HAIS & HAMEL in caps. thro' out.

Operation Pluto

Chapter Three : The steel pipe conundrum

Two very experienced oil men, B.J.Ellis, Chief Engineer of the Burmah Oil Company, and H.A.Hammick, Chief Engineer of the Iraq Petroleum Company, had been seconded by their companies to the Petroleum Department of the Ministry of Fuel and Power. They had both witnessed many of the trials and experiments with the Hais cable and had remarked on the rigidity of short lengths compared with the fact that long lengths could be coiled like any other cable. This led to the idea that possibly an ordinary steel pipe would behave similarly, as they had seen how flexible long lengths of pipe could be when handling them in the oil fields.

With the assistance of Stewarts and Lloyds of Corby, Northamptonshire, together with J.& E. Hall of Dartford, Kent and A-1 Electric Welding Machines Ltd. of London and Inverness, trials were carried out with a 2 in internal diameter steel pipe. These proved that the pipe could be wound in coils of 30 feet (9.1m) in diameter and when uncoiled was relatively straight and free from kinks. A film was made of the experiments and of the whole process of production and in it the coiling trials are shown. A large horizontal wheel is rotated by a wire pulled by a steam locomotive moving along a track with the apparently rigid steel pipe being coiled round the perimeter of the wheel quite easily. The pipe itself was then attached to the locomotive which pulled it off the wheel just as easily and with little sign of distortion or bending. The rather Heath Robinson and no doubt hastily contrived device had proved conclusively that it was possible to coil and uncoil the steel pipe almost as easily as the Hais cable. There were of course other characteristics in which the two systems differed considerably. No documents so much as hinting at the cost of the respective pipelines has been sighted but there is little doubt that The Hamel system - so named after the inventors, HAMmick and ELlis - to produce.

So far so good, but there were still plenty of problems to solve. The steel pipe was not sufficiently flexible to be coiled in the hold of a cable ship like the Hais cable and the only possibility seemed to be to wind it on to a large drum. As with the Hais cable a full scale trial was necessary but it was not considered that this need be over a distance of as much as thirty miles.

At the suggestion of B.J.Ellis, a hopper barge of the type used to dump spoil at sea through doors in the vessel'S bottom, was converted to carry a huge drum. The doors in the bottom were removed and the drum, which had a barrel of 35ft (10.6m) and a length of 15ft (4.6m) was fitted in the hold, the lower edge of the flanges of the drum projecting five feet (1.5m) below the keel. Carried on specially designed Timken tapered roller bearings the drum and bearings weighed 155 tons and was designed and constructed by Head, Wrightson & Co. Ltd. of Thornaby-on-Tees. Originally Hopper Barge W24 she was later re-~~Christened~~ HMS Persephone but known affectionately to the sailors as HMS Pregnant for quite obvious reasons.

Some miles of 2in ID steel pipe were welded by hand in Portsmouth dockyard and wound onto the drum of Persephone. The first full scale trial of the Hamel system was carried out in the Solent and the pipe laid from Stone point on the Hampshire shore to Gurnard in the Isle of Wight in ~~June~~ 1943. The laying operation appeared to be remarkably simple and was quite successful but there were difficulties in cutting the pipe at the end of the run and in joining the end to the shore installation. This latter problem was to dog Force Pluto throughout its activities and bring the whole enterprise close to failure. However, at this early stage the main thing was that the apparently rigid steel pipe could be laid on the sea bed without obvious difficulty. Joining up the shore ends needed some more thought and experiment but was surely capable of solution. Persephone was commanded by Lt. Cmdr. J.A. Lee RNR, an extremely competent and versatile officer who became one of the key members of the Pluto team.

At the same time it was realised that Persephone or similar craft were not going to be capable of carrying sufficient pipe for the cross channel operation and once again B.J.Ellis came up with a suggestion which must have raised some eyebrows to uncomfortable heights - especially those of the bushy type reputed to go with high rank. When Persephone was having the pipe reeled on her drum at Portsmouth dockyard the expressions of extreme disbelief uttered by onlookers were many and forceful. This later proposal was calculated to stagger all concerned.

Mr Ellis suggested that since the pipe must be coiled on a drum and the drum would be too big to go in a ship, the drum must float on its own and be towed by a tug, uncoiling the pipe as it went along. He visualised huge floating drums like gigantic cotton reels, capable of carrying all the steel pipe for even the longest channel crossing. And by now it had been decided that 3in id pipe must be used so that the stowage space required for every mile would be much greater than for the original trial. Quite a large number of people viewed the Hais project as a crazy gamble but when they heard of the Hamel proposals it was certain that they considered that there were lunatics at large.

