

The artificial invasion harbours called

# MULBERRY

*A personal story by Sir Bruce White KBE*



## CONTENTS

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Foreword	
Introduction	
The Early Days	1
The Military Ports	
Number 1 Port, Faslane Bay	2
Number 2 Port, Cairn Ryan	3
Cranes and Mechanical Handling	4
<i>Illustrations-centre pages</i>	
Port Repair Vessels	5
The Port Repair Depots	
Dock Gates	
Pontoons	
Information on Foreign Ports	6
MULBERRY – The Artificial Harbours	
After the War	10
Historical Dates	11
Appendices	12
Maps	Inside back cover

## MULBERRY

Sir Bruce White KBE

### Foreword

On several occasions I have been asked to write a history of Mulberry but was unable to do so because of the many continuing commitments with my consulting engineering firm. Also, owing to the reservations of the Official Secrets Act, there was much that could not be published until the expiration of the time limits imposed. Further, we were given instructions that no diaries, for obvious reasons of secrecy, were to be kept and this instruction was respected.

The visit and reunion at Arromanches—the site of Mulberry B—in June 1980 provides an opportunity to recount some details concerning the conception and background of Mulberry, the vast organisation which was established and to record incidents and events which have hitherto not received mention or been given the importance which they deserve.

I have often been asked why the artificial invasion harbours were called 'Mulberry' and, secondly, what form the overall organisation took.

Shortly after my return from top-secret meetings in North America during August and September 1943, which were concerned with planning Operation Overlord, the Allied invasion of Europe, I found on my desk at the War Office a letter from a senior officer. The letter had no cover of secrecy and was headed simply 'ARTIFICIAL HARBOURS'. This breach of security appalled me. Fearful that such a letter could reveal a most important secret, in the wrong hands, I immediately sought an interview with the head of security at the War Office. I insisted that the project be given a code name. During the interview the security chief turned to a young officer behind him and asked for the next code word appearing on the list. The officer consulted a large volume and announced the word 'Mulberry', which I accepted. At the time we were already using 'Gooseberry' and 'Whale' but had I been offered 'Raspberry' I should not have accepted! This was the name adopted for the project and so it has remained to this day. Numerous myths have grown up about the origin of the code name but this is the actual story of how it came about.

So far as the organisation which was built up, this consisted of direction by myself with a deputy with a great number of properly qualified people with delegated responsibility. The latter were trained as military officers because, although in the early stages they would be responsible for design, ultimately these men would be sent overseas with the forces.

The greatest possible use was made of consulting engineers and other specialists. Many committees were formed consisting of experts acting in an advisory capacity to ensure the success of every branch of our activities.

Harbour engineering is always a lengthy business but in the circumstances it was clear that ways and means would have to be found, by the fullest use of originality and improvisation, to provide special equipment and techniques to shorten the period of construction of all our responsibilities.

The organisation, therefore, was a specially selected staff of engineers at the War Office to deal with the many facets of harbour engineering, both for control and design. For their operation, a large force of Royal Engineers (REs)—again officered by experts—was built up and formed into various companies. Among these companies were Port Construction and Repair, Port Operating, Port Maintenance, Repair Shops, Dredging and Inland Waterways.

The force eventually reached a total of 1,332 officers and 51,740 men. They served in the ports, harbours and beaches of every theatre of war. I am pleased to place on record that, in the whole of the military forces employed within this group, the officers were all civilians who joined for particular duties.



## Introduction

“It was the absence of important harbours in all this stretch of coast which had impelled Mountbatten’s staff to propose the synthetic harbours. The decision at the Quebec conference confirmed the need and clarified the issues. I kept in touch with the development of this project, which was pressed forward by a committee of experts and Service representatives, summoned by Brigadier Bruce White of the War Office, himself an eminent engineer. It was a tremendous undertaking, and high credit is due to many, not least to Major-General Sir Harold Wernher, whose task it was to co-ordinate the many interests concerned.”

Sir Winston Churchill, *‘The Second World War’, Vol. v.*

The author was a Major in the Royal Engineers during the First World War, involved in the construction of a military port alongside Richborough Castle in Kent known as ‘The Mystery Port’. From there, the British Expeditionary Force, together with all the materials and equipment to maintain an army in the field was ferried. In the First World War, all the necessary ports and canals on the Continent were available for the landing and transportation of troops and equipment and it was possible to conduct the war from the military port at Richborough, which served all the Front. It was not necessary to fight a sea battle and the whole of these operations were in the hands of the War Office.

In the Second World War, however, having been driven from the Continent, we could not return except by an invasion. We did not control any ports on the Continent and upon invasion these would in any case be demolished by the retreating Germans.

Under these circumstances, it was essential to provide such a facility. The technical matters concerning the engineering design of the artificial harbours and roadways have been adequately covered in various articles, papers and publications. This story deals mainly with the organisation which it was necessary to create in order to implement such a complicated military engineering project of unprecedented size and complexity.

Due to the limitations of this publication I have refrained from mentioning names as there were so many who played important parts in the design, planning, supervision, execution and operation of the Mulberry harbours.



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## The Early Days

In May 1940 I entered the War Office and was posted as Staff Captain with two staff in the Directorate of Transportation, Royal Engineers. My responsibility was designated as 'Ports and Inland Waterways'. I had been interviewed by a Brigadier who knew me and my past military record. During the First World War I was at Richborough and worked on the construction of the 'Mystery Harbour' there, described in Appendix A.

The question has often been asked "Why are soldiers responsible for ports; surely this is the work of the Navy?" This may appear reasonable as ports are connected with the sea. In war, however, the building and control of ports and harbours is normally the work of civilian harbour engineers and operatives whereas the Navy runs its fighting ships. Sir Winston Churchill recognised this and at a meeting used words to the effect that "seamen go to sea in ships and it is in their absence that the landmen build harbours and refuges to which are brought back the fruits of their service".

Nevertheless, it was apparent that there should be a definition of the duties of the services, particularly of the Royal Navy and the War Office. It was decided at an early meeting that, while the War Office would be responsible for all harbour work of a commercial nature, the Engineer-in-Chief of the Royal Navy would devote himself to the services of the Fleet and control of the naval dockyards and bases. The War Office had therefore to build up an organisation to carry out its own specified duties in port and harbour work.

On taking up my appointment, which I presumed was in connection with an ultimate invasion to liberate Europe—as well as my domestic duties—I wrote a report outlining what I considered were my responsibilities and the provisions it would be necessary to make to enable me to carry out my job. I submitted my report to my superior at the War Office, who asked me rather brusquely "Who asked you to write this?" I gathered that I should have waited to be asked. Not getting very far, I sought an interview with the Deputy Quartermaster-General, who allotted me five minutes. Fortunately he was so interested in the various proposals which I had submitted that the interview lasted one and a half hours.

The gist of my report was that my department should concern itself not only with repairing damaged ports and maintaining others but should also be making provision for any subsequent invasion of the Continent. At this stage, of course, the idea of artificial harbours to replace those closed to the Allies by enemy occupation had not been conceived. This was to come later.

I had joined the War Office at about the time of the fall of France and the Netherlands and the evacuation of the British Army from Dunkirk. There was then general despondency among the armed services and the people of Britain. There was no question of mounting an invasion of the Continent; rather, it was necessary to prepare our defences against the German invasion which was widely expected.

My department continued with its duties throughout this period while I considered the

organisation necessary for a successful invasion. While Britain was on the defensive, Sir Winston Churchill boosted the morale of the nation, especially by his wireless speeches. His phrase "fight on the beaches" showed that he was not considering an invasion at that time.

He was successful in inspiring the nation during those dark days. Then a perceptible change occurred when the weapons of war which had not been available began to arrive under 'Lend-lease' from the United States. By May 1942 the mood was changing from defense to attack and the beginning of a scheme for the invasion of the Continent was evident.

On May 30 1942 Sir Winston Churchill sent from 10 Downing Street a famous memorandum to the Chief of Combined Operations, Lord Mountbatten:

### "PIERS FOR USE ON BEACHES

They must float up and down with the tide. The anchor problem must be mastered. Let me have the best solution worked out. Don't argue the matter. The difficulties will argue for themselves."

I shall recount later how my department had the responsibility for following up the memorandum. The organisation for carrying out the Prime Minister's request was being built up and at the time was engaged in the construction of military ports in Scotland—the training ground for Mulberry.

## The Military Ports

The collapse of France, Belgium, and the Netherlands resulted in the virtual closure of the East and South Coast ports, especially for large ocean-going ships. Their vulnerability to attack, particularly from the air, made such ports unusable to a large extent.

It was necessary to establish alternative operating bases from which cargoes could be handled. An early solution was the construction on the River Clyde in Scotland of the 'Clyde Anchorages' under the direction of the eminent engineer Sir Robert Letch. As it was impossible to use sea routes it was necessary to transport large numbers of barges from the River Thames to their destination the River Clyde by road! At the time, convoys of lorries carrying Thames barges on their trailers could be seen heading North.

Sir Winston Churchill's appeal to the United States for military supplies took effect on June 3 1940. Three weeks later, the first shipment, including 500,000 rifles, 80,000 machine guns, nearly one thousand 75mm field guns and 130 million rounds of ammunition reached Britain. The grave problems caused by the bombing of deep-water berths and the increased demands being made by the military of the commercial docks caused the Minister for Shipping to report to the Cabinet that he could not guarantee meeting the needs of the general public. He suggested that ports specifically for the use of the armed services should be built.

A reconnaissance of existing facilities on the West Coast showed that they could not cope with additional military traffic and that if there were losses from enemy action, the position would further deteriorate.

An investigating committee was set up under my chairmanship and consisting of representatives from the War Office, Ministry of War Transport and the London Midland and Scottish Railway. Finally, the West Coast of Scotland was decided on for the construction of deep-water berths. After investigation, we concluded that the Gare Loch and Loch Ryan were suitable and we submitted a report to that effect.

As a result, the Cabinet agreed to the building of two military ports, known subsequently as Military Ports Numbers 1 and 2. The whole of the work was to be the responsibility of the Transportation Department at the War Office.

