OPERATION PLUTO : Force Pluto and the naval involvement

Operation Pluto (from Pipe Line Under The Ocean) was the outcome of a request made in April 1942 by the Chief of Combined Operations, Rear-Admiral Lord Mountbatten, to Mr Geoffrey Lloyd (now Lord Geoffrey-Lloyd) who was Secretary for Petroleum: He asked for a fuel pipeline across the Channel.

One of the many vital problems facing the planners of 'Overlord' and its Naval partner 'Neptune' was the supply of petrol and other oil products for the invading armies. These were calculated to amount to 2,000 tons a day in the early stages increasing to 7,000 tons a day as the armies advanced. The American requirements were said to be similar but in fact became more than double. Supplies of petrol were originally planned to be shipped in the standard commercial 4 gallon tins but experience had shown that these were susceptible to rough handling and prone to leak badly with dangerous consequences.

The capture in North Africa of many thousands of German fuel containers, immediately dubbed 'jerricans', showed them to be vastly superior to the tins and they could be refilled from bulk supplies. So for 'Overlord' new factories were set up and 13,000,000 jerricans manufactured and pre-filled with 180,000 tons of petrol. Of these 1,000,000 filled with 14,000 tons of petrol were loaded for the assault stage.

To refill the jerricans throughout the campaign the planners proposed to rely on tanker shipments but it was clear that no harbours or tankage would be likely to be available for some time after the landings and also tankers loaded with petrol would be prime targets for enemy air attacks. How were bulk supplies to be provided before a harbour was available? And how reliable would this method be?

This and other problems exercised the minds and directed the activities of CCO* and his staff. Captain Thomas Hussey, his Director of Experiments and Operational Requirements, and his small team had the responsibility of finding, or helping to find, the answers. They sought help wherever it might be found and this included the advice of Sir Solly Zuckerman and J.D.Bernal whose encyclopaedic knowledge was invaluable.

For the immediate post-assault phase it was proposed to pump fuel ashore from a ship lying at moorings off an open beach. Royal Engineers would construct 6 inch (150mm) pipelines which would be hauled out to the moorings. This followed a system used in the reverse way for loading tankers abroad but needed modifications in view of the close proximity of the enemy. This operation was code-named 'Tombola' and full scale trials were carried out off Westward Ho! beach in Devon by Combined Operations in conjunction with the Royal Engineers. These proved that on flat, sandy beaches the method was simple and satisfactory.

Meanwhile Geoffrey Lloyd had consulted his experts who initially envisaged a 6 inch (150mm) ID** pipeline laid in sections but decided that owing to probable conditions of weather and tides in the Channel together with the threat of enemy action the idea was not feasible. But A.C.Hartley, Chief Engineer of the Anglo-Iranian Oil Company (now BP) was not convinced that this was the only possibility. He recalled that over difficult terrain in Iran 3 inch (75mm) pipelines had been used successfully. Working at a pressure of 1500 psi they delivered 100,000 gallons a day over forty miles. He was convinced that the pipe must be laid in one continuous operation and probably at night. He then suggested using a large submarine cable containing a hollow lead pipe as a way of achieving this. At this time it was understood that the pipe would be laid in the vicinity of the Dover strait and Hartley pointed out that a number of pipelines could be laid to produce

* Chief of Combined Operations ** Internal Diameter

an acceptable throughput. Geoffrey Lloyd at once told Hartley to pursue the idea further. He consulted Dr Wright, managing director of Siemens Brothers and Company of Woolwich, a firm with great experience in the making and handling of submarine cables. Dr Wright thought the idea feasible and immediately put in hand a trial length of the type of cable suggested.

Details of the work of producing the HAIS cable as it came to be called (from Hartley- Anglo-Iranian - Siemens) have been given in numerous articles and lectures and are beyond the scope of this article. Eventually every large cable company in the country became closely involved together with the Post Office cable-ships' organisation and many individuals whose unselfish teamwork enabled this highly technical and novel proposal to become operational. The first Hais cable produced and tested was of 2 inch (50mm) ID and weighed 44 tons to the mile filled with water, as it had to be for handling and laying. Subsequently the size was increased to 3 inch (75mm) which weighed 65 tons to the mile.

