Manufacturing Munitions at Pembrey during the Two World Wars

Alice Pyper

'The factory is built on the Burrows (ie sandhills), the most desolate spot in the world… factory sheds are built with a large mound of sand all round them, and are entered by a small tunnel though the mound. In this way the sheds are quite invisible from outside, and the place looks more like a gigantic rabbit warren than anything else.'

Gabrielle West, 1917.[1]

The Pembrey Burrows must have seemed like an ideal location for a dangerous industry; the land was sparsely populated, though well connected by the mainline railway, and the treeless, open sand dunes could be easily landscaped to provide blast protection. In addition a supply of labour was close at hand; as well as the local villages of Pembrey and Burry Port, the major towns of Llanelli and Carmarthen lay within easy reach and Swansea was only a short distance by train.

The factory referred to by Gabrielle West was that built by Nobel's Explosives Company Ltd in 1914, which covered around 771 acres of Pembrey Burrows to supply munitions for the First World War.[2] Recent research into the munitions industry of Pembrey has explored the site to gain a better understanding of what survives from this period. The project was carried out as part of a Cadw-funded programme to investigate, record and assess the archaeological legacy of the First World War in southwest Wales. The Heritage Lottery Fund also funded an interpretative leaflet of the site, a series of pop-up exhibition panels, educational resources, and enabled students from Glan y mor Secondary School in Burry Port to carry out course work as part of their GCSEs on the archaeology of the site.[3]

INTRODUCTION

The majority of the site is now located within Pembrey Country Park, which is owned and managed by Carmarthenshire County Council. A substantial part of the factory dating from the First World War also lies within Pembrey Forest, which is managed by Natural Resources Wales.

The primary aim of the project was to understand the impact of the First World War munitions industry and identify surviving archaeology from this period; however in doing so it was particularly important to grasp the effects of its subsequent reuse in the Second World War and later.

Documentary research was undertaken at Carmarthen Archives, the West Glamorgan Archives, Llanelli Library and Local Studies department, the National Archives at Kew and the Imperial War Museum.

Key plans of the site were located at the National Archives, principally the *c.*1917 Block Plan of Plant and the R.O.F. Pembrey, Layout of Factory.[4] These plans were compared to the modern Ordnance Survey[5] to highlight how the site was laid out during different phases of use. LiDAR[6] data provided an image of the ground surface stripped of vegetation and also highlighted areas of surviving earthworks. Aerial photographs were assessed from those taken in the 1940s to modern satellite imagery.[7]

Areas of high archaeological potential were identified and prioritised for fieldwork which was carried out with local volunteers in September and November of 2015. Recording included taking digital photographs of features with a scale, and a customised recording sheet was developed for volunteers to record archaeological features.

THE HISTORICAL BACKGROUND

THE DYNAMITE WORKS

The earliest factory on the site was built in the late 19th century, and was a short-lived venture. In 1881 newspapers reported that the Stowmarket Explosive Company applied for a licence to manufacture explosives in a new factory at Pembrey on land leased from the Earl of Ashburnham. This consisted of an area of land of 150 acres along with the lease of the old harbour and docks.[8] As soon as the factory opened the Stowmarket Explosives company was superseded by the Explosives Company. Explosives were manufactured, along with detonators and fuses, for industrial use in collieries and quarries rather than manufacturing munitions.

The factory was in operation for only a few months when on the 18th November 1882 a terrible explosion killed seven young workers, aged between 13 and 24 years old. The newspaper accounts of this horrific event, which left the village in mourning, give some insight into the factory itself.

The subsequent inquest reported that the factory consisted of 80 small sheds, scattered over a large area with a small locomotive used to reach the manufacturing areas. The sides of the sheds were composed of thin boards with roofs made of felt and floors of sand. The sheds were flimsy in order to offer little resistance to an explosion but they were placed 70 yards apart with a high mound of sand in between.[9] The company was licensed to store 144 pounds of dynamite – however, it was alleged in Parliamentary questions, just two days before the explosion, that there were over 300 tons stored.[10] The explosives were kept in twelve magazines far removed from each other and almost buried underground.

This disaster appears to have been a catastrophic blow to the Explosive Company, as on the 22nd May 1885 it went into receivership and ceased production, and was succeeded by the South Wales Explosives Company.[11] However, further misfortune beset the enterprise in 1893:

> A fire took place at the dynamite works on Saturday evening, when three large sheds were burnt to the ground. Serious damage was done, and the loss is heavy. The works have been idle ever since the great explosion some years back, and the cause of the fire is as yet unknown.[12]

Although no longer in production the site was still in use for storage as it was reported that 'fortunately the magazine was saved from contact with the flames.'[13]

The second edition Ordnance Survey map published in 1908 is the only cartographic record to show the layout of the 'Old Dynamite Works' (*Fig. 1*). It depicts the site more

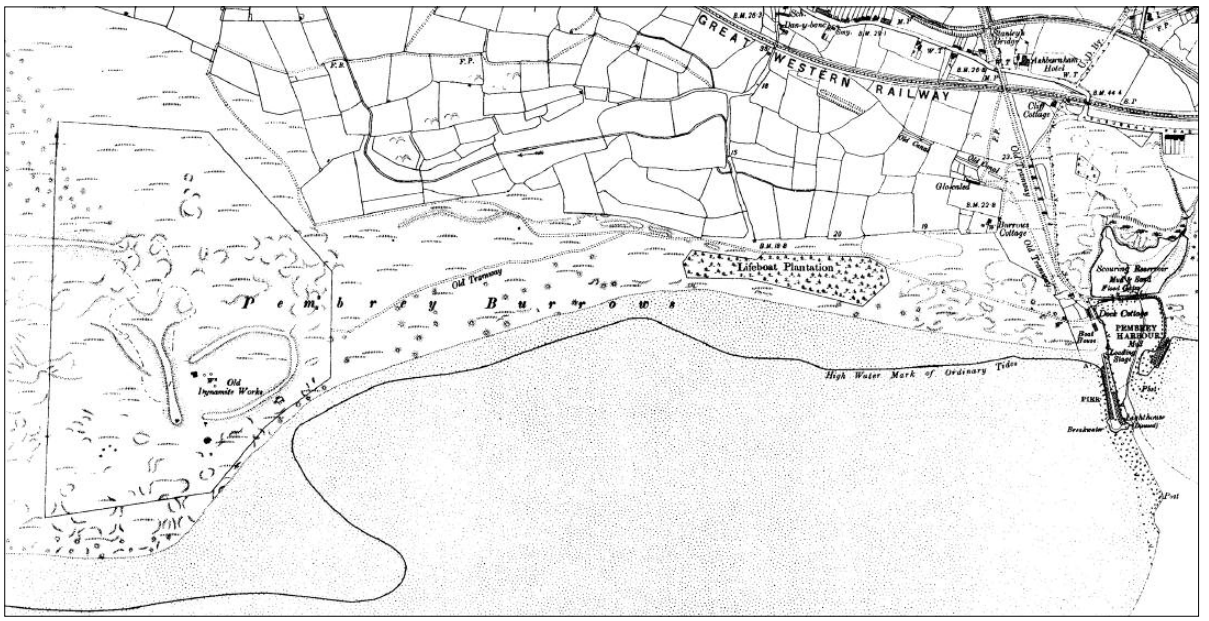

Figure 1. *The Old Dynamite Works, Ordnance Survey second edition, Carmarthenshire sheet LVII.NE, surveyed 1878-86, revised in 1905, published 1908.*

than 20 years after it ceased production, however it does give some detail to its layout and shows the course of the tramway connecting the factory across the Burrows to Pembrey Harbour. The site is shown to consist of a number of buildings and structures enclosed within an irregular boundary and a horseshoe shaped bank around the factory. It is unclear if this ridge was an artificial construction, perhaps a blast bank, or a natural topographic feature, whatever its origin it appears that the factory layout respects the feature.