The site selected for Number 1 Military Port was at Faslane Bay at the northern end of the Gare Loch, north of Glasgow, where there was deep water and rail connections could be constructed to the site. Number 2 Military Port was to be built at Cairn Ryan on the eastern side of Loch Ryan, six miles from Stranraer—served by the London, Midland and Scottish Railway.

The work of building the ports had to be carried out within the framework of a military organisation by military labour who also had to be soldiers. The employment of military labour was a complex problem since no companies specialised in this class of work existed. In addition, it was necessary to seek consulting engineers specialising in dock and harbour works who would advise the War Office and prepare designs. As a result of my meeting with General Venning, the Quartermaster-General, during his visit to the early works in Scotland, these engineers were duly appointed. They formed a panel called 'The Joint Engineers' and, led by Mr (later Sir) William Halcrow, carried out work on the design and construction of military ports at Gare Loch and Loch Ryan.

When the schemes had been prepared and approved by the War Office, I had to obtain not only Treasury sanction but also the approval of the other interested ministries. I was most dubious about the Ministry of Labour. At the time the minister was Mr Ernest Bevin. I explained to him why it was necessary to do the work with military forces instead of using civilians. At our meeting in Whitehall we sat together on his bed and discussed the proposals. He eventually agreed to my requests, to quote from the minute by which he gave formal approval, "subject to there being no admixture of civil and military labour". Except for two or three cases of civilians holding supervisory positions, the building of the military ports was carried out entirely by military forces with skilled civilian craftsmen in uniform commanded by carefully selected, qualified engineers.

The building of the two military ports involved far more than the construction of deep-water quays against which ships could berth. There also had to be cranes, rail tracks, rail connections, roads and bridges and accommodation for a work force of several thousand. Amenities such as water, gas and electricity, canteens, administration buildings, stores—in

fact everything to cater for two large resident communities in lonely parts of Scotland had to be provided.

The military construction force comprised several specialist companies of REs each with their own commanders. Among them, the divers were trained by the Royal Navy. There were also railway construction and operating, catering, transportation, stores, port construction and operating and stevedoring companies. This force was called 'Transportation, Royal Engineers' and eventually served in every theatre of war. Without it, the works described later and particularly the artificial harbours called Mulberry might never have been built. The men were also soldiers trained to fight.

Work on the military ports was of great urgency and had to be continuous day and night, seven days a week. They were the training grounds for the conception, design, manufacture and building of Mulberry.

There, all grades of Sappers were trained and many were taken into the 21st Army and employed in unloading from Mulberry.

The personnel employed at the military ports were, from early days, regarded as exceptional. At one time a secret mission to Africa was mounted and the vessels were loaded and despatched from Military Port Number 1. Quantities of petrol had to be stowed in flimsies on the ship's decks. When the mission returned from Africa, I was again asked by the Ministry of Shipping to take the ships. They were in very poor condition and, it was clear, no other port could have handled them. Petrol had flooded them and they posed a high risk. When the crews had been disembarked, arrangements to save the vessels had to be made hastily. Almost every available compressor was engaged to operate the bilge pumps discharging the petrol into lighters alongside. During the operation, the decks had to be covered with protective tarpaulins. Sappers were able to descend into the holds for short periods, under observation by medical officers. Happily, this dangerous episode had no disastrous effects, thanks to the efficiency of the officers of the port.

### Number 1 Port, Faslane Bay

**BERTHS:** The port at Faslane Bay in Gare Loch was designed to provide six deep-water berths of a total length of 3,000 feet, a lighterage wharf of 900 feet, a mechanical transport ferry berth and a berth for a 150-ton floating crane. Facilities were built for ships up to 600 feet long with a 30 feet draught and deep water close inshore was provided, as was an ample area for manoeuvring ships. All berths had wharf cranes and cargo handling equipment.

**RAILWAYS:** Land communication with Faslane Bay was mainly conducted by rail. It was necessary to provide extensive sidings which were then linked to the Highland Railway. Seven miles of double track with passing stations from the point of 'take-off' had to be built up to the sidings. Two bridges, two level crossings, six sets of sidings and a passenger platform at Faslane Bay were constructed in all.



On one occasion, when work was proceeding, an elderly farmer asked to see me. He said that the rail alignment would involve the destruction of a knarled old tree; if the work continued and the tree was destroyed, the man told me that three deaths would occur. No diversion was possible and the tree had to be buried. For good reason I told nobody of this superstition. What follows is a statement of strangely coincidental fact: Sir Keith Nuttall, of the well-known contracting firm in Scotland bearing his name, was appointed as the Chief Resident Engineer in charge of the work. After a few months Sir Keith fell ill of a mysterious disease and died. His replacement was his deputy, who, after a short time, also died. A third appointment was necessary but this time, perhaps because he was moved to the Number 2 Port, no death occurred.

**ROADS:** A new road had to be built to the military port involving two bridges and a level crossing and extensive roads within the port itself.

**CAMPS:** Accommodation was built for 2,000 men in five camps to replace the tents which they had used in the first instance.

**WATER:** To increase the water supply for the camps and the port, the water level of a nearby dam was raised by two feet six inches and the water piped down the hillside and connected to the existing county supply. The water was pure enough for domestic use and no treatment was necessary.

**ELECTRICAL:** Only a limited supply was available until two diesel generating plants were installed. These dealt particularly with the requirements of the cranes, which were powered by DC motors with a total output of 2,600 Horsepower.

**BUILDINGS:** Numerous buildings were erected, such as transit sheds, a supply depot, administration offices, erecting shops, a locomotive shed, blacksmiths shop and so on.

## Number 2 Port, Cairn Ryan

The Number 2 Military Port built in Loch Ryan was also served by rail. It provided considerable reception sidings for traffic being formed in the Stranraer area. As at the Number 1 Port, personnel required for the eventual invasion were trained in both the construction and operation of a port.

**RAILWAYS:** From the reception sidings near Stranraer, a new railway was built along the north side of the loch to the military port itself, formed in deep water at the western end. The line was built by a railway construction company attached to the establishment under the command of a Chief Resident Engineer. As at the Number 1 Port, he had previous civilian experience of port management. A shunting yard was built at Leffnoll capable of holding 2,000 wagons. The line to Stranraer was partly double and had seven signal box sections. Ten locomotives were allocated to the port.

**BERTHS:** The Number 2 Port was designed with four berths and a provision for a fifth of a total length of 2,000 feet. A lighterage berth was constructed with reception sidings close by.

As at the Number 1 Port, my personnel were recognised for their special skills: at a midnight meeting at the Admiralty on one occasion I was asked for the assistance of the military forces working at Loch Ryan in building a jetty for American ships. These were loaded with the materials required to provide berths for American destroyers. This work led to our assistance in the construction of the base at Roseneath.

The personnel were used to unusual requirements and happenings. Several noteworthy incidents took place during the construction of Cairn Ryan. Once, when pile-driving using 'screw-crete' concrete piles was proceeding satisfactorily, one of the piles suddenly refused. On withdrawing the pile some timber was found clinging to the cutting edge. It was suspected that a wreck had been found and the department of the Board of Trade responsible for wrecks was consulted. Apparently, many years before, a sailing vessel carrying a cargo of coal had caught alight and foundered. The remains of the vessel, including its cargo of coal, were then dug up by a heavy dredger working on the port. Such was the need for economy that the coal was subsequently used to fuel the steam locomotives serving the port!

**ROADS:** Roads had to be widened, improved and built within the port.

**CAMPS:** There were eight camps built to hold 4,000 men.

**WATER SUPPLY:** The water supply for the Number 2 Port was taken from hillside burns and nearby lochs. A dam was constructed across Glen Burn about one mile from the main road at Cairn Point to give a reservoir capacity of one and a half million gallons. A purification and filter plant was built.

**ELECTRICAL:** An adequate supply was fed from Stranraer.

**BUILDINGS:** As at the Number 1 Port, all the facilities for an active port were provided.

**TOWER CRANE:** For the loading and unloading of heavy lifts a tower crane was bought from a port on the East Coast, repaired in accordance with the requirements of a military port and erected.

**CARGOES:** Both Number 1 and Number 2 ports were used in the early days for unloading Liberty ships carrying 'Lend-lease' cargoes from America, as well as many other forms of cargo. Ships sailing for all the theatres of war were loaded at the military ports, including those carrying aeroplanes as deck cargo. These were loaded by the heavy lift floating crane, as was heavy artillery.

In both Number 1 and Number 2 ports, military personnel operated them with a Colonel in charge as Port Manager.

*A ROYAL VISIT:* The Royal Navy had asked to use the berths when necessary. One night, the Chief Resident Engineer telephoned me and asked me to be present at the classification sidings at Stranraer the following morning. He could give me no further information. At the sidings, I noticed a train consisting of a steam locomotive and three carriages, including a special saloon, drawn up. Soon, the Royal Train entered the sidings and halted. A window was opened and an officer, leaning out, asked where he was. He was told that he was at a military port at Stranraer. The officer then informed us that the King and Queen were aboard the train. We were invited into the saloon and proceeded along the new railway to the lighterage wharf at which the PHOEBE, a small cruiser, was secured. The Royal Navy, recognising that the berths were part of a military establishment, had drawn up the guard of honour aboard the cruiser rather than forming up ashore. The Royal pair went aboard.

### Cranes and mechanical handling

The establishment of the two military ports in Scotland could not proceed even in the design stage without consideration of the equipment, particularly cranes, with which they would be furnished.

The principal requirement was cargo-handling cranes with a long outreach of 80 to 90 feet.

Britain, at the time, was mainly concerned with defence against invasion and I became aware of demolition plans for several ports on the East and South Coasts. One of these was Southampton, where an Admiral was demolishing or rendering useless much of the equipment of the great port.

I visited Southampton and explained to the Admiral the need for cranes with which to equip the military ports in Scotland. This was virtually an auction at which I was the bidder on behalf of the War Office.