After a number of intensive trials a full scale lay was made from Swansea to Watermouth near Ilfracombe across the Bristol channel. A 1500 ton coaster was modified for cable laying and became HMS London. Her Captain was Commander Treby Heale, a very experienced officer whose previous command the cable ship Faraday had been lost through enemy action. He carried out the lay with calm expertise in spite of worsening weather at a speed of nearly five knots. It all looked too easy. But joining up the main cable to the shore installation proved anything but that and in fact took nearly three months. This was due to an LCT being used to run in a short length of cable to the shore. The heavy cable made the craft virtually unmanagable and it was not until the Post Office engineers suggested special barges fitted with cable-handling machinery that the connection was finally made.

The eventual satisfactory conclusion of the trial led to orders to proceed at once with the manufacture of sufficient Hais cable to meet a large proportion of the fuel requirements for Overlord. Further experiments carried out by Siemens later brought about an increase in the size of the cable to 3 inch (75mm) ID. About 100 miles of 2 inch Hais was produced before the change to the 3 inch.

The Hais cable project used vast quantities of material and of lead in particular. The total production capability of the cable-making firms in Britain was not sufficient to meet the desired throughput of fuel and arrangements were made for the manufacture of 140 miles in America. Then two other oil experts, H.A.Hammick, chief engineer of the Iraq Petroleum Company, and B.J.Ellis, chief engineer of the Burmah Oil Company, suggested that as ordinary mild steel pipe was reasonably flexible in long lengths it might be possible to coil it on a large drum and lay it like cable. This was greeted with incredulity by quite a lot of people but tests at Stewarts and Lloyds works at Corby confirmed the suggestion. As a result the order was given for the Hamel pipe, as it was called after its originators, to be given a sea trial as it could be a useful supplement to the Hais cable.

A hopper barge was converted to carry a 30ft (9m) diam/drum revolving on trunnions with its lower edge below the place normally occupied by the hopper doors. She was name HMS Persephone. Eventually a sea trial proved that this strange vessel could lay the steel pipe in much the same way as cable would be laid. But it showed signs of being even more difficult than the Hais when it came to connecting the shore end. Nevertheless, it was decided to proceed with the system at high priority.

Initially the Pluto pipelines were planned to cross the

Channel from Dungeness to Boulogne but soon after work on the Hamel project commenced it was known that the first lays were to be between the Isle of Wight and Cherbourg. B.J. Ellis had already proposed that the Hamel pipe should be laid from huge drums towed by tugs; this added to the numbers of the incredulous. Tank tests proved the idea practicable and six steel monsters, to be known aptly as Conundrums, were put in hand. Arrangements were also made for the building of assembly, welding and loading sites for the pipe at Tilbury.

With both Hais and Hamel now considered out of the experimental stage the main responsibilities for Pluto were transferred from Geoffrey Lloyd and the Petroleum Department and Combined Operations Headquarters to the Petroleum Warfare Department and its Director-General, Major-General Sir Donald Banks and Miscellaneous Weapons Development at the Admiralty. This latter department dealt in all sorts of odd devices which did not fit in with the more conventional and staid divisions like torpedo and gunnery. The date was April 1943.

The provision of the necessary ships to lay the Hais cable had been receiving some attention and also the requirements of Tombola and the Conundrums. Designs and plans were dealt with by the Director of Naval Construction in the Admiralty and in particular by a naval constructor, M.K.Purvis. Force Pluto consisted of Holdfast and Persephone, used for the initial trials; Cable ships Latimer and Sancroft, converted from merchant vessels of 10,000 tons and Algerian of 2,500 tons. The bigger ships carried 100 miles of 3 inch Hais and Algerian 30 miles. In addition there were five cable-laying barges for connecting the shore ends together with accommodation and storage barges and a number of motor launches. HM Trawlers Cedar and Grampian were detailed for Tombola duties and HMTugs Marauder, Bustler, Danube V and VI and

Schelde were made available for towing Conundrums as required. HMS Campanula was command ship for the Senior Naval Officer Force Pluto who now comes into the picture.