FIRST WORLD WAR

The official account of the industry at Pembrey is recorded in the *History of the Ministry of Munitions* written in the years following the war.[14] There were two factories on the site, located side by side, one manufacturing TNT, a high explosive, and the propellant cordite, and the second, occupying a smaller area of land, was the shell filling factory.

NOBEL'S EXPLOSIVES COMPANY AND THE MINISTRY OF MUNITIONS

In 1914 Nobel's Explosives Company Ltd of Glasgow intended to develop the site for the production of industrial explosives, however with the outbreak of war they entered into an agreement with the Secretary of State for War, 'to erect and manage a TNT factory at Pembrey'.[15] Local newspapers record that work commenced in the winter of 1914-1915 when between 800-1000 men were 'employed preparing the ground and erecting sheds',[16] and by May there were nearly 1,800 employed.[17] The works clearly drew large numbers of labourers from far and wide, who worked 50-60 hours a week at sixpence an hour, and following a dispute about pay, a 3s 6d weekly war bonus. The influx of workers led to a serious housing problem in the local area[18] and reports of an increase in drunkenness and bad behaviour.[19]

The official account records that the first element of the factory in production was TNT manufacture, which began in July 1915. The construction of various elements then proceeded at a rapid pace, with an agreement between Nobel's and the Admiralty to put a cordite production plant in place, followed by a further extension for the production of propellants including ordnance cordite, rifle cordite and ballistite.[20]

In all, the factory covered an area of 771 acres with 400 buildings, and its construction was managed by Sir Frederic Nathan who had previously managed Nobel's first factory at Ardeer in Scotland, a site located on a peninsular of sand dunes, not dissimilar to Pembrey.[21] From the 1st January 1917 the plant was nationalised and became government property under the newly established Ministry of Munitions, but in practice continued to be managed by Nobel's. Two hundred tons of crude TNT were produced weekly and with further capacity this increased to 300 tons, amounting to 15,000 tons over the duration of the war. Cordite was produced at a rate of 225 tons a week at its peak[22] and 20,000 tons over the duration of the war.[23]

In October 1918 there were 4765 workers employed and of these 58.6% were women.[24] Workers were transported to the factory on special trains, from Llanelli, Carmarthen and Swansea, and brought to Lando, a special stop created on the GWR mainline for the factory at Pembrey. In addition trains with specially equipped dust-proof and steam fitted carriages exported the propellant cordite at a stable temperature to the munitions factories at Faversham and Chilworth in Surrey, via Reading and the Southeastern Railway.[25]

NATIONAL FILLING FACTORY, NO. 18 PEMBREY

As part of the contract of 1915 between the War Office and Nobel's Explosives Company a loading plant for the filling of shells, torpedoes and mines was built on a site adjacent to the TNT factory. The factory was built and equipped by the Explosives Loading Company. Along with the adjacent explosives factory, this plant was also nationalised on 1st January 1917 and became the National Filling Factory No. 18 Pembrey. At its peak the factory used more than 200 tons of high explosives every week in shell production and in less than two years 1,143,000 shells were exported from Pembrey to the battlefronts of Europe and the Middle East. From May 1917 filling shells ceased and the factory began breaking down and disassembling defective munitions to recover components. In 1917, there were 1050 workers in the filling factory, many came from outside the immediate area, and were brought in on trains from Swansea and Carmarthen. Women accounted for a greater proportion of the workers in the filling factory, with 70.5% recorded in March of that year.[26]

HM PEMBREY AND NFF NO. 18 PEMBREY – THE END OF PRODUCTION

Work continued at No. 18 Filling Factory disassembling munitions until the end of 1919 when many workers were laid off and presented with a certificate for their labour.[27] Sales of machinery took place through the early 1920s; Plant Machinery in July 1922, and Chemical Plant and Machinery in November 1922.[28] In 1926 the final sale took place including the 771 acres freehold with buildings, cottages, steam, electric, and pumping plants, weigh-bridge, 13½ miles of railway sidings, 21½ miles of tramways, 100 circuit automatic telephone installations, water service with reservoir etc. At the sale, held in the Hotel Metropole in Swansea, the factory was sold in one lot for £30,000 to a local firm of breakers and scrap merchants.[29] Of the period between the First and Second World Wars little is known. However from 1935 the site became one of a chain of school camps for children from economically deprived areas of South Wales, using the general administration office for this purpose (*Fig. 2*).[30]

SECOND WORLD WAR: ROF 34, PEMBREY

With war in Europe looming again in 1938, the government proposed building a new factory at Pembrey and work on construction began that year, continuing into 1939. The work was tendered out in a number of contracts.[31] Photographs of the construction show that many of the earlier manufacturing buildings were demolished (*Fig. 3*), although the administration buildings survived (*Fig. 2*).

The factory was government owned from the start and known as the Royal Ordnance Factory Pembrey. It was one of four factories producing TNT, the others being Irvine, Drigg and Sellafield and it was the largest supplier of TNT, tetryl and ammonium nitrate. The factory was around 270 acres smaller than the earlier factory of the First World War, excluding an area to the northwest.[32] Production began in December 1939 and at its height the factory employed 3000 workers, which after the war reduced to 1300. The factory's production of ammonium nitrate which during the war had been combined with TNT to make the explosive amatol, was afterwards used to make agricultural fertiliser.

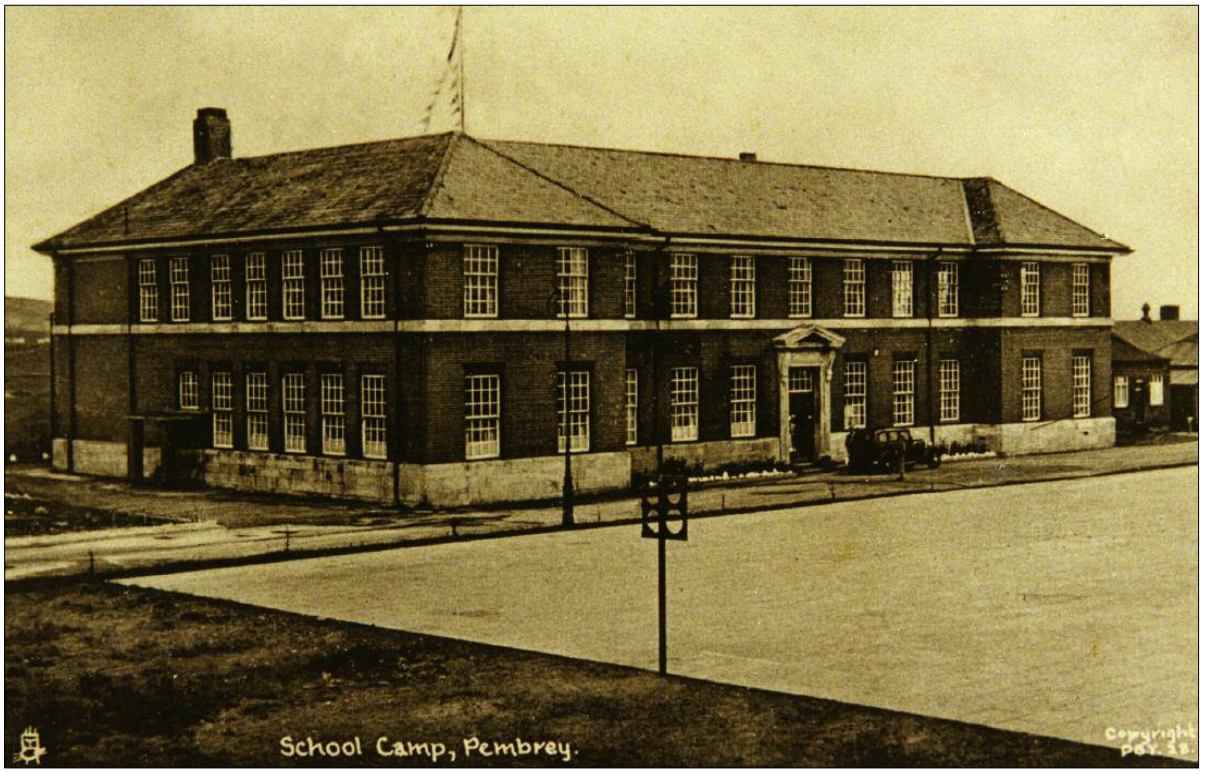

Figure 2. *The General Office, used as Pembrey School camp between the wars.*
(Dave Hughes)