The Admiral asked me how long it would take to remove the cranes. I said that my recently-established port maintenance and operating companies would work 24 hours a day, seven days a week. When dismantled, the cranes were removed for storage throughout the country until they were needed in Scotland.

The same speed was not possible with the 150-ton floating crane from Southampton of which we also took possession. The massive crane was mounted on a very large pontoon and could not easily be dismantled. We decided to tow it complete to the Military Port Number 1.

We discovered that the crane was registered as port equipment but not for sea transport to the Clyde! However, it was towed to Portsmouth where work started to prepare it for the long sea voyage. The steel work involved in strengthening it, as well as other works, were carried out under an RE Colonel. Before embarking on the voyage to Scotland the heavy jib had to be lowered on to a trestle. Before this, retaining pins of 12-inch diameter had to

be removed. The crane at that time was 17 years old. The usual method of jacking up the structure and then removing the pins failed. The drastic measure of burning them out was resorted to by my engineers. The damaged pins could then be withdrawn to be replaced when the crane was erected in Scotland.

The floating crane was finally taken in tow on November 27 1941. It had reached Torbay when I was told that, because of gale force winds, the giant structure was towing its tugs around the bay, owing to the windage which it presented! Eventually the tow managed to put into Torbay for shelter. I immediately contacted the Admiralty and asked for a powerful naval tug. This was readily lent and took up the tow round Lands End, which finally arrived in the River Clyde on December 5 1941. From there, the floating crane was brought to Faslane Bay, with a military crew sufficient to operate it on a 24 hour basis. In this case the services of a Southern Railway Civilian Master were retained during the whole period the crane was operated under War Office control. A separate berth was built together with the necessary railway tracks.

The 150-ton crane was engaged in the regunning of workshops, the unloading of aircraft from the decks of ordinary steamers that had sailed across the Atlantic and the placing in the sea of one-man miniature submarines. These were delivered to the port on railway wagons under the cover of tarpaulins.

At the Number 1 Port, the lighterage wharf was equipped with eleven 30-cwt cranes transferred from Deptford. The deep-water berths were designed to carry the Southampton Dock cranes of 2- and 5-ton capacity and the Southern Railway made available nine 5-ton and eleven 2-ton cranes. All these had to be dismantled and re-erected by military personnel from units under my control.

For Number 2 Port, the lighterage berths were equipped with four 2-ton, two 30-cwt and two 3-ton cranes, all transferred from other ports. The deep-water berths were provided with eleven 6-ton, eight 3-ton Port of London cranes and a 60-ton cantilever crane from a disused yard in Sunderland.

The officers charged with the administration and operation of the ports had, in private life, held appointments with major shipping companies and were widely experienced. The actual movement of vessels however was controlled by the Ministry of Shipping.

In all, 120 cranes were removed from ports where they were immobilised and dismantled before transfer to Scotland for re-erection. It is worth noting that the cranes were only obtained on loan and had to be returned after the war.

I do not wish to give the impression that the two military ports in Scotland were the only activities of the military units under my direction. They were also heavily involved elsewhere in the world, particularly in the Middle East. There, for example, thirty modern 3-ton cranes from the Port of London were installed, having been dismantled and packed before shipment.



In the event of an invasion of Europe, cranes would be a vital necessity at ports captured by the Allies. Cranes take a long time to manufacture and must be ordered well in advance of need. I therefore persuaded the War Office to place a major contract with Messrs Stothert and Pitt of Bath for a total of 360 cranes. This order was completed in the record time of 18 months, production at times reaching a maximum of ten cranes per week.

It may be questioned why the order for 360 cranes was placed at one time: the order took into account that, apart from the need for cranes in captured ports on the Continent, provision had to be made for cranes in other ports which might be devastated before the war ended.

We anticipated that captured ports on the Continent would have no electric supply and so provision was made for each of the 360 cranes to have its own diesel generating set.

The cranes were built on the unit construction principle in order to assist speedy manufacture of the separate units by different contractors and each unit had to be interchangeable. It was also decided that, in view of the need for speed of assembly, each unit would be electrically wired by the manufacturer, the assembled units forming a complete crane which could then be quickly connected on assembly by means of plugs and sockets. In fact, it took about 27 hours to erect each crane.

In accordance with my general procedure, personnel from the port maintenance and operating companies were trained in erecting and operating the cranes at the manufacturer's works.

Many of these cranes are still in use in ports around the world. Some went to captured ports in France, such as Rouen, Honfleur, Boulogne, Calais, Le Havre and Dieppe and others to ports as far away as Australia and India.

### **Port Repair Vessels**

Port repair vessels were another of the department's responsibilities. It was thought unlikely that repair work could be done with on-site facilities when ports were bombed—or, later, captured. We therefore fitted out five small tramp steamers of about 800 tons to ensure that the necessary plant could be moved quickly to work sites. These ships were officered and manned by RE personnel and were fitted out to War Office requirements with workshops, pumps, compressed air plants, diving equipment, diving bells and heavy derricks. In addition, they carried a great variety of construction equipment.

The port repair vessels served in many areas as a form of 'flying-squad' and greatly helped in the problems of clearance and rehabilitation of captured and devastated ports. They were of particular value after the invasion of Europe, in the recaptured French ports. The Americans thought so much of the port repair vessel that they copied them.

The port repair vessels operated with great distinction overseas from the period when the

First Army landed in North Africa in November 1942 until the last port construction troops in the Central Mediterranean Force were disbanded in the summer of 1945.

### **The Port Repair Depots**

An essential part of a military port repair organisation was the establishment of suitably equipped bases for the storage and issue of special "transportation" stores.

We therefore established two such bases for our needs. The bases were also used for testing and inspecting equipment, servicing the port repair and ancillary vessels and as training depots for specialist troops.

These depots were at Marchwood on the west side of Southampton water on land reclaimed by a man named Kalis and at Richborough—the site of the First World War 'Mystery Port'. These depots were designated Numbers 1 and 2 Repair Depots.

### **Dock Gates**

An important item which was considered necessary for use by the port repair forces in rehabilitating captured French ports was replacement dock gates. Although demolition of the ports and dock gates by the retiring Germans would take place, this would not necessarily destroy the dock walls.

I discussed the matter with my staff and equipment was designed for replacing damaged gates. The equipment was made out of sections built out of steel plates. Components of various sizes were constructed so that any size of dock could be fitted with a gate made up of the sections bolted together.

A contract to manufacture a number of these units was placed with a firm in Essex and when I witnessed a test at an unused dock in London it was so successful that full-scale manufacture was immediately put in hand. I understand that the first application of these units was at the damaged port of Calais.

### **Pontoons**

In most ports the movement of cargoes cannot be carried out without the use of a lighterage wharf. Therefore, an essential provision for the invasion of Europe was the construction of pontoons made up of steel tank plates which could serve as temporary wharves. Messrs Braithwaite carried out the work of assembling the tank plates into pontoons at Bosham on the South Coast.

One of the functions of such pontoons was to tow them out to ships lying at anchor outside a port, load them with cargo and then tow them back to port for unloading. In





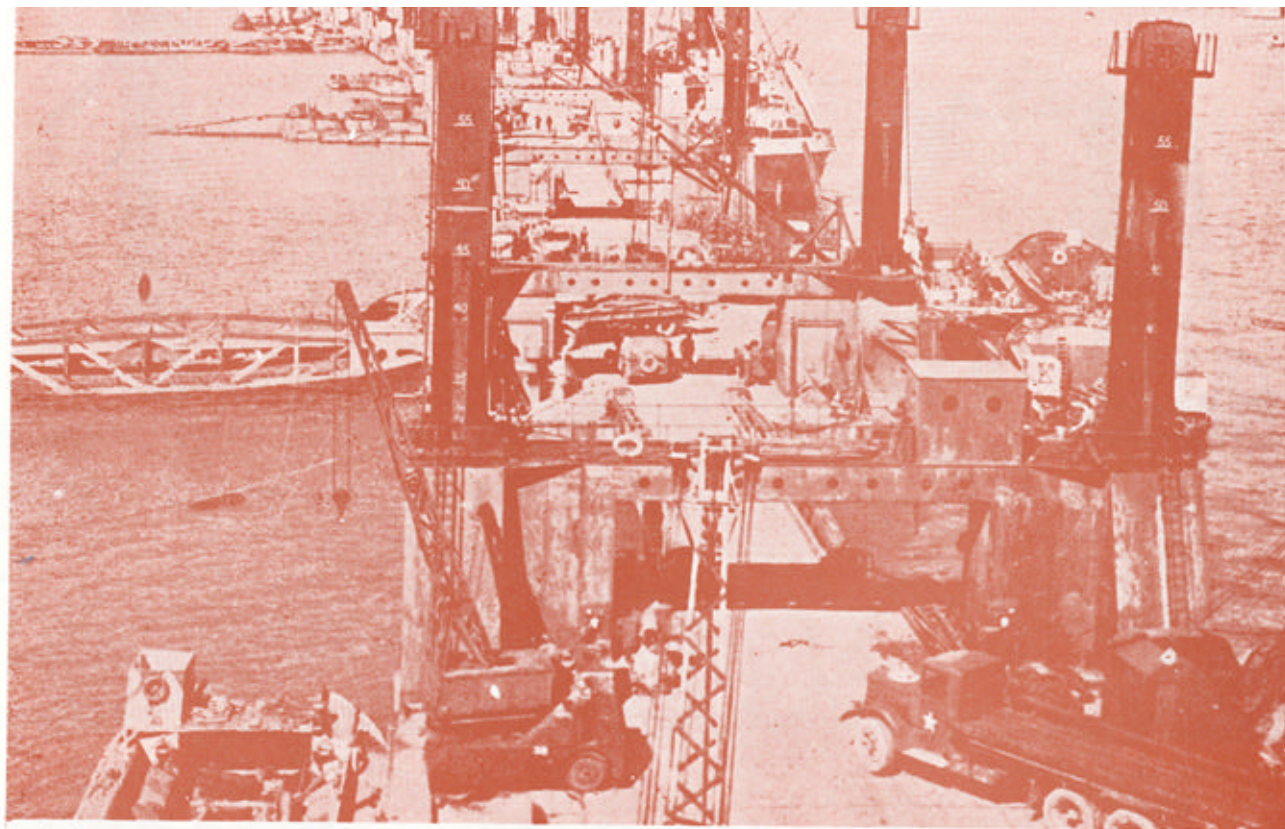
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Whitehall.