Captain J.F.Hutchings DSO OBE was a retired submariner and known to his intimates as 'Mad Hutch'. He was serving in MWD when Force Pluto came into being and since he had a reputation for dealing with innovations he was promptly appointed in command of the somewhat problematical operation. To say he entered into the task with enthusiasm would be an understatement. Force Pluto could not have had a more dedicated, energetic leader. Indeed, he became almost obsessed with the idea that in Operation Pluto lay the key to the success of Overlord.

Manning presented many problems. Pluto was a comparatively late starter and it had already become difficult to find men for the many additional tasks arising from Neptune. In fact a number of warships were taken out of service in order to provide parties for special invasion duties. Force Pluto was largely manned by merchant seamen on what was known as T124X or cable ship agreements. Few of the officers had previously been engaged in cable laying and Treby Heale was the only one fully experienced. He became the guide and mentor of the fleet. Lieut. Commander Lee, who became adept at handling the rather unwieldy Persephone, was promoted to commander and made captain of Sancroft. He proved to be a fine seaman and made some of the most successful lays according to Treby Heale.

The shore terminals, code-named Dumbo at Dungeness and Bambi at Sandown in the Isle of Wight, were manned by men of the Royal Engineers and Royal Army Service Corps. Storage tanks and pump rooms were cunningly camouflaged, the latter in war damaged buildings. Petrol was fed from the strategic land

pipelines which connected the Mersey and Avonmouth to the south and east. Persephone laid pipelines across the Solent to carry petrol to the terminals at Sandown and Shanklin.

Captain Hutchings' main preoccupation was to get training started as soon as possible, although he had other problems. Tombola training was done in Christchurch bay with the Royal Engineers carrying out their job of assembling the pipe and generally dealing with the situation on shore. Things did not always go according to plan, the trawler hauling out more than the pipe on one occasion and the perversity of inanimate objects well to the fore at awkward moments. In general the system worked well on the flat sandy beaches.

Latimer was loaded with seventy-two miles of Hais cable and an additional five miles for training purposes - all that could be spared. With Commander Lee and the crew of Sancroft also on board she proceeded to the Clyde where Treby Heale put all hands through a short but very comprehensive course covering all the cable work they were likely to have to do. The five miles of Hais was laid over the bow sheaves, recovered and relaid over the stern rollers; coiled in a tank and then used to demonstrate the method of changing from one tank to the other while laying. Treby Heale expressed himself as highly satisfied with the way his pupils picked up the essential techniques. In May 1944 he said the whole of Force Pluto was ready for action. Perhaps not a moment too soon.

Work on the Tilbury Hamel complex had gone ahead and in August 1943 the first of the Conuns as they were usually called was ready for trials and a length of Hamel pipe was laid in the Thames. A further trial in January 1944 with the Conun carrying the normal mileage of pipe produced a setback. The tug Marauder with the Conun in tow could do no more than stem a 3½ knot tide at full speed. It was found that this was due to the wash of the tug impinging on the Conun and as a result

it was decided to use two powerful tugs towing ahead and spread so as to keep their wash clear.

All through the training period Hutchings was everywhere, advising, ordering, cajoling. Even stripping to his pale blue underpants to go over the side and clear the propeller of the launch he was using. And, it must be admitted, occasionally throwing a fit of temperament. His two secretaries, Miss Knight, a civil servant, and 2nd Officer WRNS Attlee worked long hours and endured many a crisis. Miss Attlee with a notebook and typewriter at the ready both ashore and afloat.

So D-Day came and went with the weather unsettled and unsettling for those responsible for setting in motion the biggest seaborne invasion in history. Amongst the worries must have been the thought of what a rough Channel crossing would do to the morale of the thousands of men who had to face the fire of a determined enemy in the morning. It is difficult to be brave and seasick. No doubt many had to stiffen the sinews that day.

Captain Hutchings, and probably most of his men, waited eagerly for their turn to show what they could do. The first Pluto task was the provision of the Tombola lines at Port-en-Bessin a small fishing harbour near the border of the British and American sectors. Tombola was planned for D+10 and as soon as Hutchings was informed that Port-en-Bassin was cleared of mines and obstructions he led his Pluto party into action. The Royal Engineers had made a smart job of clearing the harbour and they ~~also~~ erected storage tankage to hold 15,000 tons of petrol. It was also their task to assemble the pipeline to be hauled out to the tanker moorings.

