Operation Pluto

Chapter Five : Pluto ships and craft

(From details supplied by M.K.Purvis R.C.N.C.)

Naturally all the early Pluto efforts were directed towards producing a pipeline which could be laid across the channel reasonably quickly and with a fair degree of certainty. Concurrent with these efforts it was necessary to ensure as far as possible that ships or craft would be available and able to carry out the laying operation. Once again, the fact that this would be subject to wind, weather and our extremely brave and clever adversary, meant that there could be no un-necessary chances taken. Technical achievement of a high standard was required with development of new and ingenious techniques in handling the equipment. This again was clearly going to involve intensive training. With barely two years from the idea to the operation it left little room for doubts and indecision.

Here it must be made clear that the ideas for the types of craft required had already been formulated by members of the Petroleum Warfare Department, A.C.Hartley, B.J.Ellis and H.A.Hammick, before the Director of Naval Construction was approached. Even so a great deal of development work was necessary to put these ideas into practice.

For the Hais cable it was necessary to provide ships of much greater carrying capacity than any of the existing cable ships and also to equip them with cable handling machinery able to deal with the massive and extremely heavy 3" Hais. For this equipment the Petroleum Warfare

Department turned to Johnson and Phillips, a firm which had been making cable-laying equipment for over sixty-five years and for use all over the world. The Post Office Alexander Bell, provided a complete set of Johnson and Phillips cable picking-up and paying-out gear, which had just been completed for them, and gave valuable technical information which materially assisted the designing of the Pluto gear. Details of the ships themselves and the many auxiliary craft necessary for handling the shore ends of the cables and for the Tombola operation will be set out later, but the far more unusual requirements of the Hamel 3" (76 mm.) mild steel pipe must first be described.

M.K. Purvis, a naval constructer on the staff of the Director of Naval Construction, was principally responsible for the design of the strange craft, if that is a suitable term for them, which were to carry the ninety miles of Hamel pipe required to complete the lay between Cherbourg and Sandown bay in the Isle of Wight. Since nothing of the sort had ever been produced before, there was little to go on except basic technical facts and Ken Purvis must have had unbounded confidence and enthusiasm in order to complete his task successfully. From his own notes it is possible to give some interesting details of the work involved.

The Hamel pipe used for the initial trials had a 2" (50 mm.) ID and $2\frac{3}{8}$" (59 mm.) OD. It was 0.212" (5 mm.) thick and weighed 13.3 tons per nautical mile. The 3" Hamel pipe had a $3\frac{1}{2}$" (89 mm.) OD, was 0.212" (5 mm.) thick and weighed 20.23 tons per nautical mile.

Experimental work with H.M.S. 'Persephone', the converted hopper barge, had made it clear that the Hamel pipe could not be handled and laid successfully from a ship as could the Hais cable. It will be remembered that B.J.Ellis, one of the Hamel inventors, had suggested the large cotton reel idea and experiments proved that this was feasible, incredible as the whole thing appeared.

The requirement as put to the Director of Naval Construction was for a drum without its own motive power capable of being wound with ninety miles of 3" flexible steel pipe. It was to float with its axis horizontal and be capable of being towed in a direction perpendicular to its axis with the object of laying the pipeline on the bed of the sea.

Originally the length of pipeline to be carried was forty miles of the 3" ID but this was later increased to ninety nautical miles. In fact this considerable modification only entailed increasing the depths of the flanges on the ends of the drum to accommodate more turns. This additional load was possible because in the original design sufficient permanent water ballast was provided to ensure a reasonable draught. For the increased length of pipe with its much greater tonnage, this permanent ballast was dispensed with and arrangements made for ballasting during laying as the draught decreased.

The reasons for the use of a cylindrical main body with conical ends and separate flanges were (apart from the fact that a cylinder was the only shape suitable for coiling and carrying the pipe):

(1) In order to obtain longitudinal towing stability.

(2) To provide simple towing attachments for the bridles.

(3) To limit the heel of the drum if damaged.

(4) To simplify construction.

The size of the drum was controlled by the minimum diameter on which the 3" pipe could be coiled and this was determined as being 30 feet. The length of the drum between the flanges was fixed at 1½ times the diameter as this ensured reasonable stability, even if damaged, providing there was sufficient reserve buoyancy.

The method of laying the pipe from the drum was decided as a result of tests carried out with models at the National Physical Laboratory. These proved that there was less resistance and the least strain on the pipe if it were under-run; that is, if it came off the bottom of the drum rather than the top.

A laying speed of five knots was aimed at and it was anticipated that this would be achieved by towing with one tug of the Brigand or Bustler classes of 3,000 IHP and 3,200 BHP respectively. Towing was done by means of a bridle attached to the towing bearings at the end of the drums.