PIERS FOR USE ON BEACHES

C.C.O.  
or deputy.

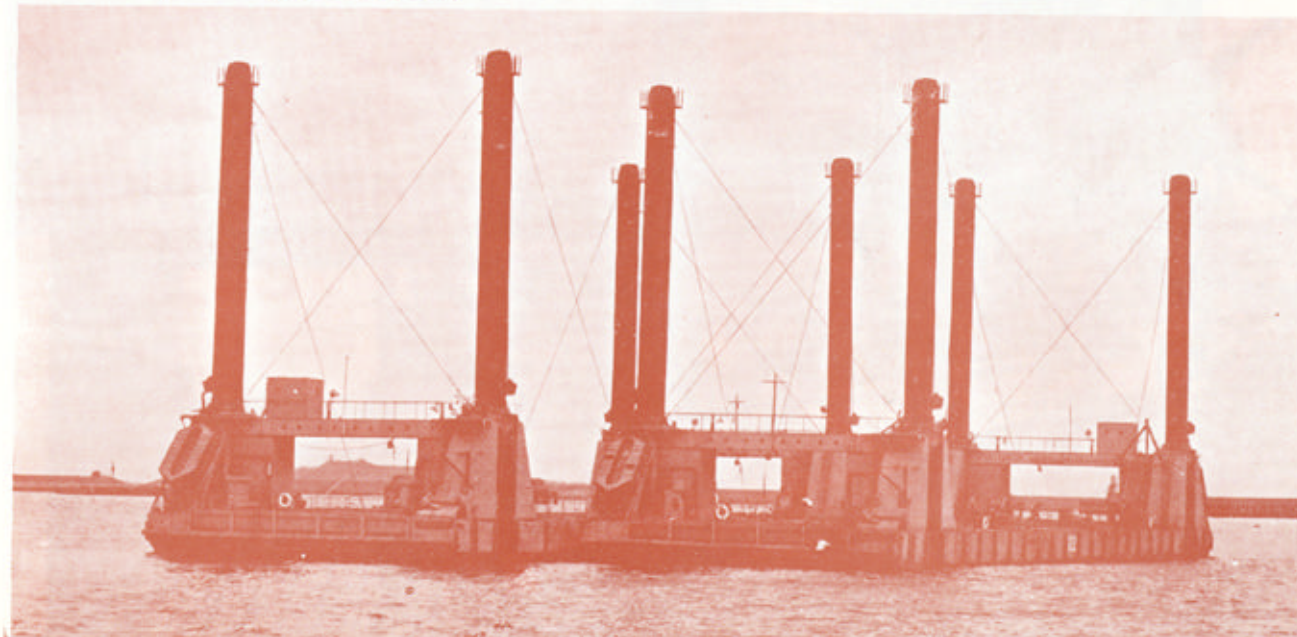
They must float up and down with the tide. The anchor problem must be mastered. Let me have the best solution worked out. Don't argue the matter. The difficulties will argue for themselves.

30. 5. 42.



*Pierheads in action, Normandy June 1944.*

*Pierheads with spuds raised, off Leith May 1944.*



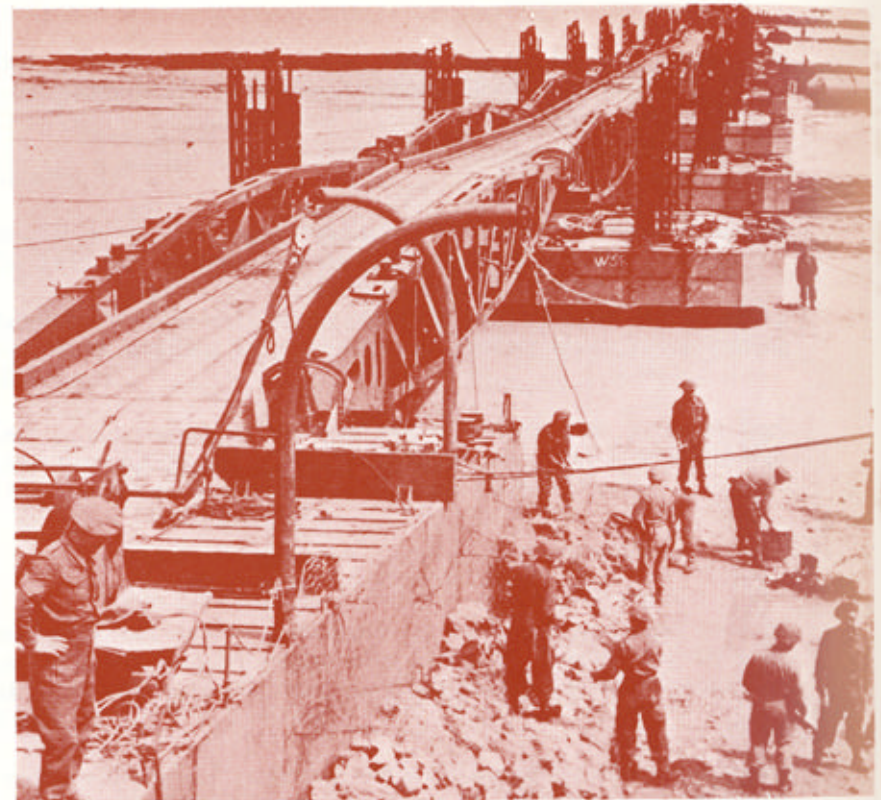
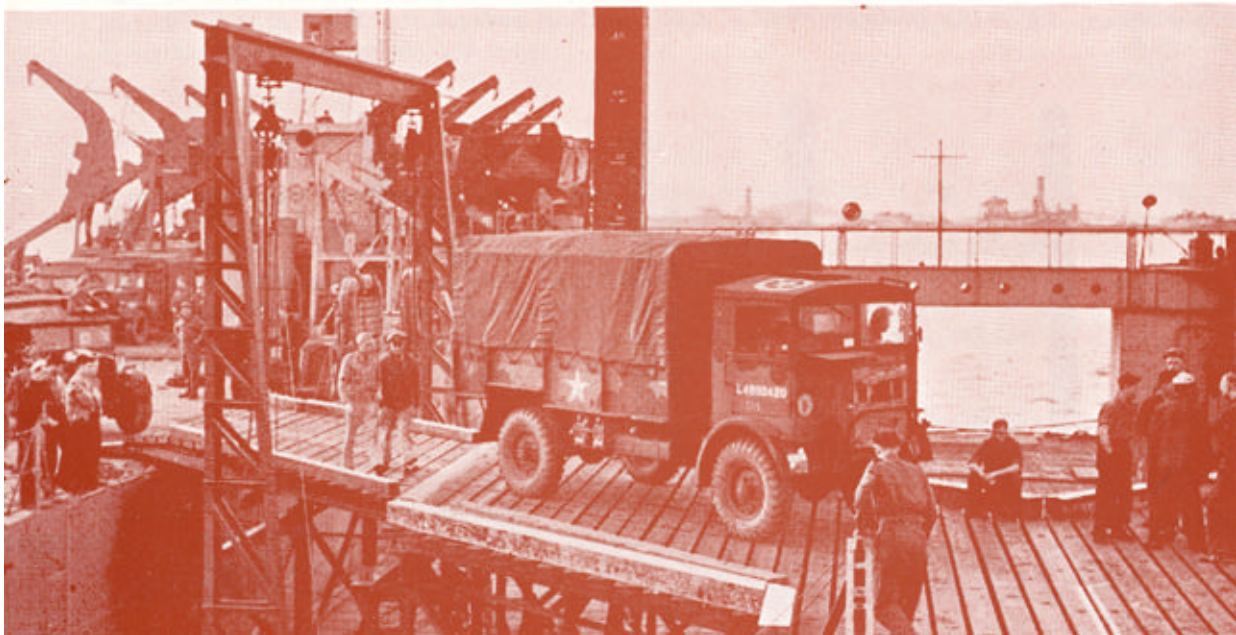
*Churchill's memorandum to the Chief of Combined Operations, May 30 1942.*





*A tank about to cross the floating roadway.*

*An ingenious adjustable ramp whereby vehicles could be unloaded from the decks of LST's.*