Tombola was not an unqualified success as conditions were somewhat different from Bournemouth or Christchurch bay with

rocky outcrops and an uneven beach. There were delays due to pipes fracturing but soon a tanker was secured on the mooring and also coastal tankers were entering the little harbour when the tide served.

These small vessels were known as the Hamble Circus and their crews, British, Canadian and American merchant seamen volunteers, entered into the spirit of their dangerous task. They ran a sweepstake on the fastest turn-round - Hamble-Port-en-Bessin-Hamble for which the prize money was said to amount to £270. The general enthusiasm led to a certain amount of bumping and boring with the result that at one time a third of the fleet was undergoing repairs in the Hamble river. Tombola lines were also laid for the American forces at St. Honorine in their sector.

The storm which occurred on D13 wrought havoc on the beaches and a large number of craft were damaged or completely wrecked. The Force Pluto vessels took shelter in Port-en-Bessin and escaped serious damage but the Mulberry harbour in the American sector was wrecked and the British one damaged. The weather was showing it could do what the enemy had failed to do - bring the landing of troops and material to a halt.

Bambi, the Cherbourg-Isle of Wight operation, was planned to commence as soon as the port of Cherbourg was captured and cleared of obstructions. The capture was expected to take place about D8 but in fact it was D63 before the port was reported clear. All this time Port-en-Bessin was providing the only bulk supply of fuel reaching the British and American armies. 200,000 tons of petrol were landed at Port-en-Bessin of which the bulk must have come from the tankers berthing in the harbour. Certainly the name Port-en-Bessin deserves to be remembered.

To Captain Hutchings Tombola was probably no more than a

than a curtain-raiser. He was eager to see his cable ships and Conundrums go into action but there were indications that some other people were not. The Allied forces broke out of the Normandy bridgeheads at the end of July and Cherbourg harbour was reported clear of mines and obstructions early in August. Pluto was given the go ahead. But in September the first ocean-going tanker from America docked in Cherbourg and the Channel was opened for tanker traffic.

The Americans wanted the Overlord supplies of fuel to be shipped direct to the continent as far as possible. Stocks in Britain were low and it ~~is possible~~ may be the suggestion had been made that Britain might seek to improve her stocks with supplies intended for Overlord. Admiral Ramsey was said to have described Pluto as one of his biggest headaches and thought he could make better use of the 100 officers and 1,000 men.

But Hutchings had been told to proceed and on 12 August with all thoughts of grouse shooting out of his mind Treby Heale commenced the first operational lay in Latimer. The shore lines were run from Naqueville bay, just to the west of the harbour, and starting from here Latimer proceeded with what Treby Heale described as half the British Navy and numerous aircraft of the RAF as escort. In fact the enemy completely ignored the ~~whole~~ proceedings as they did throughout the whole of Operation Pluto.

Latimer went ahead at a steady four knots, paying out the cable over the bow sheaves as in normal cable ship practice. The successful lay in the Bristol channel was made over the stern rollers of Holdfast giving an entirely different lead to the cable. Why the change was made is not recorded but it seems that all subsequent lays were made over stern rollers. It is possible that this may have had some bearing on the failure of the first cable laid although defects in the couplings were found and remedied later.

With HMS Brinmaric acting as navigator along the two miles wide specially swept channel the lay proceeded smoothly. Revolutions of the cable drum and dynamometer readings were taken at frequent intervals and remained remarkably constant. The lay started at 0345 and at 1200 speed was reduced on changing from one cable tank to the other. At 1900 Latimer was fast to her buoy in Sandown bay. The first operational lay of 3 inch Hais cable had taken fifteen hours and had been carried out without a hitch. All those involved were highly delighted - but not for long. One of the escorts, HMS Mimico, signalled that her anchor was foul of an obstruction, probably the cable just laid. This proved to be the case. Captain Hutchings' remarks were not recorded and although repairs were made the line leaked badly and had to be abandoned.

Commander Lee in Sancroft commenced the second lay on 14 August with a very reduced escort and had a trouble free run right through to Sandown bay. But again the gremlins were busy and Algerian, assisting with the shore end connection, got a rope round her propeller and it was some time before the link-up was made. Leaks in the line were suspected and a coloured dye was pumped through the line to try and locate the position of the leaks. It was not until 22 September that pumping of p petrol was started after a further water test.

