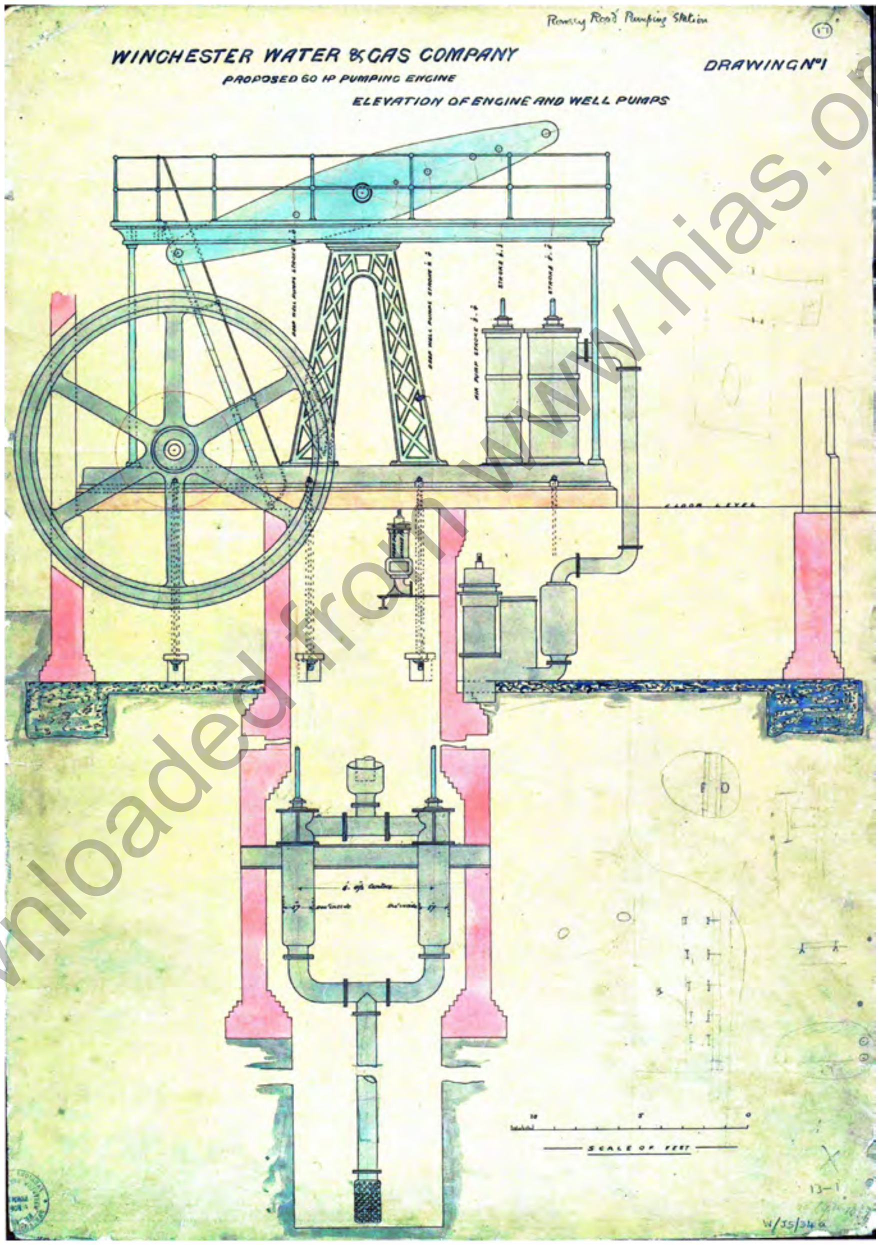
ISSN 0967-3474

Hampshire Industrial Archaeology Society

Journal



No. 16

2008

Front cover picture:
Winchester Water & Gas Co. Drawing of the Lilleshall Company beam engine supplied to the Company in 1885 for the Romsey Road pumping station in Winchester. (HRO, W/J5/34a)

Back cover pictures:
UPPER; *Southampton Royal Pier*, early 1900s.
LOWER; *A Note on Influences on Polish Railway Station Design*. Wisla Oblaziec station.