*The shore end of a floating roadway at low tide.*



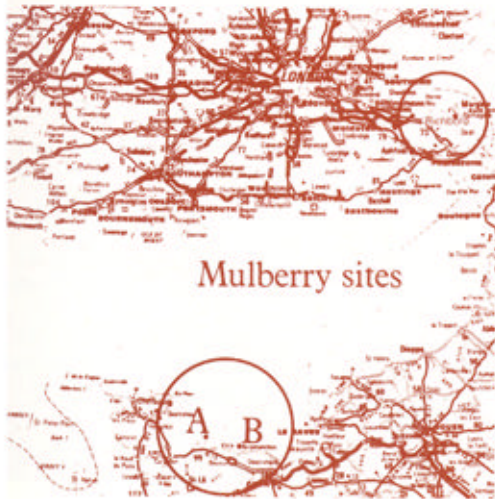




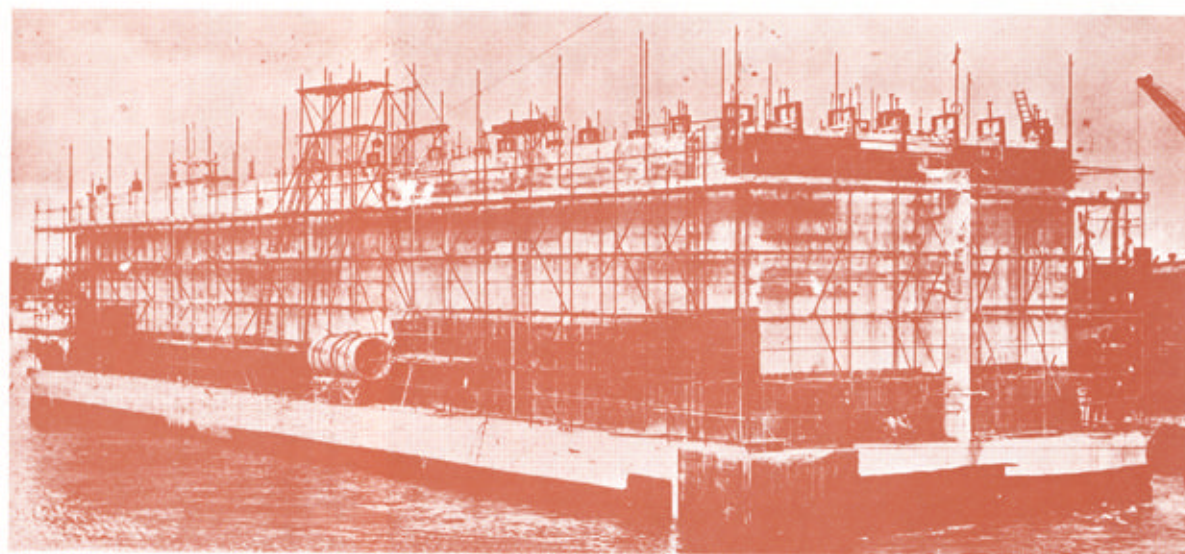
*Ambulances using the floating roadways to drive direct to a hospital ship.*



*A hospital ship berthed at an LST pierhead.*

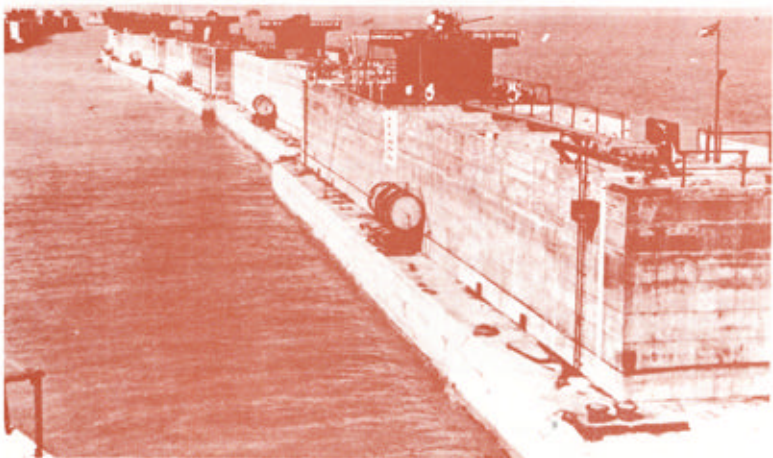






*Construction of concrete caisson nearing completion in the London docks.*

*Blockships were scuttled to form part of the northern and seaward breakwaters.*



*The larger caissons were equipped with anti-aircraft guns.*





addition, they were equipped for port repair work and were invaluable as platforms for pile driving and carrying cranes. Such pontoons were eventually used at Mulberry at the berths on the pier heads and were in almost continuous use, unloading supplies.

### Information on Foreign Ports

In the 21st Army, groups of Royal Engineers were assigned to the repair of ports in France, Belgium and Holland. On landing they would be likely to find that the Ports had been demolished by the Germans before evacuation.

While such groups would be accompanied by the repair ships, repair work could not effectively be carried out without a full reconnaissance of the damaged port. I felt that such repair units could be assisted and I therefore formed a separate organisation, which was housed on the top floor of the Institution of Civil Engineers—who had kindly loaned it to me for the purpose.

The object of the organisation was to prepare a volume containing all the information which could possibly be obtained on the ports which were likely to be recaptured. A search was therefore made of all technical papers regarding such ports, descriptions of their original construction, as well as any other information from journals, newspapers and even private sources.

Translators of the various languages concerned were engaged so that the engineers would have the fullest information in the volume for each port. The books also contained copies of the aerial photographs of the ports with an expert appreciation of the damage which might be caused by the retreating Germans.

### MULBERRY—The Artificial Harbours

Early in 1941 a new branch of the War Office was formed under my direction and given the title 'Transportation 5' or Tn5 as it was known. Tn5 was given the job of controlling the port construction and repair and maintenance companies as well as administering the port repair ships, dredgers, floating cranes, port operation and the construction of certain railways.

Tn5's initial responsibility was the creation of Military Ports Numbers 1 and 2, described previously.

The experience gained there and the resulting organisation, particularly the training of military personnel, was to be used to the full in the planning, design, construction, assembly and testing of all the engineered elements for the invasion of 'Fortress Europe'.

However, it was not until the summer of 1943 that the plans for landing on the Normandy beaches under the code word 'Overlord' was agreed by the Allied Commands and not until

late August 1943 at the Quebec Conference that the Combined Chiefs of Staff approved the construction of artificial harbours code named 'Mulberry'.

The design proper was not actually started until October 1943, although much preparatory work and testing behind the scenes had been done since Sir Winston Churchill's memorandum 'PIERS FOR USE ON BEACHES' of May 1942 to the Chief of Combined Operations, of which group I was a member. The actual invasion was planned for May 1944.

Following the Quebec Conference, only eight months remained to achieve an engineering accomplishment never previously matched—nor equalled since.

I have already related how it was necessary to create a register of engineers, particularly those who had an experience of port engineering. At the time, many were either in one of the services or ministries—or still in civilian life. From this register a team of about 150 specialist engineers was formed but the Treasury, while seeing the importance of such a body, insisted that a loan should pay for the fees of such specialists and their staff. As the availability of such men was required quickly I put it to the Treasury that paying them at once out of a 'float' was the only practicable method.

The Treasury finally acquiesced and this float became renewable, subject to the provision of receipts.

At an exhibition of the models of the invasion harbours given later for the benefit of the Houses of Parliament, Lord Lloyd George—son of the First World War Prime Minister—enquired about the organisation for Mulberry. When I explained about its financing he said that no-one had ever succeeded in obtaining from the Treasury a continuous 'float' out of which fees for specialist civilian engineers were paid and there was no precedent for such a method of payment. He told me, "you are the only man to have achieved this".

In addition to the register of engineers, consulting engineering firms were engaged to supervise the many contracts being carried out in various parts of the United Kingdom. Nearer the date of the invasion, eminent civilians were also employed in examining aerial photographs of the various French ports which might be demolished on evacuation by the Germans and advising on the remedial measures which would be necessary to repair the ports.

Such an organisation was essential to complete the various works in a specified time. In advance of D Day the artificial harbours, having been built, had to be towed 100 miles to their destinations at about the same time as the assault troops to enable them to be established in position, albeit 'under fire'.

Absolute secrecy had to be maintained about the operation. In order to maintain it this great engineering complex was divided into separate parts, particularly for the manufactured items. Orders for supply were placed with numerous firms—about 500 in all—spread throughout Britain. The manufactured items were brought together as near as possible to the date of the invasion.



Nearly all personnel had to be kept in complete ignorance of the purpose of the components and their eventual use.

The maintenance of security of this nature was in itself a great burden of responsibility, particularly when added to the other strains which must be carried in a project of this magnitude.

As pressure built up in Britain and elsewhere, especially in France, for a 'Second Front', the military planners focussed their attention on the real possibility of an invasion of Europe. The Russians, too, were anxious for a Second Front as it would relieve pressure in their sector. Since early in the war, as I have recounted, my department had been making contingency plans for such an invasion and the part which we should play.

It was clear in the early days that an operation involving the invasion of the Continent should be vested in combined operations of the forces, namely the Royal Navy, the War Office, and the Air Force. I represented the War Office at meetings of Combined Operations under Lord Mountbatten to discuss invasion plans.

At one such meeting, a naval captain produced Sir Winston Churchill's memorandum concerning 'PIERS FOR USE ON BEACHES'. As representing the War Office, whose responsibility among others was the building of ports, I said that it was my duty to undertake action on the Prime Minister's instructions and accordingly took the memorandum away from the meeting for consideration.

In my view, the memorandum indicated that the Prime Minister was not satisfied that enough attention had been devoted to the subject. I therefore approached Sir Winston Churchill's office, where I had a brief conversation suggesting that I had the solution to his memorandum, and asked that I should be granted the opportunity to explain to Sir Winston the manner in which his memorandum would be dealt. My request resulted in an invitation to Chequers, where, I was told, I would be given the opportunity to explain my plans.

I was received at Chequers by the Prime Minister's scientific adviser, Professor Lindemann—later Lord Cherwell—who showed me my room, where I changed for dinner. Downstairs in the drawing room I was given a drink and soon the door opened to admit 'Bomber' Harris (Marshal of the Royal Air Force). We chatted for a few minutes until Sir Winston, who had been in London, joined us and we went in to dinner.

After dinner Sir Winston took me away so that I could explain my proposals for dealing with his memorandum. At the time, he had just signed an undertaking to the Russians that the Second Front would be opened later in the year, if conditions were right.

I told the Prime Minister that I had frequently been involved in dredging, and particularly the equipment used for dredging, through my work for my firm. I then explained about the dredger which had been seen working in the harbour at Valparaiso during 1924.

A storm had broken out and all the ships in the harbour had foundered, with the exception of the dredger. This craft, built at Renfrew in Scotland, was fitted with three 'spuds' or legs. The able master of the dredger made use of the vessel's ability to be lifted up and down on the legs by raising her above the waves, thereby avoiding the water's turbulence.

Such a technique not only met his request that 'they must float up and down with the tide' but also answered the 'anchor problem', since the spuds would be firmly placed upon the seabed.

After this explanation and a description of the extensive work which my department had already deployed so far in this direction, the Prime Minister was satisfied that much had already been accomplished towards resolving the engineering problems associated with the invasion. I think that his confidence was gained and this surely resulted in the help which Sir Winston gave me throughout the following years.