Meanwhile the first of the Conundrums had arrived from Southampton where it and its five fellows had been lying at moorings for some months. When positioned off the shore for the start of the first Hamel lay some difficulty was experienced in hauling the pipe ashore off the drum. This duty was performed by a steam ploughing engine which the Americans greeted as the British secret weapon. It was found that the Conun had accumulated a massive growth of weed and barnacles during its stay in Southampton water and it took a good deal of effort to remove this.

When the Conun eventually slipped from the buoys in Nacque-
ville bay on 14 September HM Tugs Marauder and Bustler were towing with Danube V trailing. At first the steel pipe paid out smoothly from the revolving drum and looking not unlike the Hais cable disappearing into the depths. Geoffrey Lloyd and H.A. Hammick accompanied Hutchings in Campanula. Some of the more superstitious members of Force Pluto may have thought this was asking for trouble.

For about an hour all went well and then there was a loud crack and the drum stopped revolving. The pipe had broken.*

The feelings of Mr Hammick must have been akin to those of a father at an accident to a favourite child. Mr Geoffrey Lloyd can hardly have been less concerned and Captain Hutchings, after the frustratmations of the previous weeks must have felt it a body blow.

There was still plenty of pipe on the drum so it was towed back to the shore and a second start made. This time the Conun took a sheer and was lying at an angle of about 40 degrees to the course. This caused the pipe to come off across one of the flanges. Not surprisingly it did not put up with this treatment for long and about thirty miles from Cherbourg it parted. This time there was no second chance and Hamel 1 lay had ended in failure. The suggested cause of the sheer taken by the Conun was not specifically stated but it may have been due to tidal conditions in view of the late start.

On 29 September the second Hamel line was laid, this time towed by HM Tugs Marauder and Growler and Danube V again trailing. The release of the powerful tugs used for towing was not at all popular as they were in very short supply and needed for salvage and other urgent work. The trailing tug was used for

* The fracture was found to be due to a faulty weld. The only one discovered out of nearly 200,000 welds.

steering and as a brake if necessary.

In spite of the fact that the weather was not good the lay went ahead smoothly and the connection in Sandown bay made without undue difficulty. The line was tested by pumping water through to the far shore followed by petrol with the centrifugal pumps working at 750psi pressure which only produced about 100 tons a day on the other side. With the second Hais line also pumping petrol it was felt that in view of the difficulties of such a long lay after so little experience a fair measure of success had been achieved. Had it been necessary to lay more lines it is possible, even probable that a reasonable throughput would have resulted. As it was the supplies reaching Cherbourg from Bambi were considered negligible. In many of the immediate post-war articles and lectures on Pluto the events at Bambi were glossed over.

On 3 October it was decided to increase the pumping pressure to 1,000psi and for a time the flow increased steadily. Then in the middle of the night the pressure on the Hais line dropped to nothing and shortly afterwards the Hamel line failed ~~also~~. The feelings of those closely involved must have been close to zero also. Indeed, had it not been for the confidence of Geoffrey Lloyd, Sir Donald Banks, Captain Hutchings and the inventors of the Hais and Hamel systems it is likely that Operation Pluto would have ended then and there.

In fact tankers had been discharging their cargoes in Cherbourg harbour since early September and during the month the whole of the Channel coastline fell into Allied hands. Le Havre was captured with its oil tankage practically intact. Land lines to supply bulk petrol to the forces were being laid close behind the advancing troops and Cherbourg was now in the rear. There was a strong lobby to dispense with Pluto but with an American request for the release of tankers for the Pacific and some support from General Eisenhower Hutchings received orders

to commence operations immediately at Dumbo. Bambi was shut d down but a large proportion of the Hais and Hamel lines were subsequently recovered providing some useful salvage.

On 10 October Commander Lee in Sancroft laid the first Hais line from Dungeness to Boulogne at a speed of nearly five knots. Captain Eagle RNR, a very experienced oil man, was in charge of the cable barges and the joining-up operations on the far shore; a responsibility which undoubtedly gave him a number of grey hairs. It would be not unreasonable to say that this part of Pluto was never solved really satisfactorily.