Figure 3. *General view looking NW showing Building P3 (steelwork) and clearing of site for Building P1 dated 29/8/1938.* (National Archives)

From 1944 the factory was also breaking down defective ammunition. This necessitated extracting the TNT which would be burnt off on the 'burning ground', and a by-product of this process was carbon black, which was captured for use as printers' ink.

POST WAR

The Royal Ordnance Factory continued breaking down surplus ammunition for many years after the Second World War ended, although demand for munitions during the Korean war saw a brief resurgence in production. A steady decline in operations continued until, in its final two years, it employed only 400 people. A departmental review between 1960 and 1962 concluded that the remaining activities at Pembrey would be dispersed elsewhere. By December 1963 the ROF was closed and up for sale. Hopes for the factory to be bought and redeveloped by another business proved fruitless and finally a firm from Halifax stripped the site and removed anything of value. Some parts of the factory continued to be used with small-scale industrial units established in some of the vacant buildings. Between 1969 and 1970 a controversial proposal to move the Shoeburyness experimental gunnery range to the Pembrey peninsula was successfully fought through a local campaign and a public inquiry.[33] Eventually the site was cleared, landscaped and established as a country park opening to the public in 1980.

THE ARCHAEOLOGICAL LEGACY

During 2015 groups of volunteers worked with DAT to investigate the archaeological legacy of the munitions industry at Pembrey. Any visitor to Pembrey Country Park

will be aware of the massive concrete bunkers which lie between the dunes and the shoreline, the railway tracks embedded in concrete roads and other utilitarian brick buildings which lie around the park. However, the history of the site and what these features represent is not easily understood. One of the key questions of the project was: did any archaeology from the First World War survive on the site? Had the redevelopment of the site for the Second World War, and subsequently for landscaping the country park, removed all traces of its earlier industry? The investigation focussed on identifying the archaeology from the First World War and its significance.

Overlying the plans of the First and Second World War factories was a first step in discovering which areas of the factory might be undisturbed by the late 1930s redevelopment. The industrial use of the site can be broadly broken down into three phases; Phase 1 the Dynamite factory, Phase 2 the First World War factories including HMF Pembrey and the National Filling Factory, and Phase 3 the Second World War and post war ROF Pembrey. The extent of each of these factories is mapped (*Fig. 4*).

PHASE 1: DYNAMITE FACTORY

The site of the factory shown on the second edition Ordnance Survey map[34] (*Fig. 1*) lies in an area which later maps show was completely cleared when the site was

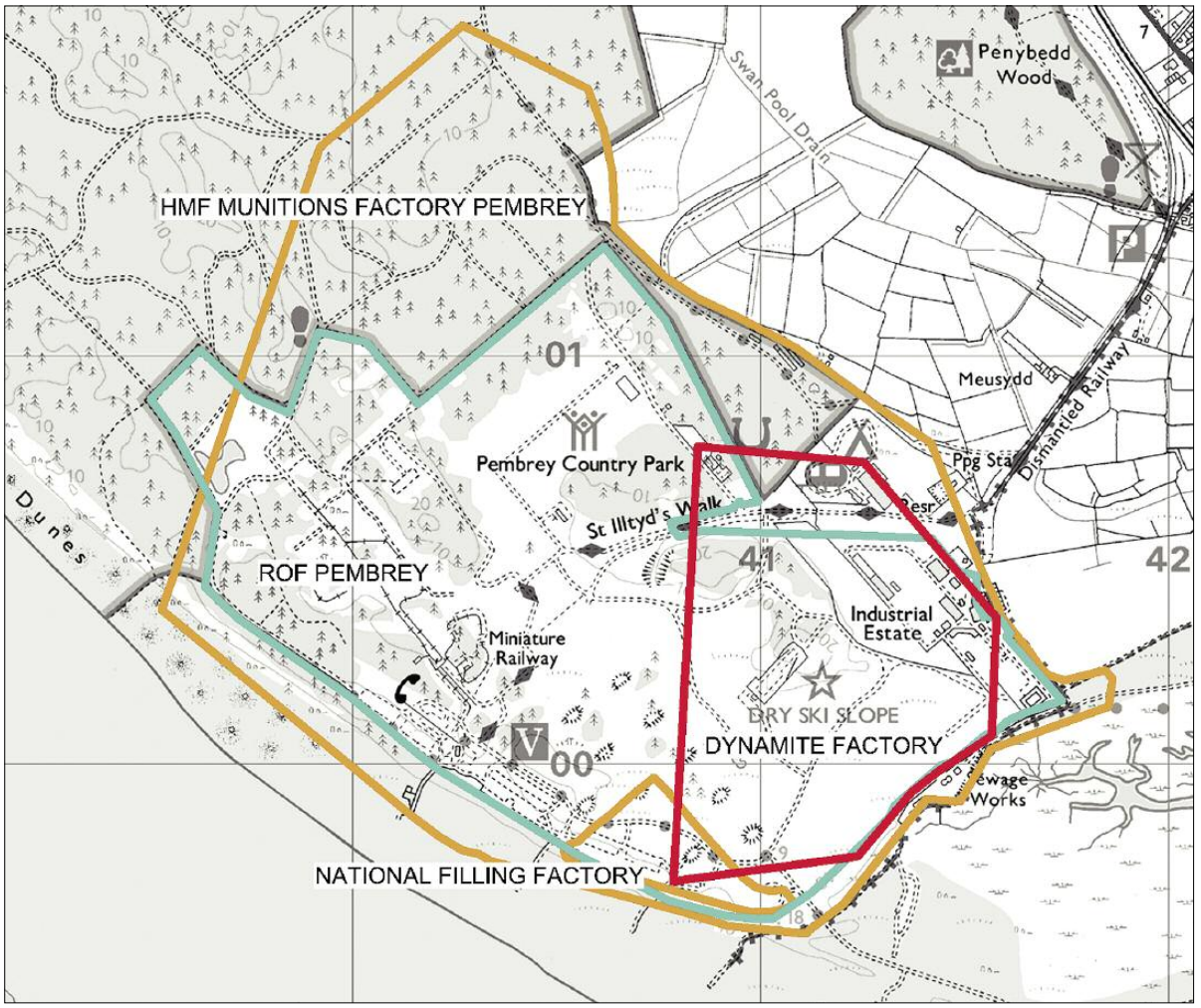

Figure 4. *The factories of Pembrey; 1880s. Dynamite Works in red, 1914-1919 HMF Pembrey in orange and NFF No.18 Pembrey in orange and 1930s ROF Pembrey in blue.*