The people actively concerned with the supply of fuel to the biggest invasion force in history were far from being lunatics. From Admiral Mountbatten and Mr Geoffrey Lloyd downwards they were all experienced, hard-headed and extremely practical; and the oil men, at least, had learned their business in a very tough industry. Perhaps it was as well that it devolved upon Combined Operations to see the Hais and Hamel projects through to the point where their practicability and possibilities were not so easy to question as in the initial stages. The staff of COHQ were quite used to dealing daily with a stream of ideas for all sorts of incredible weapons and warlike equipment, some brilliant, some bizarre, but all had to be evaluated. Many became of the utmost value to the forces. Some good ideas may have failed to pass the filter. Pluto was one of COHQ's major projects.

Tests made by the National Physical Laboratory proved that the floating drum - now given the code name 'Conundrum' - was a practical proposition. As a result it was decided to proceed with the Hamel project and in common with the other requirements for special ships and craft for Pluto the matter now passed to the Director of Naval Construction. Here it fell to the lot of naval constructor, M.K.Purvis, who was also responsible for most of the Pluto fleet designs and modifications. His paper on the subject, which was read to a meeting of the Institute of Naval Architects on 11 April 1946 gives comprehensive details. It is clear that as so much of the work involved unexplored territory most of the problems needed not only a technical mastery of naval architecture but a lively imagination as well. Ken Purvis provided both.

One of the outstanding characteristics of the development of Pluto was the almost fanatical faith in the idea which was held by those closely involved in it. This belief in the eventual success of the scheme was not held universally and in some cases high ranking officers were said to have used extremely uncomplimentary remarks about the whole idea, coupled with the names of its leading protagonists. To this day there are divided opinions as to the necessity for Pluto and the value of its contribution to the defeat of Germany. At a most critical time, Pluto undoubtedly made enormous demands on manpower and material. Indeed, it might well be said that the ability of Britain to devise, produce and carry out such a demanding and complicated project as Operation Pluto, at such a time and in such circumstances, gave Pluto a shining niche in history that is all its own.

The construction of the gigantic Conundrums was placed in the hands of a firm named Orthostyle Ltd. of Scunthorpe in Lincolnshire who described themselves as 'Contractors for unusual work' and this particular job certainly gave them a chance to live up to their boast.

Each Conun - the 'drum' was usually dropped from the description - was 52ft (15.8m) in diameter to the extremity of the flanges and 90ft (27.4m) long overall. The portion of the drum on which the pipe was wound was 40ft (12.2m) in diameter and 60ft (18.3m) long. There were teeth on the edge of the flanges which allowed the drum to be rotated by means of a chain drive and thus wind the pipe on. 70 miles of 3in id steel pipe could be carried in this way making a total weight of 1,600 tons. As Mr Churchill might have said, 'Some bobbin'.

A great deal of thought had to be given to the towing arrangements, bearing in mind the fact that there would be no crew on board the Conundrum, nor was it likely that men could be put on board once the contraption was at sea.

The drums had hollow conical ends which protruded 15ft (4.6m) beyond the flanges and to the tips of these, hollow steel trunnions were attached. The trunnions were 10½in (279mm) in diameter and fitted with Timken roller bearings in cast steel housings. Each trunnion was provided with a pair of vertical pins 4in (101mm) in diameter to which the tow ropes were to be attached.

Not only was this an entirely new type of construction but the makers suffered the common disadvantages of such work in war time - limited space, limited time and a limited labour force. As a result, prefabrication of large sections weighing up to 15 tons was put in hand, using jigs in order to make the units interchangeable as far as possible. The drums were constructed on roller tracks in cradles conforming to their shape so that they could be rotated at will. This proved highly successful and the six Conuns were completed in nine months. Messrs. Orthostyle pointed out that the building of the drums on land was a continual problem as point loads of 150 tons had to be allowed for in a vessel which, out of its element, was little stronger than a conventional tin can.

In the construction some 11 acres of steel plate were used and 270 miles of electrodes for welding. The painted area amounted to over 20 acres. It is hardly surprising that these strange objects were received with wonder, admiration and occasionally disbelief wherever they were seen. The skipper of a tug towing a Conundrum, on receiving a signal saying 'What on earth is that?', replied hopefully, 'A new device for putting a head on war-time beer!'

At the same time the construction of the enormous length of 3in id steel pipe had been put in hand. The experimental work had been done partly at Stewart and Lloyds Coombs Woods plant and partly at Corby using pipes of 3in nominal bore, .212in thick. They came in lengths of 20 to 24 feet and 40 flash/ feet and were joined into a continuous length by/butt welding. Comprehensive tests were carried out by Stewarts and Lloyds, A-1 Electric Welding Machines Ltd., and the National Physical Laboratory, which established beyond doubt that a steel tube of required specification could be flash-butt welded and the weld subjected to bend, repeat bend and tensile tests giving equivalent properties to the parent metal. From these tests it was clear that automatic flash-butt welding gave the complete answer to the construction of the Hamel pipeline. This method of welding produced a ridge or extrusion on both the inside and the outside of the pipe at the join. The external ridge was removed by a Taylor cutting machine and the internal one by a special boring head and brush, followed by an air blast to expel the swarf.