Ballasting. It was considered that 12 ft. draught above the bottom of the main cylinder was the minimum at which the drum would be manageable in a seaway and it was necessary to admit sea-water ballast to achieve this. In order that the draught could be adjusted to allow for the change in load as laying proceeded, the astern tug was able to pump water into the drum through the journal of the towing bearings.

In the first Conundrum a water brake was fitted to prevent the cable over-running and unwinding from the drum due to its own weight. In practice this proved to be unnecessary and the device was omitted from the remaining drums.

Other experiments were made to determine the tension on the pipe due to hydrodynamic forces when laying. The results showed that in still water and at a laying speed of five knots the tension was about 1½ tons. A three knot tide with the tow increased the tension by 100 to 200%, whereas a three knot tide against the tow decreased the tension by about 75%. The maximum tension allowable during laying was 16 tons.

The work of constructing the Conundrums was given to Orthostyle Ltd. of Scunthorpe in Lincolnshire, but the actual building was carried out at Tilbury and the Conundrums were launched here.

The first trial of laying the steel pipe from a Conundrum was carried out in the River Thames in August 1943. The towing was done by H.M. Tug Marauder and the pipe laid in a depth of six or seven fathoms. The extreme draught was 16 ft. (4.9m) to the bottom of the flanges, 10 ft. 3 ins (3.1m) to the bottom of the drum itself. A laying speed of 7½ knots was reached without difficulty. The main requirement of this trial was to prove that the pipe could be laid by this method.

A further trial was carried out in January 1944 when pipeline and winding facilities permitted the loading of a full mileage on H.M.S. 'Conun I' (as the first Conundrum was called. H.M.T. Marauder was the towing vessel again.

The tide in the Thames off Tilbury was estimated to be ebbing at 3 to 3½ knots and the Hamel project at once received a decided set-back as Marauder was only just able to stem the tide with the Conun in tow.

The immediate solution appeared to be to increase the towing power, but experiments with the model were also put in hand at Haslar to obtain the effect of the wash from the tug's propeller impingeing on the drum and any increase in this effect due to shallow water. The earliest date at which another powerful tug could be made available and on which there was a suitable tide on which to move Conun I to Southend was 8 February 1944 and it will be realised that, in view of the probable date of what became known as operation 'Overlord', time was beginning to run out. For the movement and trial the tugs used were Marauder once more, commanded by Lt. Cdr. Jennings and H.M. Tug Bustler commanded by Lt. Cdr. Sanders who later became a Trinity House pilot and eventually Superintendent of Pilots of Harwich.

The trials were of necessity of an improvised nature owing to the restrictions imposed by the River Thames and the fact that it was imperative to get the Conun to Southend and moor it safely. The results showed that the towing speed attained by the use of the two powerful tugs was 1¾ knots less than the calculated speed which meant that the resistance was 100% more than that calculated. It was clear therefore that the effect of the wash from the screws of the towing vessels was largely responsible for the reduction in the speed obtained from that calculated.

A further trial was arranged in which the ahead tugs, towing from the same point of the towing bridle, separated sufficiently to prevent the wash from their screws impingeing on the drum. The result was highly satisfactory, a towing speed of six knots being obtained. As a result, Conun I was towed to Southampton on 15 and 16 March 1944.

In view of the close proximity of D-day, laying trials were confined to one lay of 12 nautical miles of 3" Hamel laid in a complete circle to enable pumping trials to be carried out and to determine pipe friction effects in addition. These trials showed that the braking compartment was not necessary.

H.M.S. **'Persephone'**: When the suggestion was made that the mild steel pipe could be handled in much the same way as Hais cable, the problem of a suitable vessel for trials became acute. Time obviously did not permit the designing and building of a special vessel and modification of an existing one presented great difficulties. B.J. Ellis was responsible for the brilliant suggestion that a hopper barge should be used with a large drum mounted vertically in the hold. A hopper barge is used for carrying spoil out to sea for dumping and may be self-propelled. The main feature of these craft is the hold for carrying spoil which is fitted with doors in the bottom which can be opened to dump the contents. Hopper barge W.24 was self-propelled with steam engines and oil fired boilers. She was 200 ft(61 m.) long and the hopper opening was 75 ft. (22.9 m.) long by 20 ft. 6 ins (6.2 m.) wide. Her displacement was 725 tons with the hopper open to the sea and 2000 tons loaded with 1,200 tons of spoil.

The conversion was carried out in Portsmouth Dockyard. This involved fitting a large drum supported in Timken tapered roller bearings to carry 43 miles of 2" Hamel pipeline which weighed 500 tons. The drum had an outside diameter of 48 ft. (14.6 m.) over the flanges, the barrel being 35 ft. (10.7 m.) in diameter and 15 ft. (4.6 m.) long. The lower edge of the flanges projected 5 ft. (1.5 m.) below the level of the keel of the vessel. The weight of the drum and bearings was approximately 155 tons. It was designed and constructed by Head, Wrightson & Co. of Thornaby on Tees.