After our discussion, he said, "Come along, we must hear the midnight news". We went along to his communications room where we heard the BBC announce that Hamburg had suffered a heavy raid. This presumably explained why 'Bomber' Harris was at Chequers that night.

Thus, the department continued its efforts to find engineering solutions to the problems of landing vast numbers of troops and munitions from artificial harbours. I had been told in absolute secrecy in July 1943 that the Normandy beaches were to be the site of the landings. At the same time that Tn5 was working on the artificial harbours, breakwaters, floating roadways and other components, different teams elsewhere were also conducting research, including the Admiralty—to a certain extent—and the Americans.

It was necessary to test the components for the artificial harbours. I tried out any proposal, whether it was made by my own staff, by another Service or even by individuals. A testing site had to be found in the UK for these trials. A search of various areas resulted in the selection of a location in the Solway Firth where the rise and fall of the tide—about 24 feet—was similar to that off Normandy. It was also subject, at times, to very rough seas. Above all, however, its remoteness from London decided the issue, as interested visitors were reduced to the minimum. Police protection was provided when I approached the Scottish authorities and a small unit was established at the experimental site.

Tests were carried out on concrete caissons, including towing, manoeuvring and even sinking the units. We also tested alternatives to the caissons, such as compressed air breakwaters. A number of tugs and other vessels were retained at the site in addition to the usual military equipment required for the work.

At about this time, appeals were made to the public to send in any information, including photographs, postcards or holiday brochures of continental locations. When collated, this information was invaluable to the invasion forces and their planners. One such photograph, a seaside snapshot of a courting couple leaning against a cliff, enabled the engineers to

assess the height of obstacles to be demolished as well as other vital information.

In August and September 1943 a crucial conference was held in Canada and the USA finally to settle and agree the invasion plan, code-named 'Overlord'. Sir Winston Churchill and a very considerable staff proceeded to America aboard the QUEEN MARY.

At about this time, I was asked whether permission could be given for a test of passenger stock on the seven miles of railway from the West Highland Railway to the Number 1 Military Port at Faslane Bay. Subsequently, the Colonel in charge at Faslane telephoned me to say that my presence was required at the port on a certain date.

On that date, at the appointed time, a restaurant and sleeping car were shunted down the slope and onto the quay. The train disgorged a number of staff officers who made their way to the cross-Channel steamer MAID OF ORLEANS moored alongside.

The train was moved to a siding and was then followed by another, from which Sir Winston and Lady Churchill disembarked, along with a number of senior staff. They too boarded the MAID OF ORLEANS. I was asked to come aboard and to proceed to the bridge. The Prime Minister wished to obtain particulars of the military port from which he was embarking to board the QUEEN MARY, anchored in the River Clyde. When I learned of the purpose of the Prime Minister's voyage, I felt like Cinderella, not being allowed to go to the ball.

However within a few days an urgent message came from Sir Winston Churchill, then in Quebec, asking myself and a party of experts to join him there. Myself, along with Mr Reginald Gwyther, Major General Wernher and Colonel Steer-Webster made preparations to fly to Quebec to discuss the provisions for the invasion, in particular the artificial harbours.

We flew in a bomber for 15 hours across the Atlantic, clad in double flying suits and lying prone on the deck of the aircraft, head to tail. At Montreal we boarded a small aeroplane which took us to Quebec where the party was lodged in one of the Canadian Pacific hotels, the Chateau Frontenac.

At Montreal, breakfast had been the first food we had eaten since we left England. But at the Chateau Frontenac every possible kind of luxury which I had not had for many years was available on the menu. My most outstanding recollection was that, after the flights and preliminary talks in Quebec, I was most anxious to sleep: I remember being awoken by a tap at the door from a waiter who came into my room bearing a salver on which was mounted a large bowl containing crushed ice in the middle of which was planted a large glass of fresh orange juice. My room was some height from the ground. I thought that I was approaching heaven.

We went to Quebec to discuss among ourselves the plans which we had made and then proceeded to Washington to meet our American allies. One meeting with Sir Winston

Churchill stands out in my mind: it took place in his bedroom in Washington. He had been away for some reason, and to save time, my demonstration of some models which we had brought took place in his bedroom to illustrate certain aspects of the artificial harbours.

On another occasion, a meeting took place in President Roosevelt's study at the White House, at which Admiral King, chief of the US Navy was present. The President and Sir Winston Churchill sat behind a long desk on which there was mounted a huge vase in which was displayed a magnificent arrangement of yellow rose buds. Admiral King and I sat facing the desk and at the start of the meeting Major General Ismay leaned over to me, handing me a White House pad and asking me to make notes, if I would be so kind, as he was not too familiar with the subject. I then passed my notes to him for preparation of the minutes.

At a final meeting, the whole of Operation Overlord was examined and the proposals for producing the artificial harbours were discussed fully. The American chiefs of staff approved our provisions. It was then decided that there should be two artificial harbours, the American became Mulberry A and the British, Mulberry B. The meeting was conducted by General Marshall, who asked whether our arrangements were such that the harbours would be available by May 1944, the date fixed for the invasion.

In view of the organisation which had already been created, consisting not only of the panel of expert advisers but also the extensive supporting military organisation, I gave an affirmative reply, subject to the availability of certain materials and a supply of tugs to tow the completed sections. I felt a great responsibility in giving this reply but I was aware of the strength of the organisation at home.

On my return to Britain, the commitment weighed more heavily. The most important item to be concentrated on within the short time available was the provision of 150 concrete 'caissons' weighing 7,000 tons each to form breakwaters. I immediately contacted Sir Andrew Duncan, the Cabinet minister with responsibility for supply.

At a meeting at 8 a.m. at Steel House in Tothill Street the minister asked what was wanted. I explained to him the mission to North America and the extreme secrecy attending the discussions and their great purpose. I said that it would now be necessary to set up a new organisation for dealing with the supply of concrete which had not previously been catered for. Sir Andrew asked what form this new department should take. I told him that it would now be necessary—among other things—that large numbers of contractors should be coordinated by an experienced engineer on the staff of his ministry. By the same afternoon, the appointment was made.

The production of the 150 concrete caissons required the allocation of a large number of building sites at which accommodation for the work force was available, as well as roads and railways and office accommodation.

In addition, facilities had to be found for the consulting engineering firms responsible for supervising the work.

One such site was Stokes Bay, Gosport, Hampshire where the caissons formed on the promenade were advanced sideways across the slipway into the sea. The East India Dock in London was dewatered for the construction of caissons and flooded to float them into the River Thames.

My greatest disappointment in finding sites was at Southampton, where the King George V Dock had been allotted to me and in which at least ten caissons could have been built. Unfortunately, the Admiralty stepped in and claimed the dock for the manufacture of their steel alternative to our concrete caissons, named bombardons, although these could easily have been built on a beach and rolled into the sea.

I established several working committees to progress the development of Mulberry. One of these became known as the Artificial Harbours Committee and met at Montagu House. In addition, two civilian committees were established, the Caisson Design Committee and the Contractor's Committee. These committees reported to me through my deputy, Colonel (later Brigadier) Rolfe.

By December 1943, with the assistance of Mr Ernest Bevin, the Minister of Labour, we had recruited over 25,000 men who were deployed at various locations throughout the country for the construction of the Mulberry harbours. Altogether, some 300 firms were involved in the construction of the pierheads, to which ships would moor for unloading, and a further 250 were making the floating roadways to carry the vehicles onto the beaches. None of these contractors had drawings of the complete scheme and complete security was maintained.

A total of 23 pierheads, built to the same principles as the Valparaiso dredger but with four spuds instead of three, had also to be made. The prototype pierhead, I am pleased to say, was built by the same firm—Lobnitz of Renfrew—which made the one which had been in Valparaiso. The pierheads were eventually fitted with cabins for their personnel, as well as anti-aircraft guns. The final design for the pierheads allowed them to ride up and down with the tide, the spuds automatically adjusting to the water level, so that Sir Winston Churchill's requirement was even improved upon, as they were firmly anchored to the seabed by their spuds. The tides in Normandy ranged up to 25 feet.

As roadways connecting the pierheads to the shore were necessary under any scheme for the invasion, the Ministry of Supply placed contracts with steel firms for the parts required to construct the roadways. The flexible roadways had to carry loads of up to 30 tons, floating on 'dolphins', pontoons made for the most part of steel. Some dolphins were made of concrete because steel had been diverted to the manufacture of bombardons. Other special requirements, such as reeling drums for anchorage and anchors for mooring the dolphins were provided.

The roadways were supported on girders and were made up of steel decks. They were ten feet wide and a special unit enabled the roadways to telescope to accommodate movement caused by the rise and fall of the tide. Vehicles were carried to the pierheads in LST's, vessels which could carry 22 tanks and 20 motor transport vehicles. The floating roadways

were finally assembled at Richborough, where a special yard was established, and launched there.

In addition to designing pierheads for ships to come alongside we also had to plan for the LST's. I advised a floating beach system, sufficiently wide to beach an LST and made of steel, wedge shaped and curved. The detailed design was undertaken by Ove Arup and Partners, who introduced diesel pumps and compressors to adjust the slope of the floating beach.

Inevitably, so much maritime engineering required a number of divers for underwater examinations and ultimately the setting of foundations. However, at the time the divers available within the construction companies were not competent on the structures being built for Mulberry and in any case would not be prepared to work on the 24-hour basis needed.

Eventually, a force of divers was trained by the Admiralty and secured for the sole purpose of working on Mulberry. They were military men who were paid on Admiralty rates. Hundreds were trained during this period. At the end of the war they pursued their careers and I have no doubt that they substantially answered the demand for divers in connection with the oil exploration undertaken around the world subsequently.

On March 17 1944 at a meeting in Norfolk House, I was advised that immediate and urgent consideration should be given to extending the life of the Mulberry harbours by 90 days, into the winter months. A particular requirement was to secure the concrete caissons. The suggestion that they should be filled in with dredged material was dismissed and eventually the enormous structures were capped with steel plates to protect them from the seas.