For the major production in quantity, sites had been chosen at Tilbury dock with suitable waterside facilities. It would be interesting to know how this location came to be chosen. It was convenient for the final construction and launching of the Conundrums and there was ample room for the stacking, welding and winding on of the pipes. But it would seem to have been a place where works of the size involved could hardly have been missed by air reconnaissance and it was a very long tow for the unwieldy Conuns to either Dungeness or Southampton, most likely against head winds. No doubt other sites were considered but the advantages of Tilbury held to outweigh its disadvantages.

Two plants, designated A and B were constructed side by side with cross-over connections so that pipes could be switched from one plant to the other in case of damage by enemy action or other causes. Construction at Tilbury commenced with the A plant on 9 March 1943 and as by now the probable date for the invasion was early May 1944 the time element was crucial.

The B plant construction did not start until September 1943 and welding commenced in February 1944, a bare four months before the landings on the continent. It was, no doubt, the feeling of a frantic race against time that led a number of people involved to comment on the restrictive practises of the trade unions slowing up vital work, and wasting valuable manpower by insisting on two men doing one man's job. Service personnel, working longer hours for a fraction of the civilian worker's pay, took a very poor view of this approach to the war effort.

The 40ft (12.2m) lengths of steel pipe arrived at Tilbury by rail and were stored in racks which held a total of 340 miles of piping. These were continuously arc welded by the A-1 machines into lengths of 4,000 feet (1219m) and then transferred from the conveyor to further storage racks, ready for winding onto the Conundrums. At first there was some concern at the necessity for transferring such long and heavy lengths of piping but a labourer solved the problem unexpectedly. He used a pinch bar to lever one end of the long pipeline off the conveyor and to his astonishment the rest of the pipe followed, snaking down onto the rack below at what was estimated to be 120 miles an hour! This remained the accepted method of transfer in the future. It is not known whether the man responsible for this valuable discovery later applied to the Committee of Awards for some monetary recognition of his contribution to Pluto. A number of other people, possibily less worthy, did so.

In all, 975 miles of Hamel pipeline were produced at Tilbury in the process of which 103,123 welds were made in the A plant and 95,695 in the B plant to give a total of 198,818 welds. 17,120 tons of steel pipe were used.

It will be appreciated that the efficiency of the welds was all important. There were approximately 14,000 welds in the eighty mile length of Hamel pipe allowed for the channel crossing between the Isle of Wight and Cherbourg and the failure of only one weld could - and did - render the line useless unless a repair could be made. The fact that the pipe was to be coiled and uncoiled and probably subjected to many other stresses during laying meant that each weld must have properties similar to the original metal. Five per cent of all welds were given a repeated bend test on a short length of tube, Carried to destruction the fracture always occurred in the tube metal clear of the weld. There was, however, a slight panic when it was discovered that some of the pipes supplied to Tilbury were of a different and less malleable type of metal unsuitable for the work and some clever detective operations were necessary to discover the strangers and remove them from the welding complex.

The welding up of the 4,000ft (1219m) lengths of pipe was to a large extent automatic but as each length was wound onto a Conundrum it was necessary to weld on the next 4,000 ft length to form one continuous line. This was done in a final welding shop at the riverside end of the line. Now the internal ridge caused by the welding process could not be removed and this small impediment at 4,000ft intervals had to be accepted.

In order that work could continue under black-out conditions the pipe was fed into the welding shops through six inch (150mm) tubes in the walls and left the shops in a similar manner. A welding programme of twelve miles a day was maintained until the target figure was reached. The nearest the enemy got to interfering with ~~production~~ site was when a V2 rocket fell in the King George V dock at North Woolwich on 10 February 1944 when Latimer was discharging Hais cable alongside the storage site. The storage site was undamaged and Latimer only superficially. The fact that Latimer was discharging cable seems to need some explanation but no clue to this was given in the report of the incident. It is ~~probable~~ possible that the cable being discharged was ~~the remainder~~ some of the American made Hais with which trouble had been experienced, ~~when being laid by Latimer in January~~. It seems incredible but there was no damage by enemy action at any time to the sprawling Hamel plant at Tilbury.

At the river end of the production line at Tilbury was a special berth in which the Conundrums were secured for the operation of winding on the Hamel pipe. The trunnions of the drums were located in arms which allowed them to be rotated by the chain fitted over the teeth on the flanges, which in turn was driven by an electric motor. This gave a winding speed of about 2½ miles an hour and a full load of 80 miles of steel pipe could be wound on in about six days, the best day's work recorded amounting to 18 miles.