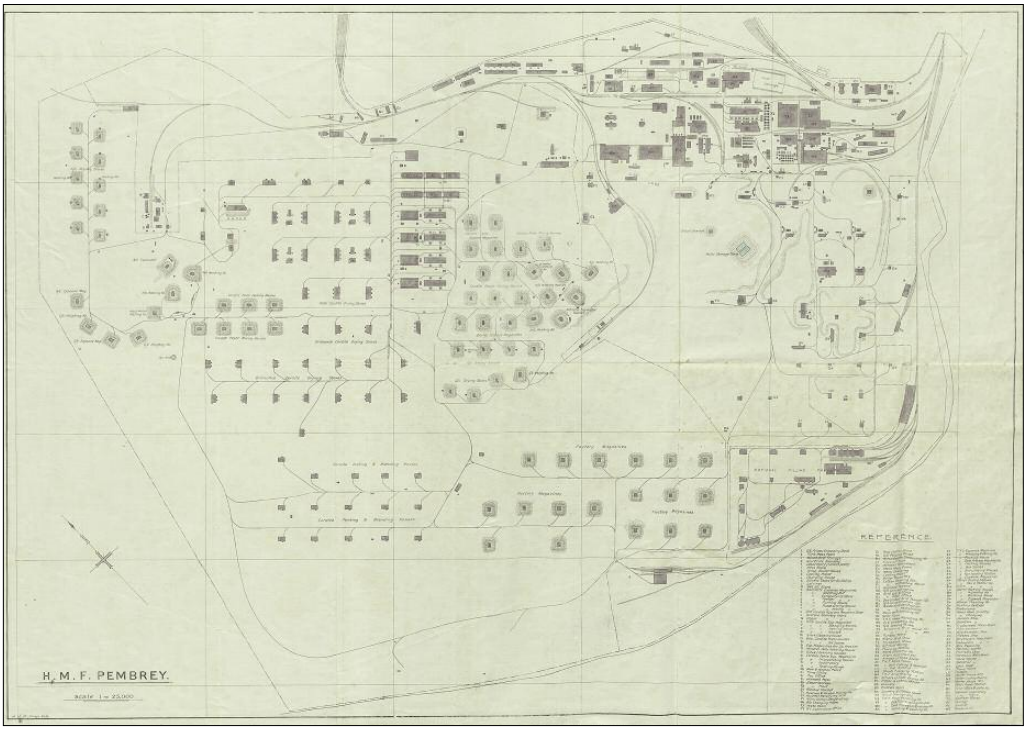

Figure 5. *Block plan of plant HMF Pembrey c.1917*
(National Archives)

redeveloped in the late 1930s, and no features survive other than the line of the old tramway which linked the factory across the dunes to Pembrey Harbour. This survives in part as the course of the footpath crossing the eastern part of Pembrey Burrows towards the harbour.

PHASE 2: HMF PEMBREY AND NATIONAL FILLING FACTORY

The key documentary source is the *c.*1917 Block plan of plant (*Fig. 5*).[35] The plan is undated, though as the plant is referred to as HMF Pembrey, it indicates that it was drawn up after nationalisation by the government, which occurred on 1st January 1917. It clearly indicates the extent of the two factories, but also internal subdivisions including a boundary which runs roughly north to south and divides the high explosive, TNT producing area, to the east of the factory and the propellant, cordite producing areas and factory magazines some distance to the west. The north-east part includes the support areas such as the administration building, workshops, raw material stores and acid plants, conveniently located for the incoming railway facilities.

TNT plant

The later redevelopment of the ROF and the subsequent landscaping of the park have left no upstanding remains of the TNT area, and photographs from 1938/9 show that this was extensively cleared and redeveloped.

Cordite production

The two areas of cordite production have suffered less in the redevelopment of the site in the 1930s and now lie within woodland. To aid the interpretation of the cordite areas a brief outline of its manufacture is given here, though these processes are more fully described elsewhere.[36] Cordite is produced by blending dry guncotton with nitroglycerine. Guncotton is an explosive made by treating cotton waste with nitric and sulphuric acid. At the start of the war this was brought in ready-made to the factory, but later on it was manufactured on site. This process is documented both on the plan of the site (which itemises a raw cotton store, guncotton pulping house and a cotton nitration house – all elements in the production of guncotton), and also from the diaries of Gabrielle West who describes the procedure from its raw state.[37] To store dry guncotton is extremely dangerous and so it was stored wet until required.

Guncotton had to be dried in drying stoves and then weighed in a weighing house before being combined with nitroglycerine. Nitroglycerine is made from treating glycerine with concentrated nitric acid and sulphuric acid. This took place in a structure called a nitrator-separator located on high ground to make use of gravity (to avoid the hazardous process of pumping or carrying) and which was commonly referred to as 'the hill'. They had double height earthwork banks encircling them, and within it a building of several levels. The resultant nitroglycerine would be run off through lead-lined gutters to a wash house and further filtration.

To make cordite, guncotton was first soaked in nitroglycerine to make cordite paste, before being taken to a mixing house and then stored in an expense magazine. The paste was then pressed and extruded into long cords (hence cordite) – narrow for rifle cordite or large diameter for ordnance. The finished cordite was sorted into batches of the same size in a blending house and packed for storage in a magazine ready to go to the filling factory.

Cordite production areas

Fieldwork has shown that large areas of earthwork remains survive where cordite production took place and two distinct areas of production have been identified one in the central area of the site, area A, and a second which lies to the north-west of the site within Pembrey Forest, area B (*Fig. 6*).

Cordite production area A

Cordite production area A survives in an area which lies to the north of the Pembrey Country Park visitor centre. Here, in an area of woodland, are fifteen earthwork banks, circular or sub-rectangular in plan. These earth and sand banked enclosures are labelled on the *c.*1917 plan according to their

