WOOLWICH YARD.
13*th May*, 1848.

Works and repairs performed at the Factory at Woolwich during the undermentioned years showing the number of Steam Vessels repaired and fitted with new Boilers and their aggregate Horse Power, the expenditure on repairs of Steamers and the total estimated value of the works performed at the Establishment.

| Financial Year | Steam Vessels | | | | Total Cost for Steam Vessels | Total value of the works and repairs performed at the Factory during the year | Wages expended at the Factory |
|---|---|---|---|---|---|---|---|
| | Repaired or received new fittings | | Received new Boilers | | | | |
| | Number of Vessels | Horse Power | Number of Vessels | Horse Power | | | |
| | | | | | (£) | (£) | (£) |
| 1840/1 | 10 | 1,646 | 1 | 76 | 4,959 | 9,539 | 5,431 |
| 1841/2 | 25 | 3,706 | 7 | 716 | 24,728 | 33,094 | 18,911 |
| 1842/3 | 29 | 4,848 | 10 | 1,680 | 27,433 | 47,066 | 26,952 |
| 1843/4 | 31 | 5,081 | 10 | 1,846 | 45,451 | 55,356 | 31,632 |
| 1844/5 | 27 | 4,247 | 4 | 532 | 26,805 | 51,814 | 29,608 |
| 1845/6 | 34 | 5,953 | 9 | 1,682 | 36,432 | 61,246 | 34,998 |
| 1846/7 | 39 | 9,116 | 11 | 1,246 | 49,584 | 71,199 | 40,685 |
| 1847/8 | 30 | 7,257 | 8 | 1,860 | 54,345 | 97,639 | 55,794 |

(*Signed*) CHAS. ATHERTON
(*Chief Engineer*).

THE COMPTROLLER OF STEAM MACHINERY,
ADMIRALTY, SOMERSET HOUSE.

# PART I

# THOMAS LLOYD, C.B.
# FIRST ENGINEER-IN-CHIEF OF THE NAVY

by

COMMANDER (E) A. F. SMITH, R.N.

The chief personalities who were responsible for guiding the early technical developments of the Engineering Branch of the Royal Navy are not well known, but their valuable contributions to naval and marine engineering are deserving of widespread acknowledgement. It would appear an appropriate time to recall particularly the work of Thomas Lloyd, C.B., who, on his appointment as assistant to the *Comptroller of the Steam Machinery* on April 9th, 1847, became the first naval engineer to be appointed for duty inside the Admiralty.

Another event of great importance to naval engineers was the issue of an Order in Council, dated February 27th, 1847, creating a new classification of engineer officers, including the rank of Inspector of Machinery Afloat. This order also granted commissioned rank to engineers for the first time. What part Lloyd played in the formulation of this order is not known, but as he had been the chief adviser on naval engineering since 1842, his name cannot be dissociated from this significant step in the recognition of the engineer officer.

The details of Lloyd's contribution to the Navy were recorded by his opinions and decisions expressed in the official dockets, reports, and other forms of Admiralty and departmental correspondence. Much of this record is no longer available and without access to any private letters this acknowledgement of his work and character is necessarily very incomplete.

He was born at Southsea on October 29th, 1803, and educated at the Portsmouth Grammar School, later studying under Professor Inman at the School of Naval Architecture. He completed his apprenticeship as a shipwright at Portsmouth Dockyard in 1825, and was then transferred to Plymouth, being employed as a shipwright until 1831.

