive, but no trace was seen of the drawings for Q13. The National Monuments Record (NMR), Swindon, has historic air photographs of the site dating from the late 1940s, which allow buildings constructed during in this period to be clearly identified. The NMR also has a series of images of Fort Halstead from the former Property Services Agency collection, but none of these appear to be associated with the HER programme. Given this lack of secondary material recollections of the memories of former employees are likely to be the most productive source of further information.

## Primary sources

### Drawings held on site

F16 Fort Halstead H.E. Research Bomb Chamber, Lightning Protection Installation 12.9.47

F16 AB 1/1 5839/21A Bomb Chamber 20 July 1947

F17 AB 2/1 5839/32A Fort Halstead H.E Research Detonation Laboratory ?Aug 1947

DB2/1 H.E. Research (Old Fort Area) drainage & cold water supply detonation lab 18 Feb 1948

### The National Archives, Kew

AB 16/1890 Woolwich Common site: general 1955-1957

AVIA22/2554 ARD accommodation at Halstead Place, Halstead, Kent

AVIA 22/2304 Fort Halstead, Knockholt, Kent: proposed occupation by Projectile Development Establishment, Signals Research and Development Establishment, Ordnance Board, Armament Design and Armament Research Departments

> Includes : Plan W1440 Fort Halstead site plan WD police quarters and a plan of main building

AVIA37/357 Departmental research programmes organisation of solid propellant work at Westcott

DEFE 15/70 MoS ARD programme arranged on the occasion of the visit to Fort Halstead of A Woodburn, esq MP Parliamentary Secretary to the Ministry on January 30th 1947

ES1/246 Move to Aldermaston Fort Halstead travel allowances

ES1/691 1956-57 Woolwich Common extensions: buildings and extensions 1956-1957

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*English Heritage undertakes and commissions research into the historic environment, and the issues that affect its condition and survival, in order to provide the understanding necessary for informed policy and decision making, for sustainable management, and to promote the widest access, appreciation and enjoyment of our heritage.*

*The Research Department provides English Heritage with this capacity in the fields of buildings history, archaeology, and landscape history. It brings together seven teams with complementary investigative and analytical skills to provide integrated research expertise across the range of the historic environment. These are:*

* *Aerial Survey and Investigation*
* *Archaeological Projects (excavation)*
* *Archaeological Science*
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* *Architectural Investigation*
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*The Research Department undertakes a wide range of investigative and analytical projects, and provides quality assurance and management support for externally-commissioned research. We aim for innovative work of the highest quality which will set agendas and standards for the historic environment sector. In support of this, and to build capacity and promote best practice in the sector, we also publish guidance and provide advice and training. We support outreach and education activities and build these in to our projects and programmes wherever possible.*

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