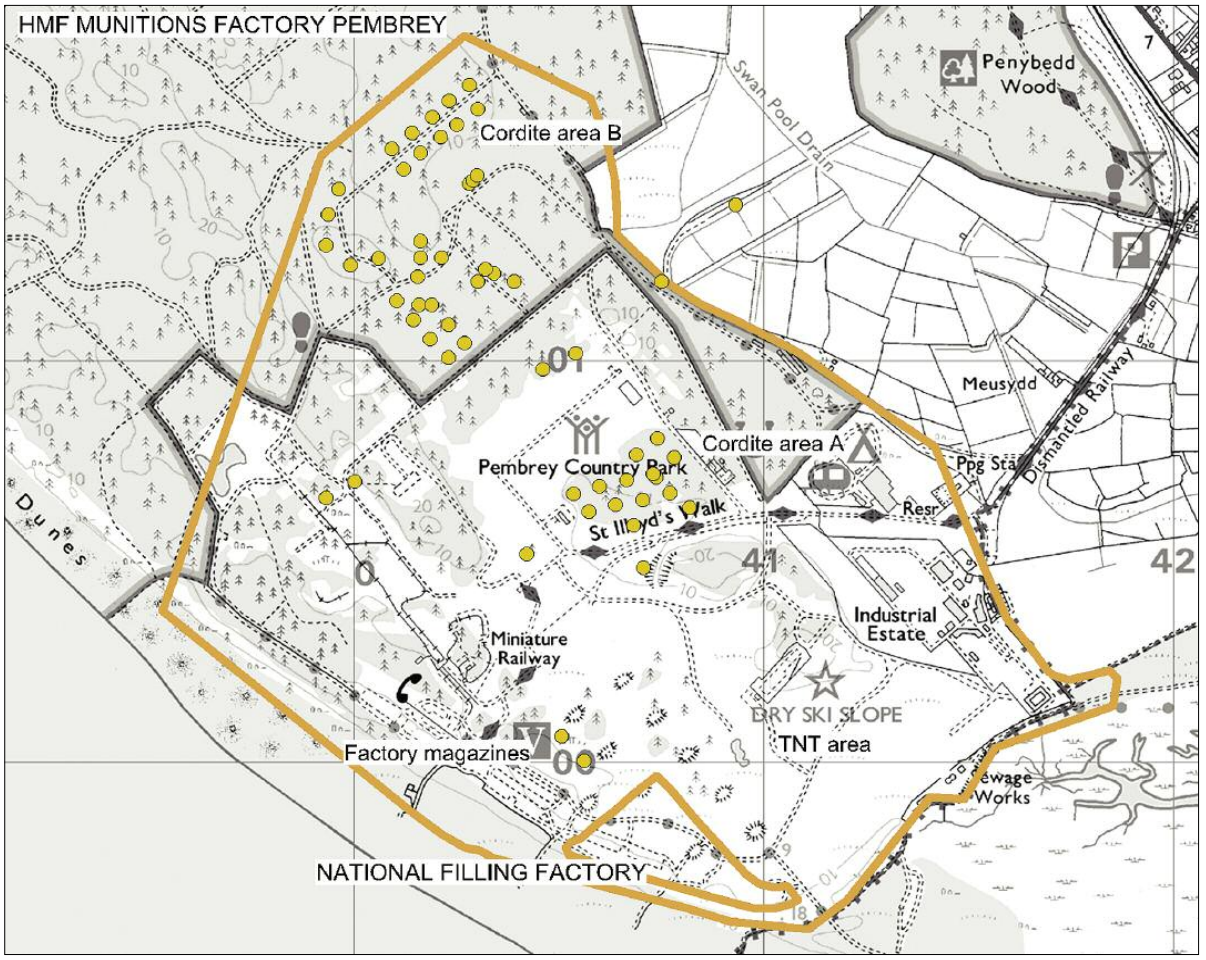

Figure 6. *First World War sites recorded as surviving within Pembrey Country park.*

function, which relate to the manufacture of cordite paste from guncotton and nitroglycerine, as described above. The enclosures surrounded the 'danger buildings', as the explosive nature of the process required each building to be surrounded by a blast bank and access was provided through a curved brick arched tunnel. The enclosures are approximately 20m in diameter, the banks *c.*3m high and the tunnels *c.*8m long, all emerging from the enclosures on their south and southeast sides. The curved tunnels allow a tram to exit the structure and join a connecting tramway. The tunnels are well constructed with arched roofs over which the earth bank continues above. In some tunnels there are traces of concrete floors. These are the enclosures that Gabrielle West describes and draws in her diary of 1917 (*Fig. 7*).

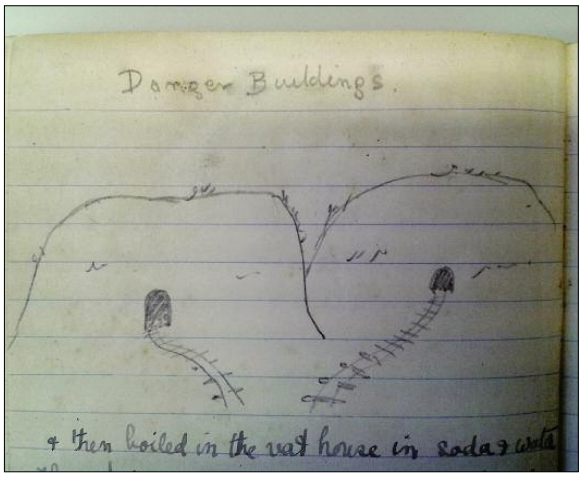

Figure 7. *The danger buildings as depicted by Gabrielle West in 1917* (Avalon Weston)

Figure 8. *The enclosures and the brick tunnel entrances survive in several areas*

No upstanding structures survive within these enclosures, but footings for a building were identified in one. This consists of a brick foundation course running northwest-southeast in the ground surface, and embedded within it are three projecting iron bolts from which a wooden superstructure was fixed (*Fig. 9*).

Figure 9. *A brick foundation course for a timber structure*

This particular enclosure is also of interest as the tunnel entrance was converted into an Air Raid Shelter during the 1930s, with partially blocked entrances at either end and blast walls to shield the entrances. Within the tunnel low brick piers are arranged along either wall to support bench seating (*Fig. 10*).

Figure 10. *A brick tunnel converted to an air raid shelter, with the remains of bench seating.*

To the south of these structures on the opposite side of the main access road into the park (the road now lies over the 1930s railway marshalling yard), is the site of the 'the hill' where nitroglycerine was manufactured (*Fig. 11*). The

remains consist of an earth and sand embanked circular enclosure with three brick arched entrance tunnels through the banks, leading to the northeast and northwest. One tunnel is 1.52m wide leading to the northwest, a second is 0.9m wide leading to the north and the third is 1.85m wide leading to the northeast. The first two have a cement render skim, the third is brick with no finish and a brick floor. The enclosure is labelled on the *c.*1917 plan as one of the nitrator-separator houses and was linked to the washing houses to the west, however these were destroyed in the later reuse of the site in the Second World War. Characteristically it is located upon a high ridge above the cordite mixing area in order to use gravity to run off the nitroglycerine.

Figure 11. *The remains of the nitrator-separator house PRN 107850.*

Cordite Production Area B

A second area of cordite production now lies within Pembrey Forest. These features are similar to those found in the central factory area (area A), however there are differences in materials and in form which suggest they relate to a different phase of construction.

These earth and sand embanked enclosures are also accessed by brick entrance tunnels. They are labelled on the *c.*1917 plan as a series of ten guncotton drying stoves and arranged in pairs from the north end of the site. They survive as earthworks, however at the time that fieldwork was undertaken they were inaccessible due to dense bramble and thorn vegetation.

Progressing to the south-west are guncotton weighing houses and expense magazines. To the east is the nitrator-separator house, and like that located in area A, is situated on a high mound. A sequence of seven enclosures represents the remains of the cordite mixing houses where the dried guncotton and nitroglycerine were mixed to create cordite.

These structures differ from those seen in cordite production area A. The brick lined entrance tunnels are less curved in plan and do not have brick arches, but are constructed with concrete slabbed roofs, and a number of them have concrete floors with the impression of wooden sleepers. In addition there is a second access tunnel on the opposite side of the enclosure. This tunnel is narrower and suggests it provided access for personnel only, not materials (*Fig. 12*).

Figure 12. *Access tunnels in cordite production area B.*

Also within this dense area of woodland are the remains of a railway platform shown on the *c.*1917 plan as a railway terminus (*Fig. 13*).

Figure 13. *The remains of a railway terminus in Pembrey forest.*

These two areas of cordite production constitute extensive areas of surviving earthworks, and where processes of cordite production can be understood with reference to the plan.

Between the two areas of cordite production were zones for rifle, ordnance cordite and ballistite production. Fieldwork was again hampered by dense vegetation, but some structures were identified including an earthwork bank and brick built tunnel identified on the *c.*1917 plan as a ballistite paste sieving and mixing house with a brick latrine nearby, which appears to be the only building surviving from the First World War plant.

Magazines

Other surviving features from HMF Pembrey include the earthwork blast banks which surround the factory magazines. The plan shows 18 structures labelled as factory magazines, however, only two survive as earthworks; the rest were destroyed during the construction of the later ROF factory magazines. These structures follow a similar form as those seen in cordite areas with a circular earthwork blast bank accessed by a curving brick tunnel and a concrete slab roof (*Fig.14*).