The Mulberry components, when completed, were towed to their assembly points on the South Coast. The 'bombardons' were secured at Portland, the blockships—hulks to be sunk as breakwaters—were moored at Poole, the 'phoenix' and 'whales' were concentrated between Southampton, Portsmouth, Selsey and Dungeness.

In order to save costs, Tn5 authorised the welding of as many steel components as possible. This had been regarded as unacceptable but proved that, within limits, it was effective both in time and costs saved. Hundreds of welders were trained for this purpose, many of them in conditions of extreme urgency.

The Mulberry forces were given the order to sail to their destination on the afternoon of D Day. It was planned that within fourteen days of the first soldiers going ashore, the artificial harbours, both British and American, would be in place. The Americans, who had no part in the construction of the artificial harbours, did not allow themselves enough time to train in their use.

At the Overlord conference in North America it had been decided that two artificial harbours would be provided. The troops involved in both countries' forces were instructed



in the object of the Mulberry harbours and their design. They were also fully aware of the importance of constructing the harbours on the sites. When the components left the South Coast in preparation for D Day I had no control over the action taken overseas. However, I was regularly informed of the progress day by day in placing both harbours.

From the reports, I deduced that, while the British harbour was proceeding according to plan, the American Mulberry was being constructed much more quickly. The result was that the American Mulberry was brought into operation earlier than the British.

While every step had been taken to ascertain the nature of the seabed on which the harbours would be founded, including very hazardous reconnaissance by mini-submarines, we could not be definite and therefore tendered a measure of caution in founding the breakwater units. The units were designed for a short period of summer weather and were open-topped, although they had the necessary freeboard.

On D Day + 13 an unusual summer storm arose. While the British harbour withstood, the American was destroyed and abandoned, possible because the breakwaters had been founded without sufficient freeboard with the result that the violent seas gained entry into the units. As usual, one badly damaged unit resulted in the collapse of other units.

The British Mulberry suffered damage too, but in the form that the bombardons, the floating breakwaters designed by the Admiralty and built of steel in a cruciform shape, broke loose. Floating freely, the bombardons crashed into the caissons causing havoc to the harbour breakwaters.

I told Sir Winston Churchill at a meeting in his underground headquarters at a meeting to discuss these structures that they would break their moorings fore and aft and thus damage the concrete caissons. Following the storm, the Prime Minister issued the following instruction:

“To whom it may concern: Brigadier Bruce White has been sent over by the War Office with several experts on Ports to find out what has happened to the “WHALES” and “PHOENIXES” and any damage which may have been done to them by “BOMBARDONS”. He is to report personally to me on Tuesday.”

I foresaw the dangers which would arise from more than one organisation being involved. For this reason I had obtained the agreement referred to earlier under which the War Office would be responsible for the provision and formation of ports other than those controlled by the Admiralty. The introduction of the bombardons disregarded this agreement. I have already referred to the difficulty which I had with the Admiralty over the King George V Dock at Southampton. In addition, the moorings which I had reserved for the concrete caissons at Selsey were used to secure bombardons. This meant that the caissons had to be sunk on the seabed and raised by pumps—which were difficult to obtain—when they were required for the invasion. These difficulties should not have occurred.

As Sir Winston Churchill said in his memorandum: ‘The difficulties will argue for them-

elves’. This was the case. I have to admit that my reference to the bombardons is a criticism of a Service which carried out its difficult duties in ferrying the men and equipment for the invasion, but I felt that it was necessary for the truth to be revealed.

The beach-head for the British Mulberry was at Arromanches, a fishing village. The establishment of the components went ahead without particular problems. The American Mulberry was placed at Omaha Beach, where considerable enemy harassment was encountered. Reconnaissance had been carried out at both sites as I have said and they had been laid out with buoys. The first components to be placed were the blockships, sunk under Admiralty supervision. Ten days later many of the ‘phoenix’ concrete breakwaters were also in position. On June 19, the storm broke, destroying the American Mulberry.

I visited the devastation at Omaha Beach where I saw bombardons whirling about in the water, numerous vessels drifting ashore and three small landing craft piled on top of each other on the beach. It was a tragic sight and I felt it could have been avoided if certain key personnel had been prepared to follow our instructions. The British harbour at Arromanches continued to operate well into the winter of 1944.

By the end of the year, 39,000 vehicles and 220,000 soldiers had landed dryshod in France. General Eisenhower stated that “Mulberry exceeded our best hopes”. The invasion of Europe, impossible without the artificial harbours, had been accomplished by British engineering skill.

### After the War

When the war ended there was much engineering work to be carried out by the experienced military companies which had been established. One example of this was the refurbishment of the French railway system, which had been considerably damaged. Rolling stock was urgently requested by the French government and had to be transported by ferry to France.

Three train ferries which had earlier been transferred to Britain by General de Gaulle were made available. The same ferries had been used during the war as bomb transporters owing to the suitability of their decks.

Although the ferries could be loaded with rolling stock in Britain, it was impossible to transfer the cargo to the quays in France except by crane. The ferries were therefore fitted with heavy cranes which were incorporated into their structure so that rolling stock could be lifted onto temporary berths in the French ports.

Another government which required assistance was the Netherlands. A Dutch Admiral visited me at the War Office; like all Dutch people he was exhausted and indeed near tears. He said that he was anxious to obtain material to close the Walcheren gaps in the Dutch coast but had been unsuccessful in his approaches to other British government departments. His requirements were pontoons, scrap vessels and other items, which, I told him, were available if he could tow them away with tugs. In the event however, the Dutch could not use the material but we were nevertheless asked for assistance in closing the gaps. Major Beckett was sent to take charge of the operation for which he was decorated by the Dutch government.

## HISTORICAL DATES

YEAR	MONTH	DAY	EVENT
1939	Sept	1st	Poland invaded.
	Sept	3rd	War declared on Germany by Great Britain and France.
	Sept	28th	Germany and Russia arrange to divide Poland between them.
1940	May	10th	Coalition Cabinet under Winston Churchill.
	May	27th	Dunkirk evacuation commenced.
	May	–	Author called up and posted as Major, War Office staff—Transportation.
	June	4th	Dunkirk evacuation ended—215,000 British and 120,000 French troops rescued.
	June	–	Military Ports organisation formed under Major Gen. McMullen, Brig. Bruce White and Major Cornick MC, RE.
	June	10th	Italy declared War on Britain and France.
	June	13th	Germans occupied Paris..
	Aug	27th	War Office meeting agreed surveys of Faslane Bay and Cairn Ryan.
	Nov	–	Work on the two Military Ports authorised.
	Dec	–	Work commenced.
1941	Jan	–	Military Port No. 1 construction started.
	June	22nd	Germany invaded Russia.
	Aug	14th	The Atlantic Charter.
	Dec	7th	PEARL HARBOUR.
	Dec	8th	USA declared war on Japan.
	Dec	11th	Germany and Italy declared war on the USA.
1942	Jan	–	Military Port No. 2 construction started.
	May	30th	Winston Churchill's famous memo to Chief of Combined Operations "They must float up and down with the tide".
	Oct	23rd	British 8th Army third offensive drove Rommel out of Egypt.
	Nov	8th	British and American expeditionary forces landed in French North Africa.

YEAR	MONTH	DAY	EVENT	
1943	May	12th	End of Axis resistance in North Africa.	
	June	1st	First dredging company formed under Lt Col Swapp and Military Depots 1 & 2 Marchwood and Richborough.	
	July	–	Brigadier Bruce White's meeting with Churchill at Chequers.	
	Aug	11th/24th	QUEBEC CONFERENCE. Planning the final Mulberry and 'Operation Overlord.	
	Sept	3rd	Allied forces landed in Italy.	
	Sept	4th	Final decision by Combined Chiefs of Staff Design and construction of Mulberry a British responsibility.	
	Sept	24th	Ministry of Supply special branch formed.	
	Oct	1st	War Office started design proper.	
	1944	Jan	3rd	Allies landed forces on Italian coast south of Rome.
		May	1st	Earliest D Day.
May		15th	Final briefing for Invasion "Overlord" at St. Pauls School—all commanders present including HM The King, Field Marshal Smuts, Churchill, Eisenhower and "generals by the score".	
June		5th	D Day due to bad weather postponed to next day.	
June		6th	Allied forces landed on the Cherbourg peninsula.	
June		16th	The King visits the invasion beaches.	
1945	June	18th	D + 13: Unprecedented storm made American Mulberry unusable.	
	June	27th	Capture of Cherbourg. First major port under Allied control.	
	Feb	7th	Yalta Conference in Crimea (Roosevelt, Churchill, Stalin).	
	May	8th	V-E Day. End of war in Europe.	
Aug	–	Brigadier Sir Bruce White left the War Office.		

## APPENDIX A

### The Mystery Port— Richborough, Sandwich, 1914-18 BRIGADIER SIR BRUCE WHITE KBE, FCGI, FICE, FIMechE, FIEE, MConsE

*The Author has been a Member of the Institution for many years and is the senior partner of the internationally known Consulting Engineers, Sir Bruce White, Wolfe Barry and Partners. He served with the Corps in both World Wars. He was, as Director of Ports and Inland Water Transport at the War Office during the last war, responsible for the Mulberry Harbours.*

Unlike the 1939 War, requiring recapture by the invasion of the Continent of Europe, in the 1914-18 War the Continent was available to us. It was therefore possible to establish a base in the UK from which various services in the Continent were supplied. In this connection the Cabinet gave directions that a base was to be formed by Major General Collard as a matter of urgency.

After investigation it was found that a base having sea access could be formed most suitably alongside Richborough Castle, which is close to Sandwich in Kent. The area selected was served by the river Stour which had a muddy estuary. Work on the base was commenced in 1915/16. As no accommodation was available the large force of Royal Engineers required for the construction was accommodated in large barges which had been brought over from the Continent and moored in the upper reaches of the Stour. The accommodation provided in the barges was so unsatisfactory that it attracted the attention of Parliament with the result that special speed had to be applied to the building of a large camp which was necessary for accommodating the personnel employed.