Hampshire Industrial Archaeology Society
(formerly Southampton University Industrial Archaeology Group)

Journal No. 16, 2008

Contents

Editorial

Welcome to Issue **16** of our *Journal,* the first one with colour on the cover. Once again the *Journal* has articles on a wide variety of subjects, showing the wide interests of members of the Society.

Jeff Pain tells the story of the Royal Pier which has been at the centre of Southampton's waterfront for 130 years, combining the roles of commercial landing stage and pleasure pier for most of that time. Ray Riley writes on some of the influences on railway station architecture, taking his examples from Poland rather than the United Kingdom. The survival of a Victorian gunboat in Portsmouth is remarkable and could add a further ship to Portsmouth's collection as it makes a bid for World Heritage Status. Keith Morton's article on the optics of lighthouses is topical as Trinity House establishes a museum at Hurst Castle. The article on Winchester's supplier of water continues a series of pieces on the history of Utilities in Winchester.

Martin Gregory
June 2008

Published by Hampshire Industrial Archaeology Society, Registered Charity Number 276898
Edited and produced by Martin Gregory

ISSN 0967-3474

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Martin Gregory is a retired schoolmaster. His interest in the history of technology goes back over 45 years. He has researched and built model steam and Stirling engines for many years and also works on the history of the sewing machine. He has been a member of HIAS and its predecessor for 40 years, has served as Secretary and Chairman and is the present editor of the Journal.

Keith Morton
Keith Morton worked in the Ministry of Defence for nearly 40 years, starting as an apprentice and graduating to project managing a wide range of radar, optical, communications and guidance projects. He took early retirement in 1995 to get his Commercial Pilot's Licence and became an instructor. He has always been interested in lighthouses and is the secretary/treasurer of the Association of Lighthouse Keepers (ALK). He is also an active member of the Friends of King Alfred Buses, having once owned two vehicles.

Jeff Pain
Jeff Pain has been a member of the Hampshire IA group since its early days in the 1960s. He was born in Southampton and, apart from wartime, has always lived and worked in the area. Educated at Taunton's School, he followed his father into the shipping world, being employed in Freight, Passenger and Ship Agency work. After the reorganisation of shipping, he spent twenty years or so with Pirelli, first at Southampton and, when that closed, at Eastleigh. His main interest has always been in transport covering ships, railways and aircraft, with road interest limited to trams and buses.

Ray Riley
Professor Ray Riley retired from the University of Portsmouth in 1993 and took a post at the University of Lodz in Poland. In 1996 he was offered a two year contract by the Polish Ministry of Culture surveying coal mines and steel works in Silesia. The present article is largely based on travels during this period. He currently teaches part-time on the MSc Heritage and Museum Studies degree at Portsmouth University.

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Ian Sturton has been an enthusiastic investigator of post-1860 warships and warship designs for many years, publishing and illustrating articles in a number of journals. He retired recently from Winchester College Science School.

Acknowledgements

My thanks are due to all who have contributed to this edition of the *Journal*. Acknowledgements and thanks for the provision of illustrations are made as follows:

Peter Brook Collection, (Fig. 46); Tony Chilcott, (Fig.16); Geoffrey Dennison, (Figs.49,51,52); Stephen Dent, (Figs.50,53); Martin Gregory, (Figs. 56,57,61,62,65-67); Hampshire Record Office (HRO), (Fig. 60 & front cover); Bert Moody, (Fig. 7); Keith Morton, (Figs. 54,55,58,59); Jeff Pain, (Figs. 3-6,8-15,17-20 & back cover upper picture); Ray Riley, (Figs. 21-45 & back cover lower picture); Southampton Library, Local History Collection (SLLHC), (Figs. 1,2); Ian Sturton, (Figs. 47,48); Winchester City Museums, (Figs. 63,64).

The authors and HIAS have made every effort to trace copyright holders of illustrations, but if we have inadvertently overlooked any, we apologise.

Southampton Pier

Jeff Pain

Introduction

Although Southampton's Royal Pier was built to service passengers and freight it developed into a seaside-style pier; catering for promenaders, providing refreshments, a band stand, tourist excursion boats, and a pavilion for dances, concerts and meetings, even including "what the butler saw" machines. Strangely, it was not included in certain listings of UK piers, presumably because it was on a river estuary and not facing the open sea. I personally recall, in my late teens, attending dances, usually on Saturday nights, hosted by Gil Hume and his Band, and also some jazz concerts. This is my tribute to a waterfront feature used and loved by many over the years.