Figure 14. *The entrance to a factory magazine*

National Filling Factory

The location of the filling factory at the southern corner of the site has suffered most from redevelopment; both from the clearance of the plant to build the ROF prior to the Second World War, and then again in its landscaping prior to the establishment of the Country Park. No structures relating to the filling factory have survived.

PHASE 3 – ROF PEMBREY

The extensive clearance of the site in the 1970s in preparation for the country park led to the wholesale demolition of most of the ROF structures, and a good proportion of it is buried beneath the sand, woodland and the grassed recreational areas. However, there are some features which remain as monuments to the massive plant that once occupied the area.

The assessment of these remains has been hampered by the lack of a schedule which should accompany the plan of the ROF site (*Fig. 15*).[38] The plans of the site which have been recovered from The National Archives, Llanelli Library and other sources have all become detached from the associated schedule which itemises each building and its function. Construction contracts from 1938-39 held in the National Archives and a sale catalogue in private hands help to identify some buildings and structures. However, the focus of this study has been to identify the extent and survival of the structures from the First World War and therefore other lines of enquiry have not been explored. A study of other Royal Ordnance Factories and tracing former workers would undoubtedly shed more light on the remaining features. A number of standing structures do survive, including the entrance gates to the factory, the factory magazines, a pump house and the footprints of some of the administration buildings and stores survive at ground level.

Magazines

The most impressive remains of the site from this period are the magazines, shown on the plan of the factory.[39] There were formerly ten magazines but only nine survive in substantial form. They are massive concrete structures with earth and turf mounds covering a concrete structure composed of 3 internal chambers, with an access walkway providing ventilation and a conduit for an electrical supply around the back of the structures. A standard gauge railway with a loading platform survives within, and some have buffer stops intact.

Sales particulars of the site dating 1963 describe them as:

> Reinforced concrete construction, mounded and each forming:
>
> 3 Chambers measuring internally 26' x 15' x 7'6" ht. with Boot Changing Room, Sampling Room and Access Tunnel with loading Bank and Rail-siding (Detailed plan available) Floor space 30830.[40]

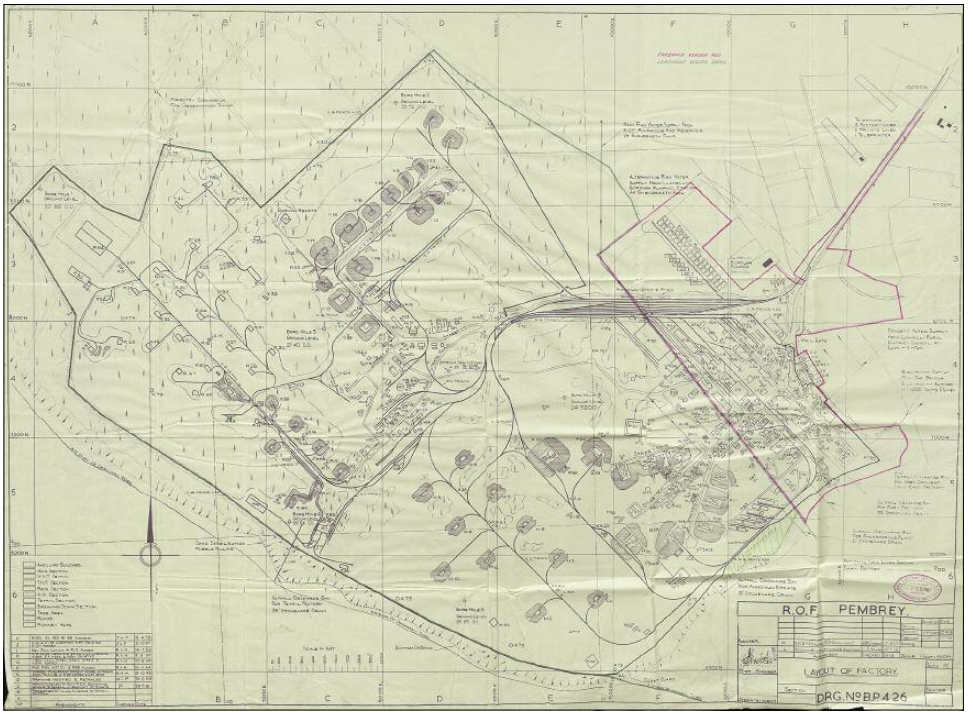

Figure 15. *ROF Pembrey BD 25/83.*

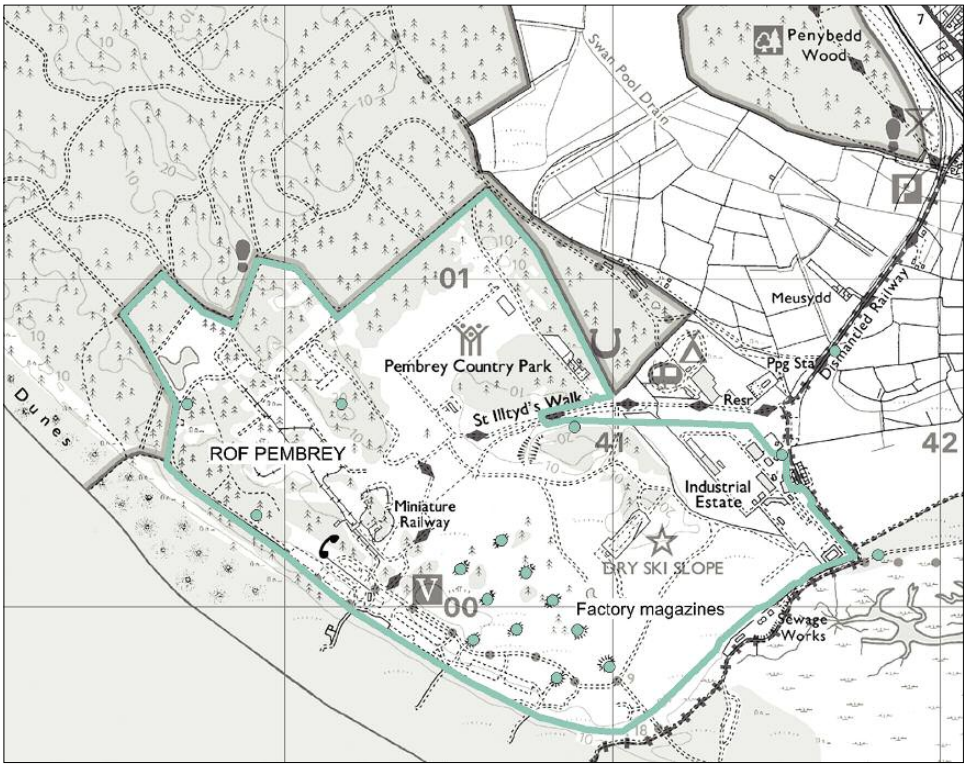

Figure 16. *A plan of features recorded from ROF Pembrey*

Plans for the specification of the magazines also survive within the National Archives[41] along with photographs of their construction (*Figs. 17 and 18*).