To complete the conversion a new mainmast, four Oerlikon guns, standard and gyro compasses, a protected wheelhouse, W/T office, taut wire measuring gear, messing and sleeping quarters and additional boats were fitted. The vessel's stability and seaworthiness were subject to weather conditions not exceeding wind force 4 or sea scale 3.

Cable ships and barges for Hais cable:: The 2 in (51mm) Hais cable first developed had an external diameter of 3½ ins. (89mm) and filled with water weighed 44 tons per nautical mile. The 3 in (76mm) Hais had an external diameter of 4½ ins (114 mm.) and filled with water weighed 65 tons per nautical mile. Because of the large diameter of the Hais cables and the absence of a solid core, it was essential that they should not be coiled to a radius of less than 5 ft. (1.5 m.). This meant modifying existing cable handling machinery and substituting a roller assembly for the normal bow sheaves fitted to cable ships. All the Hais cable laying equipment was made by Johnson & Phillips Ltd. of Charlton under Admiralty supervision. The Engineer-in-Chief of the Post Office acted as technical adviser to the Director of Naval

Construction on all matters concerning cable machinery and rendered most valuable service.

There were no unique features in the ships converted to lay the Hais cable, but available vessels were few because of the heavy demands on the merchant service. So the ships allotted for the purpose were not ideal, particularly in view of the fact that they were all single screw.

The first conversion was a coaster named London, subsequently re-named H.M.S. Holdfast. This vessel was taken in hand in July 1942, completing in October. She was designed to lay cable over the stern and recover cable over the bow for repairs. She could carry 30 statute miles of 2" Hais cable in two tanks each 30 ft. (9.1m.) in diameter.

For laying the 3" Hais cable two ships, the Empire Ridley and the Empire Baffin, 10,000 ton cargo vessels, were taken over and modified to carry 100 nautical miles of 3" cable weighing 6,500 tons. This in fact made them the largest cable laying ships in the world. They were re-named H.M.S. Latimer and H.M.S. Sancroft* respectively.

Owing to the great weight of cable which would have to be laid in one operation, special water ballast arrangements were made to adjust trim during laying. The cable was carried in two tanks of 50 ft. (15.2m.) diameter in each vessel and it could be laid over either

*It was originally intended that the two ships should be Latimer and Ridley after the martyred bishops, but the Admiralty would not permit this because of possible confusion with the destroyer Ripley. Sancroft, another bishop, was chosen instead.

the bow or stern, for which the ships were provided with two sets of cable handling machinery. It was also found necessary to fit 500 tons of permanent ballast as far aft as practicable. An extension to the rudder was fitted in each ship to improve manoeuvrability. Armament provisions consisted of ten Oerlikon mountings and two 12-pounder mountings.

An additional vessel, S.S. Algerian was modified to carry 30 miles of 3" Hais cable and arrangements were similar to those of the other two vessels.

For dealing with the shore end of the cable after laying, five Thames motor barges were converted to carry 2½ miles of 3" Hais cable. The barges were 90 ft. (27.4m.) overall with a beam of 23 ft. (7.0m.) and had 100 H.P. engines. They became H.M. Cable Barges Britannic, Oceanic, Runic, Gold Bell and Gold Drift.

In addition to the usual attendant craft, a number of auxiliary craft were converted for special duties. Two barges were fitted with winches to rotate Conundrums when moored and four tenders were fitted out with accommodation for crews and parties engaged in handling the Conundrums.

It will be seen that at a critical period of the war during the vital months prior to the biggest amphibious assault ever planned, the severely limited resources of war-time Britain were expanded to cope with an entirely new technical problem which made considerable demands on both personnel and production facilities.

As described, it may appear that the major difficulties encountered were those normally associated with the design and construction of unusual types of ships and craft with new and complicated equipment. But it must be remembered that this was in war time with strictly limited supplies and more, with enemy air attack liable to occur at any moment. Bombs fell on and near manufacturing sites occasioning unavoidable delays. The Tilbury site was, of course, in an extremely dangerous area of accessibility by the enemy.

That all the questions posed were answered adequately and all problems solved satisfactorily is without any doubt and, looking back, the brilliant efforts made, including those which ensured that all frustrating obstacles were overcome, do not seem to have received their mead of praise.

Perhaps it is still not too late to acknowledge the work of all those concerned in Operation Pluto

The one sour note ~~attending~~ in the reports on the construction and loading of craft ~~reports on Pluto~~ concerns the restrictive practices of the dockers and welders employed on various aspects of Pluto. It would be interesting to know whether the naval personnel working alongside them ever expressed an opinion of this attitude on the part of their civilian colleagues.