Lee followed up with a second lay on 13 October and a third on 24 October so presumably Sancroft had her full load of 100 miles of Hais cable on board at the start. The weather was reported as being poor with fresh to strong westerly winds, a rough sea and a strong northerly set. Navigation was by the radio beam known as Gee or QH but it was said to be unreliable at times in the Dover strait. Laying the Hais cable now seemed to be straightforward and reliable. Joining up the shore ends was not and petrol was not pumped through the first Hais line until 24 October.

When pumping commenced the land lines from Boulogne were not ready to receive it and for some time rail tank cars were filled in Boulogne stations. This led to some hair-raising emergencies when a fire occurred under one of the tank cars. On another occasion the French driver of the train moved off while tanks were still being filled. Ammunition was being loaded into a train on the adjacent track. The first Hais line delivered up to 450 tons of petrol a day (135,000 gallons).

The demarkation line between the navy and the army has been variously stated as high water mark and low water mark. In practice the Royal Engineers apparently accepted any line that they could reach without diving apparatus and on one occasion

joined up to the land line in three feet of water.

With three Hais lines across the Channel it was decided to give the Hamel method its chance. The steel pipes were only reckoned to have a life of about three weeks owing to the wear caused by panting due to pumping pressure and movement on the sea bed. In practice they exceeded this and averaged about eight weeks.

On 11 November HM Tug Marauder (Lt.Cmdr. Jennings) left Tilbury towing Conun VI with Schelde (Capt. Vlielander) as astern tug. The tow arrived off Dungeness next day and the Conun secured to the ahead buoy; that is positioned for the pipe to be hauled ashore off the drum. In attempting to swing the Conun into position the tug Danube VI had a line fast to Schelde -which was still attached to the Conun - and started to tow them both round. This was against wind and tide and u under the strain a forty ton shackle parted. Then a wire parted and Danube VI picked up the buoy mooring in her screw. All this on a lee shore.

Having sorted out this rather untidy situation the Conun was manoeuvred into position. Then the wire of the astern tug parted and the drum swung away winding the bridles round itself and generally fouling up everything within sight. To detail all the trials and tribulations of the Hamel party would fill a number of pages. When at last the tangles were unravelled once more a gale warning caused the whole operation to be called off. The bad weather did not materialise.

On 17 November when all was ready once more a full gale did materialise. Wires parted in all directions and soon the Conundrum had broken free and was sailing along merrily, uncoiling the Hamel pipe in interesting patterns on the sea bed. Its weary attendants were afraid it would proceed out into the C

Channel a menace to all and sundry. There appeared to be no possibility of attaching a tow line to the wayward Conun but there came a heaven-sent shift of wind and it drove quietly ashore at Littlestone. There it remained for a long time, a dark and brooding monster, surrounded by the tangled tentacles of steel pipe.

Meanwhile further Hais lines were being laid, ending with varying success at Boulogne where most of thrshortcomings were sorted out eventually by the indefatigable crews of the cable barges and the ever co-operative Royal Engineers and Royal Army Service Corps. After the successful efforts of Sancroft, Latimer and Algerian (Cmdr. Kennard) laid two 2 inch and one 3 inch Hais lines in November. Latimer also laid two 3 inch lines in December when bad weather brought operations to a close for 1944.

A second attempt to lay a Hamel line was made in December but a succession of gales and the difficulties of controllingf the huge, unwieldy drums off a lee shore put an end to all efforts for the time being. Pumping of petrol was proceeding steadily and Hutchings pointed out that with only three Hais lines in action 21st Army Group had asked for a reduction in supplies. By the end of December Pluto lines were delivering an average of 1,300 tons a day.

But by now tankers were unloading in Le Havre, Ostend and Antwerp as well as Cherbourg from which latter port the American pipelines ran to the south-east then to the north-east, south of Paris and through Luxembourg to the Rhine. The British pipeline ran from Boulogne though Ghent and to the Rhine at Emmerich. Petrol was flowing to the armies in vast quantities with a certain amount being skilfully milked from the landlines by enterprising black market operators. British troops withdrawn from the battle line and engaged in some mortar exercises scored a direct hit on one of the fuel lines

sending up a fountain of ~~fuel~~ petrol. The lines were constantly patrolled and a mobile repair team was soon on the spot to deal with the damage.