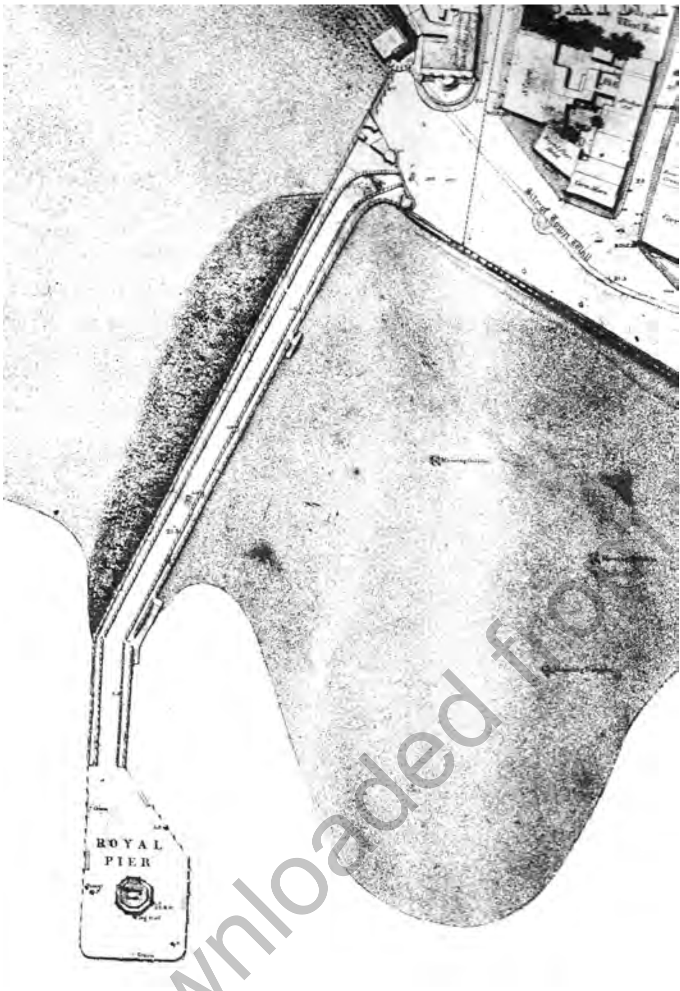


Figure 1. Detail from 1845 Ordnance Survey map. Note the Pier head has straight edges, not round as most contemporary illustrations imply. Also the road ends at the pier entrance, the extension to the Western Esplanade was not made until the 1890s. (SLLHC)

The Beginning

Southampton has for some two millennia at least, been a port for import and export of goods, with the dock area moving from along the banks of the river Itchen to around the new walled town by about the end of the first millennium. In 1680, two quays were described: 'the South Quay at the Watergate is some 223 ft (68 m) in length, 190 ft (58 m) breadth at the gate and 63 ft (19 m) at its head, the other older one at West Quay is 225 ft (69 m) long and some 58 ft (18 m) in breadth at the wall narrowing to 37 ft (11 m) at the end.'

By the start of the 19th century the West Quay was disused and the South Quay, now the Town Quay, had been extended several times by at least 180 ft (55 m). At this time passenger traffic was increasing, with services along the coast, and across the Channel, offering connections to Paris via the Seine [(1)]. Although Town Quay could offer berths at high tide it was very limited, being a working environment with restricted space, so passengers were normally ferried ashore in small boats, which was, to say the least, lacking in comfort and convenience.

In 1824 a group of steamship proprietors proposed a chain pier, and obtained a lease from the Corporation, of land apparently near the platform (east of Town Quay) with a breadth of 30 ft (9 m) to the low water mark and 60 ft (18 m) wide at the head. However lack of finance led to the failure of this scheme. In 1828 a private syndicate made an offer to the Harbour Board Commissioners [(2)] of a £7000 loan to construct a pier, the catch being they required 10% interest per annum for 21 years, suggesting this could be raised by tolls. After this period they would hand the property over on repayment of the principal.