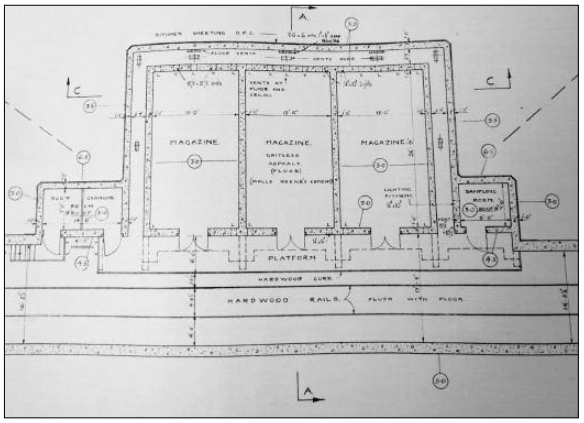

Figure 17. *Plans for the construction of the magazines.* (National Archives)

In addition to structures associated with the manufacture and breaking down of munitions are those associated with the defence of the site. These include a pillbox positioned to overlook the rail marshalling yard, the road and rail entrance gates, and a number of observation posts which survive around the site. The observation posts follow a specific design for Royal Ordnance Factories – small square pillboxes with a blast wall protecting the entrance and long narrow embrasures providing a look out position (*Fig. 19*).[42]

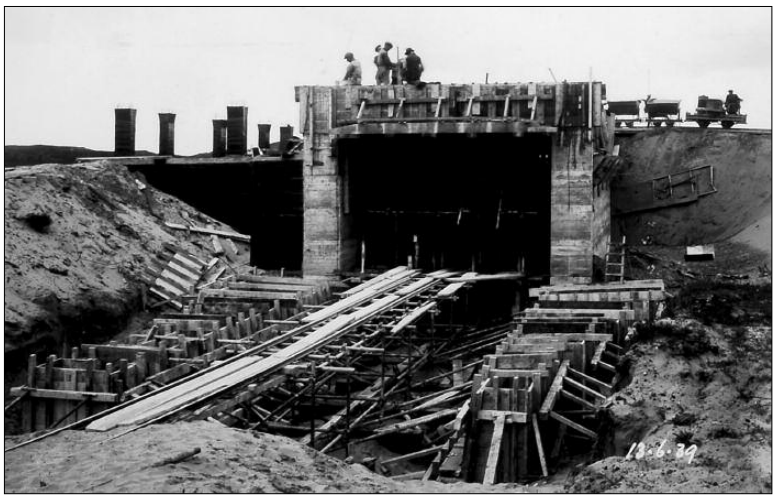

Figure 18. *Photograph of magazine no. 8 under construction, dated 13/6/1939.* (National Archives)

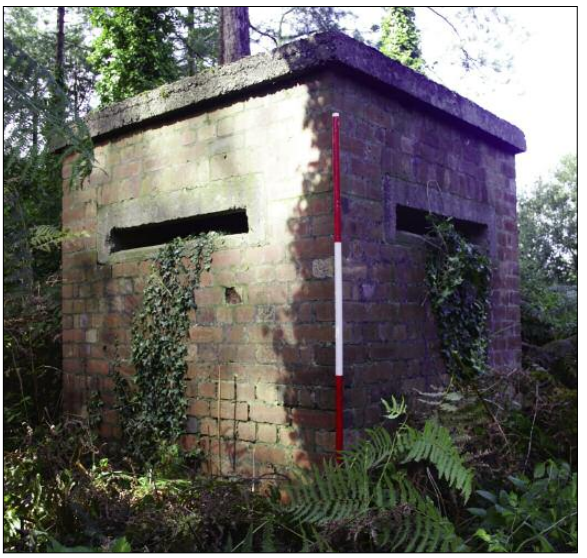

Figure 19. *An observation post, characteristic of a Royal Ordnance Factory.*

DISCUSSION

Documentary research combined with fieldwork revealed substantial and extensive earthwork structures surviving and a high potential for further buried archaeological deposits relating to the First World War munitions industry at Pembrey.

Documentary sources record episodes of construction and expansion which met the demand known as the 'shell crisis' of 1915. The archaeological evidence also suggests that the factory developed in phases, and the two distinct areas of cordite production within the plant which survive as earthworks reflect this in their material remains. Whilst the two areas are similar, they exhibit significant differences in construction; those earthworks built in area A have brick arched tunnels entering the danger buildings. Area B differs in that the tunnels have concrete slab roofs and also a second access tunnel provided opposite the first. This may represent the rapid expansion in cordite production in October 1915,[43] and further research may confirm this.

The two remaining factory magazines from the First World War which survive as earthwork structures are also similar

in construction to cordite production area B, and may form part of this phase of construction.

The legacy of the factory survives in the wider landscape of the area too, and recently a building in Llandyfaelog has been confirmed as a lost building of the 1914-1919 factory. The distinctive Belfast roof truss, a type commonly listed in the sale catalogue of 1926,[44] is the clue to this building's history. The owner, who was born in the building in the late 1920s, recalls that the trusses and framework were said to come from the 'Pembrey powder works'.

Figure 20. *A building constructed with Belfast roof trusses which came from Pembrey munitions factory.*

Elsewhere in the country many factory sites were redeveloped, so the survival of cordite production areas from 1914-1918 at Pembrey are believed to be unique in Wales. Whilst the site has a rich archaeological legacy, it also benefits from having a human story told by someone who experienced the site at the height of its production. A fascinating account of the factory is given by Gabrielle West who came to work at Pembrey as one of the newly recruited Women's Police Service. Gabrielle, the daughter of a vicar, wrote fascinating diaries about her work during the war.

Having been an active member of the Red Cross prior to the war, she worked in various Red Cross factory canteens across England until the end of 1916 when she found herself out of work. At that time the newly established Women's Police Service did not have official recognition and no powers of arrest, but Gabrielle records that the Women Police were badly needed by the Ministry of Munitions:

> the Government have recognised them (women police) and employed them largely inside factories to control the women workers and this is what they want recruits for. Pay is £2 a week, which isn't bad, but recruits have to buy their own uniform.[45]

After two weeks training she began work for a brief spell in a factory in Chester (Queensferry) before moving to Pembrey at the start of 1917. Her work involved searching the incoming workers for 'prohibited articles' such as matches, cigarettes or other combustibles, chemicals or explosives, knives or arms of any description, any exposed articles of iron or steel, umbrellas, sticks or bags. Even hairpins and combs were strictly forbidden.[46] Outgoing workers were also searched for stolen property and explosives. In addition she kept guard at the gate, conducted visitors around the site, kept time and patrolled to 'see that no one is larking or slacking'.

Her descriptions of the factory, the workers and the conditions is both captivating and horrifying in equal measure. Health and safety measures were poor and the fumes made many of the workers ill and brought on epileptic fits.

> The ether in the cordite affects the girls. It gives some headaches, hysteria, and sometimes fits. If a worker has the least tendency to epilepsy, even if she has never shown it before, the ether will bring it out. There are 15 or 20 girls who get these epileptic fits. On a heavy windless night we sometimes have 30 girls overcome by the fumes in one way or another… Some of the girls have twelve fits, one after the other.

The conditions of the factory were also less than accommodating, she writes:

> This factory is very badly equipped as regards the welfare of the girls. The changing rooms are fearfully crowded, long troughs are provided instead of wash basins and there is always a scarcity of soap and towels. The girls' danger clothes are often horribly dirty and in rags… There were until recently no lights in the lavatories and as these same lavatories are generally full of rats and often very dirty, the girls are afraid to go in.

From Gabrielle's diaries we know that she was working in the explosives factory where TNT and cordite were being manufactured. She colourfully describes both the processes taking place and the effect on anyone unfortunate enough to experience it:

> the TNT stinks; no other word describes it – an evil, sickly chokey smell that makes you cough until you

> feel sick.' However even this was not as bad as the Middle or acid section where sulphuric was turned in to nitric acid, 'The air is filled with white fumes and yellow fumes and brown fumes. The particles of acid land on your face and make you nearly mad with a feeling like pins and needles, only more so, and they land on your clothes and make brown spots all over them, and they rot your hankies so that they come back from the laundry in rags, and they get up your nose and down your throat and into your eyes so that you are blind and speechless by the time you escape… Each time you leave the Middle Section, you feel like Dante returning from Hell.