It was necessary to make provisions in the base for all of the services required. These, amongst others, consisted of a train ferry service which was operated by three vessels built for the purpose and suitable for taking on loads carried on railway rolling stock consisting of locomotives, wagons and of all types and heavy rail mounted guns. These train ferries were the first to be introduced into this country. For operation of this service terminals were built at the base and also at a number of French ports. These terminals were concrete and steel structures of considerable size.

The river Stour with its muddy estuary did not give the desired depth for the train ferries, tugs and barges used. It was therefore necessary to assemble what, at that time, was a very large dredging fleet consisting of thirteen vessels which was utilised for the purpose of creating the necessary depths and also for maintaining such depths as the river was subject to heavy siltation.

At that time the road vehicle had not obtained its supremacy over the railway which is the case at present. All movement therefore through the base from all parts of the UK had to be by rail and for this purpose vast sidings were prepared on ground requiring a certain amount of reclamation obtained from the dredging operation. As the railway played such an important part, the sidings were constructed by Royal Engineers under Officers experienced in railway construction including Colonel Robertson who in civil life held the position of Chief Engineer of the East Indian Railway.

Whilst the train ferries dealt with the carriage of heavy materials, the majority of supplies were transported by barges loaded at Richborough and towed across the Channel and into the French ports and, wherever possible, up the rivers to the front line positions. As such barges did not exist in quantity there was introduced in the base a large shipyard providing for twenty-one berths upon which the parts of steel barges made by shipbuilders throughout the UK were assembled, riveted and launched. Thousands of barges were built and utilized on the traffic to the Continent. The formation of the shipyard and its operation was the responsibility of Major Hambling who had a considerable shipbuilding background.

On the Continent the French railways were greatly extended by the forces and in addition decauville railways of narrow gauge were largely employed for services of the forward depots. For the operation of these a large number of petrol driven tractors were employed and as repairs of these could not be carried out conveniently on the Continent, it was arranged that all tractors requiring attention were shipped back to Richborough, via the train ferries, and reconditioned in a large workshop which was built in the base.

The largest establishment built in the base was that of the workshops which were designed so as to cater for all repairs to locomotives, tugs and all other plant and, in addition, were also equipped to produce certain items utilized in the base or for the use of the forces overseas. The workshops consisted of machine shops, wood-working shops and foundries both for iron and brass and covered all requirements both for the base and overseas. They were operated for twenty-four hours a day seven days a week.

In view of the great demand for permanent way material, such as switches and crossings both on the Continent and also in laying the sidings at Richborough, and the inability of supplies by firms who specialised in this particular work, it was decided to build and equip a workshop suitable for the production of switches and crossings and other railway material required. This responsibility was given to an Officer who was in normal times employed by Messrs Edgar Allan in Sheffield, specialists in this type of work. The production from this workshop was most satisfactory and greatly exceeded the production from firms which normally carried out this work. This was probably accounted for by the fact that apart from the excellence of the equipment the workshop was operated "hour-in hour-out, day-in day-out, week-in week-out".

A point of interest is that whilst I was responsible for the layout and design of the works and other equipment, the workshops were in the charge of Officers who were specialists in their particular class of work. So far as labour was concerned this was provided entirely by Royal Engineers all of whom were skilled in their particular work and who in their early days of the war were wounded in France and on recovery were made available for "home duty" only. This had its advantages especially in the shipyard which was manned exclusively by shipyard workers from the British shipyards and who, having been wounded, wished to get their own back.

The mechanical section was in the charge of Colonel Holmes, to whom I was Major Second-in-Command, and consisted of a unit of 8,000 to 9,000 Royal Engineers engaged in the workshops, shipyards, train ferries and tugs, dredging plant and working on shifts of eight hours a day. The administration of these forces rested on me, as Second-in-Command, and called for special consideration, the most important of which was that of catering. In connection with this, provision was made by the building of three main dining halls each of which was equipped with army type cooking facilities and capable of seating 1,500 at a time.



Owing to the difficulty which arose in providing hot meals throughout twenty-four hours, the attention of Parliament was drawn with the result that the Chief of Eastern Command paid a visit to inspect the arrangements in force. During that visit I was asked for my suggestion regarding a remedy; I replied that in my experience such matters called for the attention of an expert. This point was taken and resulted in Mr Gluckstein of Lyons being asked to make an inspection with a view to agreeing to his appointment of Messing Officer. Following the inspection he agreed to take over the work with the rank of Major provided that those engaged in the catering service should be found other work and further that the antiquated cooking equipment should be replaced by that in keeping with modern practice. His proposal was accepted and he became the first Messing Officer for the British Army.

Following his appointment, Major Gluckstein informed me that if I was able to advise him of the quantity of hot meals required throughout the twenty-four hour period, and also regarding the number of those affected by this, he would then make suitable provision. I told him that in all twenty-three hot meals were required at various times throughout the twenty-four hours and would be in relation to the various tradesmen coming off shifts. The result was that the catering at Richborough was equal to that at any of the Lyons hotels or restaurants. A matter of interest is that in those days the daily ration was one pound weight of meat per man per day which Major Gluckstein considered to be far greater than his needs for catering purposes and consequently underdrew the ration.

Throughout its existence there is no doubt that the effort put in construction and operation of the "Mystery Port" greatly contributed to the success of the military efforts on the Continent. As a matter of interest during the latter stage of the war when the Germans made a comeback, orders throughout the Continent were to evacuate all bases and concentrate on the Channel Ports. It was thus, on going down to the base one morning after this order had been given, that I experienced a most unforgettable sight—all sidings in the base were occupied by French wagons on which had been loaded machine tools, including the concrete bases upon which they had been mounted, and all manner of equipment which had been evacuated from the Continent by the three main ferries which were kept in continuous operation throughout the twenty-four hours.

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## APPENDIX B

Particulars of the additional Royal Engineer Companies which were formed in connection with the organisation of the Mulberry harbours and the establishment used by them:

### *Companies*

**Port Construction and Repair**  
**Port Maintenance**  
**Port Operating**  
**Stevedores**  
**Inland Water Transport (IWT)**  
**Quarrying**  
**Survey**  
**Railway Construction**  
**Railway Operating**

### *Establishments*

**For construction of the Military Ports Numbers 1 and 2**  
**For operating the Military Ports Numbers 1 and 2**  
**Establishment for the test site at Wigton, Solway Firth**  
**Establishment for the IWT depot at Southampton**  
**Establishment for the IWT depot at Oban**  
**The Richborough depot**  
**The five port repair vessels.**

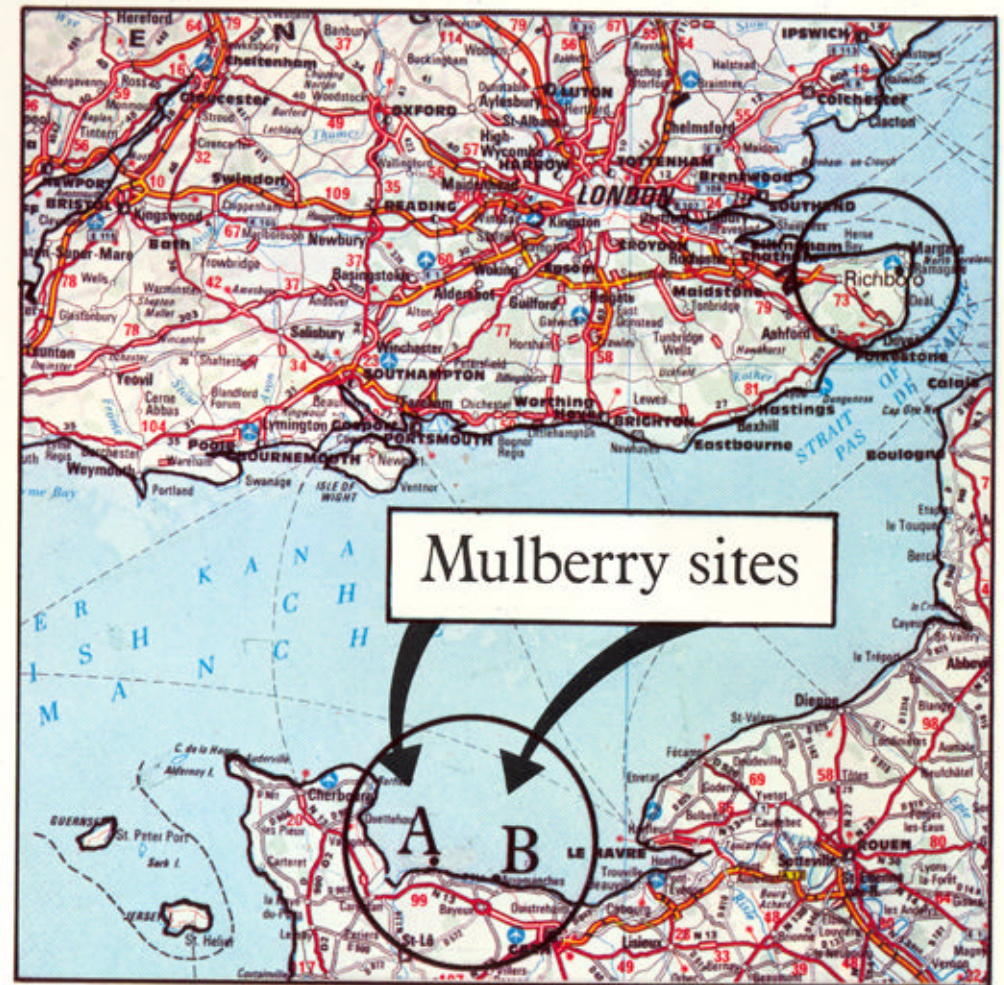
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The Military Ports in Scotland were built at Faslane Bay in the Gare Loch (Number 1) and at Cairn Ryan, six miles north of Stranraer (Number 2).



The American, Mulberry A, was placed at Omaha Beach and the British, Mulberry B, at Arromanches. Richboro was the site of the First World War 'Mystery Port' and used as an assembly point for Mulberry.