It should be recalled that the use of steam machinery in the Navy was in its very infancy. Its introduction may be said to date from the appointment of Simon Goodrich as Engineer and Mechanist at Portsmouth in 1814. He was responsible for supervising the installation of steam machinery in the dockyards, and the maintenance of any steam vessels which first included the Post Office Steam Packets. He was also the adviser to the Navy Board on engineering matters. Lloyd must have had some experience with the Steam Packets while he was at Plymouth, as it was the nearest dockyard to Falmouth, from which most of them sailed for abroad. In 1831 he was directed to turn his attention to the study of steam and its application to marine propulsion. There is a note in the Admiralty records to say that " upon the superannuation of the Engineer and Mechanist in 1831, his successor was appointed by an Admiralty Order of March 17th, at a salary of three hundred pounds. That appointment was declined by him on April 15th next ensuing. The superintendence of the engineering department then devolved upon the Masters of wood and metal mills." Lloyd was appointed as Superintendent of Wood

Mills at Portsmouth on April 16th, 1831, and it would appear that he became responsible for the steam machinery, but whatever his exact responsibility, his work was intended to give him an opportunity of studying naval engineering. In 1833 he was sent to Woolwich Dockyard, and took the opportunity of obtaining several months' practical experience afloat in a steamship.

One of the first references to the supply of steam machinery for Woolwich Dockyard is to be found in the Boulton and Watt work books of the Soho Foundry now in the Birmingham City Library. In October, 1815, instructions were issued that materials for " the forge engine, blowing engine and tilt engine " were to be forwarded " as soon as they can be got ready, to Thos. Burnett Esq. Storekeeper of His Majesty's Dockyard at Woolwich," which was to become the principal repair yard for engines and the manufacture of boilers. In 1835, Peter Ewart, a former apprentice, and one-time employee of Watt, was appointed as Chief Engineer of Woolwich Dockyard, and by the acceptance of this post became the adviser to the Admiralty on steam machinery. Lloyd, who was the younger and less experienced man, became his assistant. In July, Lloyd was again sent to Plymouth, gaining first-hand knowledge of the yard and the maintenance and repair of steam vessels. His association with the West Country was invaluable to him in later years when he had to propose the machinery plans for the Keyham extension. He returned once more to Woolwich in 1838, and remained as Ewart's assistant until the latter's accidental death in 1842. He was then made Chief Engineer in Ewart's place.

**Steam Machinery**

Lloyd was virtually the technical head of the " Steam Department " for over a quarter of a century. It was a period full of interesting development ; inventors were never slow in advocating their material schemes, and even quicker in making their financial claims, and it required a man of exceptional ability and determination to sift the good ideas from the bad, to give a fair trial to all proposals which were based on sound principles, and ensure that only the best were adapted for naval purposes. His experience with Lord Dundonald's rotary engine is an example of the difficulties with which he had to contend. This engine was first tried at Portsmouth, and later fitted in H.M.S. *Janus*. Lloyd's criticisms of this engine in 1845 were described by the designer as " ridiculous," and, presumably due to the latter's influence, Professor Airy, the Astronomer Royal, was called as a second authority, and in January, 1846, reported " most favourably " on it. Two months later, however, the engine broke beyond economical repair, and Lloyd had to issue the order for its removal from the ship.

This incident must have enhanced his reputation and his advice was much sought after, both inside and outside the Service. He had a knowledge of a great variety of subjects, and, like nearly all outstanding men, an exceptionally good memory. Although a comparatively young man, he held a very responsible position ; there were numerous maintenance troubles to be overcome, material proposals to be examined and tried, and personnel problems of intense importance to be attended to. There were trials with Hall's condenser, provision of financial estimates for material and wages, problems of incrustation in boilers, gearing requirements for propellers, suggestions for feed regulators, designs for telescopic funnels, proposals for disconnecting paddle-wheels, discussions on the use of higher steam pressures, a proposed form of jet propulsion, trials with " smoke consuming apparatus," and many other items demanding much of his time and thought.

Reliability and simplicity seem to have been two of Lloyd's standards, and his decision that a proposed scheme was " too complicated," or " would cause more trouble than it was worth," was often sufficient to condemn it. The

knowledge possessed by most engine-room personnel at that time was very limited, and no one will doubt Lloyd's wisdom in the choice of these two particular standards.