In order to facilitate the joining up of the shore ends of the Hamel line it was decided to attach a length of the more flexible Hais cable at each end. This proved to be a big improvement. On 17 January a third attempt to lay a Hamel line was made with Marauder towing and Schelde trailing. Only one tug ahead was used for the shorter Boulogne lays. Danube VI was in attendance and as the tow was behind schedule later went ahead to assist Marauder. There were no other snags and Lt.Cmdr. Jennings in Marauder took his tow right into Boulogne harbour and berthed the Conun alongside where the pipe was cut and the shore connection made in record time. Captain Hutchings stressed the fact that the length of Hais at the Dungeness end made it possible for the Conun to swing freely at the buoys, even when awaiting suitable weather.

The fact that Force Pluto was not subjected to enemy attack has been mentioned. There were two near misses from casual enemy action. While Latimer was in the King George V dock in London a V2 rocket landed not far away but inflicted only superficial damage to the ship and there were no casualties. The tug Danube V exploded a mine when weighing anchor off Boulogne and an officer and two ratings were injured.

Latimer laid a 3 inch Hais line, no. nine in the series, on 8 January and Sancroft followed with no. ten on 22 January. This last was of American manufacture which cable had proved to be very susceptible to temperature changes, the jute coating tending to peel off and jam the leads. Cmdr. Lee had supervised a number of devices for heating the cable and these resulted in another satisfactory lay. The last Hais line was laid by Sancroft on 24 May - after VE day.

The fourth Dumbo Hamel line (the first two having been abortive) was laid on 7 March the Conundrum being towed by HM Tug Bustler (Lt. Cmdr. Sanders) with Schelde and Danube V assisting. Sanders also took his tow into the harbour and berthed it alongside. Both the third and fourth Hamel lines developed leaks which were attributed to panting and possible chafing on a reef off Boulogne. Lines were originally planned to come ashore at Ambleteuse, just east of the harbour, but the beach was so heavily mined it was decided to use Boulogne itself.

Hamel five experienced some tide trouble with the Conun taking a sheer so that the pipe came off over the flange. On this occasion no apparent damage was caused and all went well until a convoy of fifteen ships appeared and crossed the line of the lay. This made it necessary for Bustler to alter course and reduce speed. The bridle for the trailing tug was picked up by the revolving drum and one wire parted. Even so the tow arrived safely. The Conun was towed back to Dungeness for repairs to the after bridle and on arrival a full gale sprang up. The Conun got out of control and Bustler got the towing bridle round her propeller. Eventually all was got under control. Captain Hutchings' reports were remarkably restrained.

Hamel six got off to a bad start as the wire to the anchor holding the end of the pipe parted. This meant that the pipe was not hauled off the drum but just dragged along the sea bed. This left a gap at the Dungeness end although by proceeding slowly a certain amount of pipe was paid out. At this point the 4th.Sea Lord arrived to watch the operation. His comments are not available but as by now there was enough pipe on the bottom for the lay to proceed he may have been impressed. The gap at the Dungeness end was later bridged and the line was said to be 100% effective. Hamel seven was laid in perfect weather conditions and everything went well for once. This too

had a little convoy difficulty but was completed at an average speed of 4½ knots with Bustler towing. Hamel eight was also successful, aided now doubt by light winds and a calm sea. There was a little difficulty in locating the end of the pipe but the line was reported to be working correctly by 8 May. This was the last Hamel line laid and events had proved that given the right conditions the system was perfectly practicable. Indeed, had a more suitable starting point than Dungeness been available some of the major difficulties and restrictions would have been avoided.

On 1 June 1945, 24 days after the official end of hostilities in Europe, the Pluto weekly report stated that of the seventeen lines laid at Dumbo eleven were functioning at full efficiency and 21,000 tons of fuel had been pumped across the Channel the previous week. Of the lines not working, two were Hais and three Hamel. The sixth line was the last Hais laid which was subsequently brought into use. With its record of having reached a million gallons of petrol a day the rather scratch Pluto team and its dedicated leader really had no reason to reproach themselves.

Pluto cannot in fairness be said to have failed; the fact was that in the event it was not necessary. The complete mastery of the air over the Channel and the Channel ports allowed tankers to go about their business virtually unmolested. Much the same thing happened to other pre-invasion schemes. No doubt it was better that way.