Her description of the female workers she was supervising indicates the range of backgrounds from which the munitions workers were drawn; some from rural sheep farms speaking only Welsh with a little broken English, others from mining families in the Rhondda valley who are 'full of socialistic theories and are perpetually getting up strikes' and the women from the Swansea Docks some of which she describes as 'really bad characters'. However, she clearly enjoys her work with them, 'they are so full of life and cheerful and there are so many characters among them.' A strong sense of these characters comes through in a series of photographs of the Filling Factory No. 18 at Pembrey, held at the National Archives. This series of images show women carrying out some of the most dangerous work, dismantling armaments and recovering the components.

It is unclear how many accidents occurred and the number of casualties there were at Pembrey, for newspaper reports remained under the cloak of censorship during the war and the whereabouts of accidents was rarely recorded. An explosion at a 'West Wales Factory' took place on the 18th November 1918 at Pembrey killing three women. The inquest proceedings record that the women 'met their death through the explosion of an 18-pounder h.e. (high explosive) shell in process of disassembling'.[47]

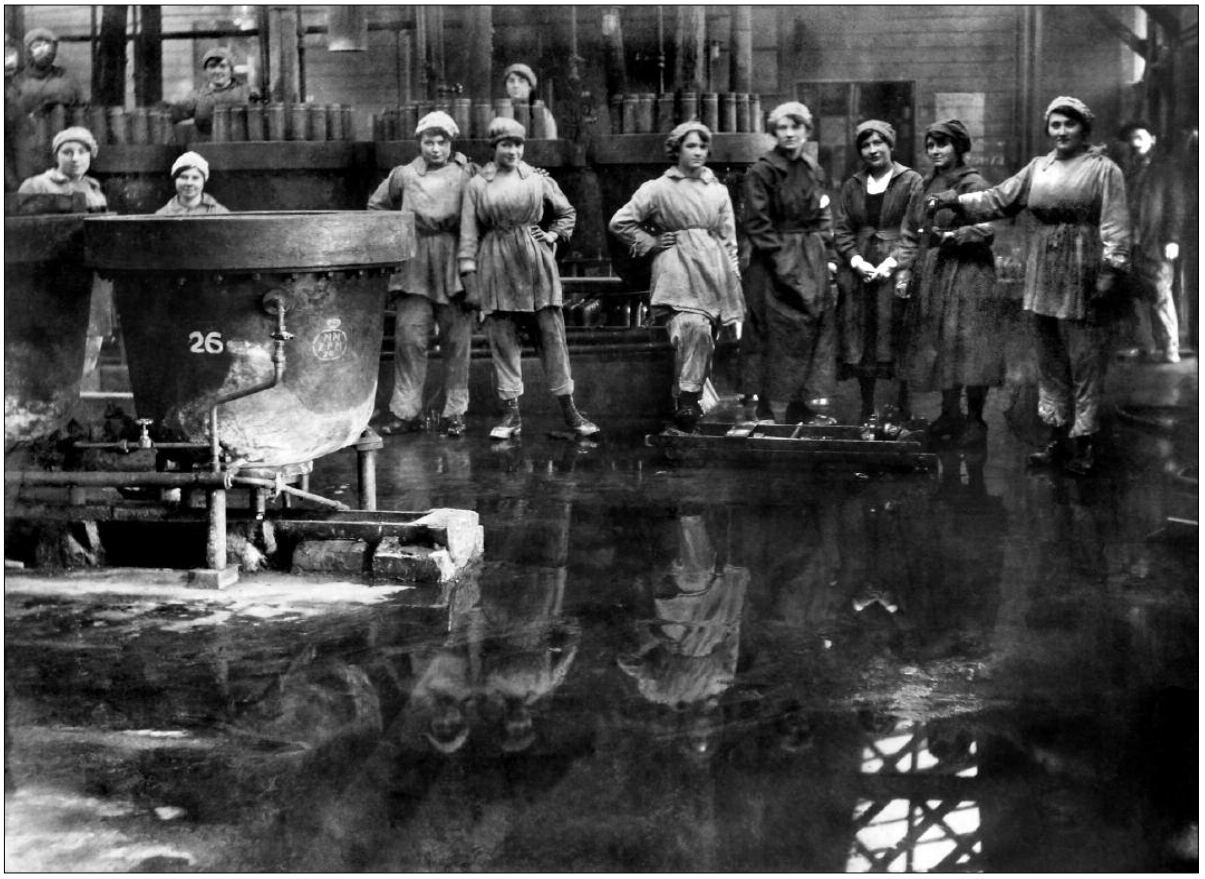

Figure 21. *Melting HE (high explosive) out of shells.*
(National Archives, MUN 5-155)

Figure 22. *Removing plugs from time fuzes.*
(National Archives, MUN 5-155)

CONCLUSION

The site is no longer in production of toxic and explosive products, and many of the structures now provide a valuable haven for wildlife. However, the remains from Pembrey's explosive past are historically significant in terms reminding us of one aspect of the nation's response to a war of massive proportions. It is hoped that this project will help raise awareness of the history of the site and, with the aid of an interpretative leaflet, allow visitors to explore the site for themselves and appreciate its history and rich archaeology. There is still much to learn about the industrial past of Pembrey, many features still await rediscovery, and there are further untold stories of those who worked there. Should any reader be aware of information to add to our knowledge, the author and Dyfed Archaeological Trust would welcome it. Before setting out on any exploration, a word of warning! The visitor does well to remember that this was once an industrial workplace, and be aware that there are lumps, bumps and holes in the ground which are hazardous to the unwary.

TIMELINE

November 1881	Stowmarket Explosives Company apply for a licence to manufacture dynamite amongst the sand dunes of Pembrey Burrows.
17th November 1882	An explosion at the dynamite factory kills seven people, the youngest only 13 years old, the oldest 24. The explosion is heard in Tenby.
22nd May 1885	Explosive manufacture ceased and staff are dismissed but the site continues to store and distribute explosives.
13th May 1893	A serious fire leads to three sheds being destroyed at the dynamite works.
October 1914	Nobel's Explosives

	Manufacturing Co. agree with the Secretary of State for War to erect and manage a TNT factory at Pembrey.
April 1915	Between 800-1000 men are employed building the new Explosives Factory.
May 1915	Explosives manufacture underway.
2nd July 1915	The filling of shells begins in a separate filling factory.
July 1915	TNT production begins.
January 1916	Cordite paste production begins.
March 1916	Manufacture of rifle cordite and ballistite begins.
May 1916	Manufacture of ordnance cordite begins.
1st January 1917	Both factories are nationalised and under the Ministry of Munitions.
May 1917	The filling factory continues filling shells and starts breaking down defective ammunition and recovering components.
14th July 1917	An explosion kills 6 people, the cause of the explosion was never explained.
18th November 1918	An explosion kills 3 munition workers from Swansea when disassembling an 18 pounder high explosive shell.
5th October 1926	The sale of the Factory and premises takes place at the Hotel Metropole, Swansea. It is sold for scrap, for £30,000.
1930s	The administration buildings are used as a school camp for children of unemployed miners of South Wales.
July 1938	Construction starts on a new munitions factory.
December 1939	Royal Ordnance Factory (ROF) Pembrey opens under the Ministry of Supply and TNT production starts.
10th July 1940	A German plane drops several bombs and 10 workers are killed.
1st November 1941	An explosion in the mono-nitration plant kills 2 men. The British Empire Medal is awarded to two men as a result of their 'courage and devotion to duty' in averting further injuries and damage.
1944	ROF Pembrey begins decommissioning munitions.
1950	Outbreak of Korean War – demand increases for munitions.
1964	The Royal Ordnance Factory Pembrey closes.
1980	Pembrey Country Park opens.

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