The loading berth was spanned by a gantry with a traversing cab which was used to guide the pipe fairly onto the drum. From the final welding shop to the gantry the pipe was supported by sheaves on a catenary which adjusted automatically to the level of the drum. The drum itself had water ballast compartments which were used to control the draft. This was vitally necessary as when 'flying light' the drum virtually sat on top of the water and the windage was enormous. Indeed, it was always realised that the handling of these gigantic sea monsters was going to be a problem of some magnitude. When the fact that these crewless - and as some of their attendants insisted - clueless, contraptions were required to lay many miles of semi-rigid steel pipe across the open sea, it needed a special brand of restrained optimism to imagine a successful outcome. Yet everyone closely involved in the operation became imbued with a shining determination that refused to recognise the possibility of failure - even in the face of devastating setbacks. Of these little local difficulties there was always a plentiful supply.

Since the whole concept of the Hamel system was new and untried*, it would have been more than surprising if unexpected difficulties had not appeared at intervals. Many brilliant minds were concentrated on the whole idea and many possible snags were foreseen. One of these was that as the drum revolved, water would be trapped in the spaces between the coils of pipe and would tend to revolve with the drum, producing a strong braking effect and increasing the towing power necessary. To overcome this, spring spacers were clipped onto the pipes at intervals, leaving a space between them to allow the water to escape.

One effect which turned out to be much greater than expected was the thrust of the wash from the propellers of the tug towing ahead. Even with the towrope veered to the maximum it was found that the wash impinging on the drum reduced the speed of tow by some two knots. For this reason, during a trial tow in the Thames, the tug, a very powerful one, was unable to do more than stem the tide with a loaded Conundrum. This difficulty was solved by

Footnote:
* It was, in fact, discovered that the idea of a floating drum to be used for carrying cargo had been patented many years ago. So, too, had the idea of a deep sea cable with a hollow core, to be used for pumping liquids. As far as is known, neither got beyond the drawing board.

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using two tugs towing ahead so that their wash went clear of the Conundrum. This meant that three tugs were required for the tow instead of two, the other tug lying astern in order to be able to steer or stop the drum if necessary.

At this stage, when full scale trials of both the Hais and Hamel systems had been successfully concluded and production of the pipelines on a large scale set in train, the operational responsibility for Pluto, now held by Combined Operations and Mr Geoffrey Lloyd's Petroleum Division of the Ministry of Fuel and Power, was handed over to the Petroleum Warfare Department under its Director General, Major General Sir Donald Banks and to the newly formed Force Pluto, commanded by Captain J.F.Hutchings DSO, OBE, RN.

Captain Hutchings had retired from the navy before the outbreak of war and had been recalled. He had had a distinguished career in submarines and at the time of his appointment to Force Pluto was serving in the Miscellaneous Weapons Development Branch of the Admiralty. This department was concerned with Pluto and also dealt with all the new and strange suggestions which emanated from all sorts of people. Some were directed at solving a particular problem of some branch of warfare, others were just ideas which might help to shorten and possibly win the war. Many of these ideas were being studied or given trials by Combined Operations' teams and at Appledore in Devon a Combined Operations Experimental

Establishment had been set up for the express purpose of carrying out trials under suitable conditions. Under the command of Colonel Courtney this offshoot of COHQ was responsible for a great deal of development of vitally important equipment for the invasion, including a good deal of frustrating work on techniques for handling the shore ends of Pluto. But this was only one of the COHQ problems, which continued to multiply daily.

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~~The formation of Force Pluto presented a number of~~ difficult and sometimes delicate problems. The original Pluto arrangements were based on pipelines to be laid across the narrow seas in the vicinity of the Straits of Dover with a distance of not more than about 25 miles. But later with ~~With~~ the necessity for much longer pipelines between the Isle of Wight and the Cherbourg area much larger vessels were required to carry the long and very heavy lengths of Hais cable - no ordinary cable ship could do it. With the auxiliary ships and craft necessary to support both Hais and Hamel projects a sizeable fleet was involved. At this stage of the planning for the re-entry to the continent there was already considerable competition for the available resources and particularly for men to form the crews. At one meeting in the Admiralty held to discuss the manning of the new cable laying vessels the question of where the men were to come from seemed incapable of solution. Then someone came up with what appeared to be a brilliant solution. 'What about the Polish crews for the two LST's which are not now required?' There was a great sigh of relief from those present and the gallant Admiral in the chair rapped on the table with the shining hook which did duty for a hand.

Delete whole para.

Yes.

'That settles it!' he exclaimed with evident relief. ~~But his pleasure was short lived, A quiet voice from the~~