One interesting proposal which needed Lloyd's attention in 1842 was Holdsworth's plan for cooling the *Victoria and Albert*, the Royal Steam Yacht, before and abaft the engines and boilers. It was also suggested that in men-o'-war this scheme could render magazine and shell rooms proof against fire. It consisted of water bulkheads of wrought iron, with a pump worked by the engines to keep cold water circulating through them. In a report signed by Lloyd and Oliver Lang, the famous master shipwright, they wrote, " We consider that the bulkheads containing water would have a tendency to keep the engine-room cool, but the reduction in temperature would not be considerable. We therefore are of the opinion that the benefit to be derived from such a plan would be more than counterbalanced by the inconveniences arising from getting out of order, and the difficulty of repairing it."

**Screw Propellers**

Francis Pettit Smith had taken out his patent for the screw propeller in 1836, and three years later Brunel carried out a series of trials with it in the *Archimedes*, but it was not till March, 1844, when Brunel and Lloyd submitted a report on " the peculiarity and advantages " of the Smith propeller that its adoption in the Navy made any real headway. Once the principle had been established that a ship could be successfully propelled by turning a form of screw in the water, it raised widespread interest. During the years 1840-47, the Admiralty was constantly receiving individual suggestions for propeller designs, and the phrase " Mr. Lloyd to report " became almost a standard initial action. Bourne in his *Treatise on the Screw Propeller* (1867) mentions over three hundred different patents and suggestions.

Numerous trials of different propellers in H.M.S. *Rattler*, culminating in the famous tug-of-war with H.M.S. *Alecto* in 1845, were mainly the outcome of the Brunel-Lloyd report. Lloyd was also associated with the manufacture of propellers and construction of disconnecting gear, and he was also responsible for the propeller trials carried out in H.M.S. *Dwarf*, which was placed at the disposal of the engineers at Woolwich for making further experiments. It was an extremely busy time, and entailed a considerable amount of travelling about the country. One trip of particular interest was in January, 1845, when Lloyd sailed in the *Great Britain* at the request of the Ship Propeller Company. He later submitted a favourable report on her qualities.

In an appendix to the *Treatise on the Screw Propeller*, as Head of the " Steam Department," Lloyd describes the " Introduction and progressive increase of screw propulsion in Her Majesty's Navy," with details of the performance of screw vessels up to March, 1865. In a reference to the multi-bladed propeller he summarises his views by saying, " On the whole, screws of three blades are probably the best for most purposes of ocean service."

**Tubular Boilers**

Captain Alexander Ellice, R.N., was the Comptroller of the Steam Machinery in 1847, having previously been associated with the Post Office Steam Packets at Falmouth. He had a good grasp of the material and personnel problems. One of his first actions when he took office in 1846 was to demand a list of engineers with details of their appointments and seniority. Prior to this, all the records of engineer officers had been kept by the Captain Superintendent at Woolwich, who was their appointing authority. Captain Ellice, apparently, had a high regard for Lloyd's ability and judgment, for immediate approval was given for his assistant to sign all official letters in his absence from the

Admiralty, but there is no known instance of Lloyd having occasion to do this till 1848. It is, perhaps, of interest to reproduce what is probably the first departmental letter to be signed by a naval engineer :—

July 4th, 1848

Commodore Superintendent, Woolwich

*Application of Brass Tubes to Iron Boilers*

With a view to determine whether Brass Tubes can be advantageously applied to Iron Boilers to a greater extent than has hitherto deemed advisable, I request you will call upon Mr. Atherton *the Chief Engineer* to make a very minute and careful examination of the various parts of the boilers of the " Firebrand " (which are fitted with brass tubes and have been in use above four years) and to report fully their state and condition and particularly whether the juxta-position of the two metals has caused galvanic action sufficiently powerful to leave perceptible traces of its action in the destruction of the Iron.

T. LLOYD,
for Comptroller.

The *Firebrand* was one of the first vessels to be fitted with tubular boilers in the Navy.

Lloyd was necessarily concerned with the production of suitable steam coals and the establishment of coaling stages and bases, both at home and abroad. Arrangements were made at Devonport for testing the suitability of coals, and between 1864 and 1867 experiments by representatives of the " Steam Department " were carried out at Wigan on the steam coals from South Lancashire and Cheshire.

The question of using fuel oil was being discussed in the department in 1865, and Lloyd was associated with the experiments carried out by Captain Selwyn at Woolwich 1866-7 but, as is generally known, the use of oil fuel was not adopted in the Navy till nearly forty years later.

**Training of Engineer Boys**

Lloyd took a keen interest in the training of the Engineer Boys, and in 1847 it was arranged that their time at Woolwich would include three days of the week " acquiring theoretical knowledge to fit them for the profession of engineers." He objected to placing these youths in the Fitting Shop of the Factory to obtain their practical experience, on the grounds that the efficiency of the Establishment might to a certain extent be compromised. " The importance, however, of making these lads efficient engineers," he regarded as being so great that arrangements were made to fit up a temporary shop containing " a few footlathes, forges, &c., and to appoint two or three mechanics for their instruction as to the use of such tools as they may have to use hereafter." It was during Lloyd's time at the Admiralty that the ratings of Engine Room Artificer and Chief Stoker were introduced.

Captain Ellice retired in 1850 and Lloyd became Chief Engineer and Inspector of Machinery attached to the Surveyor of the Navy's department at Somerset House. The title of Surveyor was later changed to Controller and in 1860 Lloyd became Engineer-in-Chief of the Navy.

In 1852, accompanied by Whitworth, Penn and the Chief Constructor, Watts, Lloyd paid a visit to the French arsenals and took the opportunity of studying the progress of steam machinery in the French Navy. It has been said that several changes which were introduced into H.M.S. *Agamemnon* were the result of this visit. The *Agamemnon* was the first line-of-battleship designed as a screw ship, and was later employed in assisting with the laying of the first

trans-Atlantic cable. Lloyd's advice was sought regarding the design of the machinery for paying out the cable, and his valuable services were afterwards acknowledged by the Atlantic Telegraph Company.

In 1856 he again visited France, this time accompanied by Rear-Admiral Sir Baldwin Wake-Walker, the Surveyor of the Navy, and the Chief Constructor, to witness the effect of artillery on a ship's side protected by shot placed in an external casing. Lloyd suggested that better protection would be obtained by solid iron plates—an idea which was soon accepted by both navies. This proposal was by no means new, but its general adoption appears to date from the time of this second visit to the Continent.

During the last few years of Lloyd's career, we find trials being carried out with compound engines in H.M. Ships. Unfortunately, the Navy's early experience with these engines showed them to be complicated, difficult to handle, and unreliable. This probably accounts for the slow adoption of this type of engine in the Service, which, in turn, delayed the change to higher steam pressures. From 1849 to 1869, boiler steam pressures only rose about 20 lb. per square inch.

Lloyd's fifty years of service may be said to cover the transition period from sail to steam, and it very nearly covers the change from wooden to iron hulls. He was serving his apprenticeship when H.M.S. *Comet*, the first naval steam vessel, was launched at Deptford, and in 1869, the year of his retirement, the keel plate of H.M.S. *Devastation*, the so-called " mastless " turret ship, was being laid. His interest in the performance of propellers never ceased and in the same year trials were being run between H.M.S. *Druid* and H.M.S. *Cadmus*, fitted with a Griffiths and a Vansittart screw, respectively.

In acknowledgement of his services, he was made a Companion of the Bath in 1868, and on his retirement the Controller of the Navy, Vice-Admiral Sir R. Spencer Robinson, wrote :—

" There is no public servant, within my knowledge, who has so largely contributed to the advance of practical science in his particular department.

" To Mr. Lloyd, more than anyone else, is due the successful application of the screw to the propulsion of steamships, and it was owing to his enlightened knowledge and his zealous exertions that the Royal Navy was enabled to take the lead in its application to ships of war.

" During a very long public life, Mr. Lloyd has been distinguished for wise and carefully considered suggestions, for improvement of the detail of marine engines ; and I venture to say that the principal marine engine makers in this kingdom have frequently consulted him and always benefited by his advice."

Lloyd remained a bachelor, and died at his home at 84, Finchley Road, Hampstead, on March 23rd, 1875.

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