Although the HBC were prepared to consider this proposal, a group of local business men, which included three of the Le Feuvnes, William Lankester and others, suggested this should be handled in house. They proposed construction of a pier using the breakwater facing the Custom House with the area enclosed to be a repair basin. This scheme the HBC rejected owing to lack of funds for such an elaborate project.

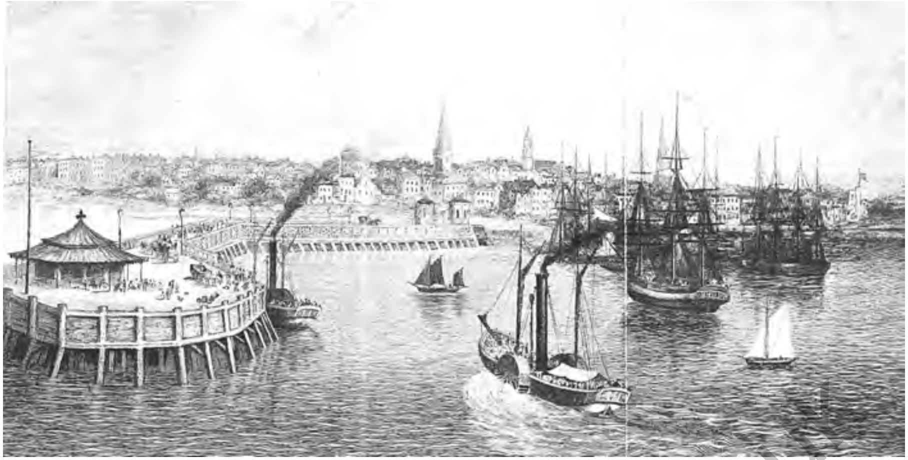


Figure 2. Mid 1800s view showing much activity around the Town Quay and passenger traffic using the Pier (SLLHC)

However the continued pressure for some action eventually bore fruit. In 1829 the HBC proposed the erection of a pier over the existing breakwater providing the Borough Council and the committee would help it to obtain an Act of Parliament to cover the work and raising the necessary capital. This was agreed and in accordance with plans submitted by Mr. Doswell, an Act was passed under 1 and 2 Will 1V Cap 1 (1831), with authorised capital of £10 000, which also created a body known as the Pier and Harbour Commission (basically identical with the existing HBC) to oversee operations. Mr. Doswell's plans offered either a stone built structure estimated at £14 000, or a wooden option at £7500. The second was chosen, although the Act allowed for some latitude, which was just as well as the final figure was in the region of £15 000.

Figure 3. One side of a stereo pair of the gateway, with (in)animation.

The official opening by the Duchess of Kent, accompanied by her daughter Princess Victoria, was originally requested for 28th June 1833, but this was changed by the Duchess to 8th July 1833. The royal party arrived on the yacht *Emerald* from the Isle of Wight, where they were staying at Norris Castle, to be greeted by the Mayor, Corporation, Gentry and Merchants. They were then conducted to a marquee at the Pier Head where the Duchess had pleasure in bestowing the name 'Royal Pier' and wishing the enterprise every success in the future.

The Middle

So its life began and very quickly the downside of using timber became apparent, as within five years, the marine borer gribble had so infested the piles that replacements were required. Doswell used the method of scupper nailing for protection on the new timbering; this entails the use of many large headed nails hammered close together to give effectively a sheet of armour which appears to have lasted until the major rebuild in the 1890s.

Figure 4. From the early 1870s. Trains have arrived, but horse drawn along just a single line with a basic platform.

Commercial traffic was attracted by the new facilities, with passengers at the Pier and cargo at the Town Quay, both under Harbour Board management. But the development of the docks which opened in 1842, by a separate company (3) with the attraction of a rail connection took virtually all the deep sea cargo and passenger traffic away, though traffic to the IOW and passenger excursion services remained. This situation remained fairly constant during the rest of its life, though there were some disputes over rates and, for a short while in 1862, the passenger service joined a recently formed competitor on the IOW service in using a pontoon on the river Itchen, moored close by the Floating Bridge terminal. However, though cheaper, it was inconvenient for passengers and the vessels soon returned to the Pier. In 1865 they purchased the competition as their facilities at Cowes were much better.

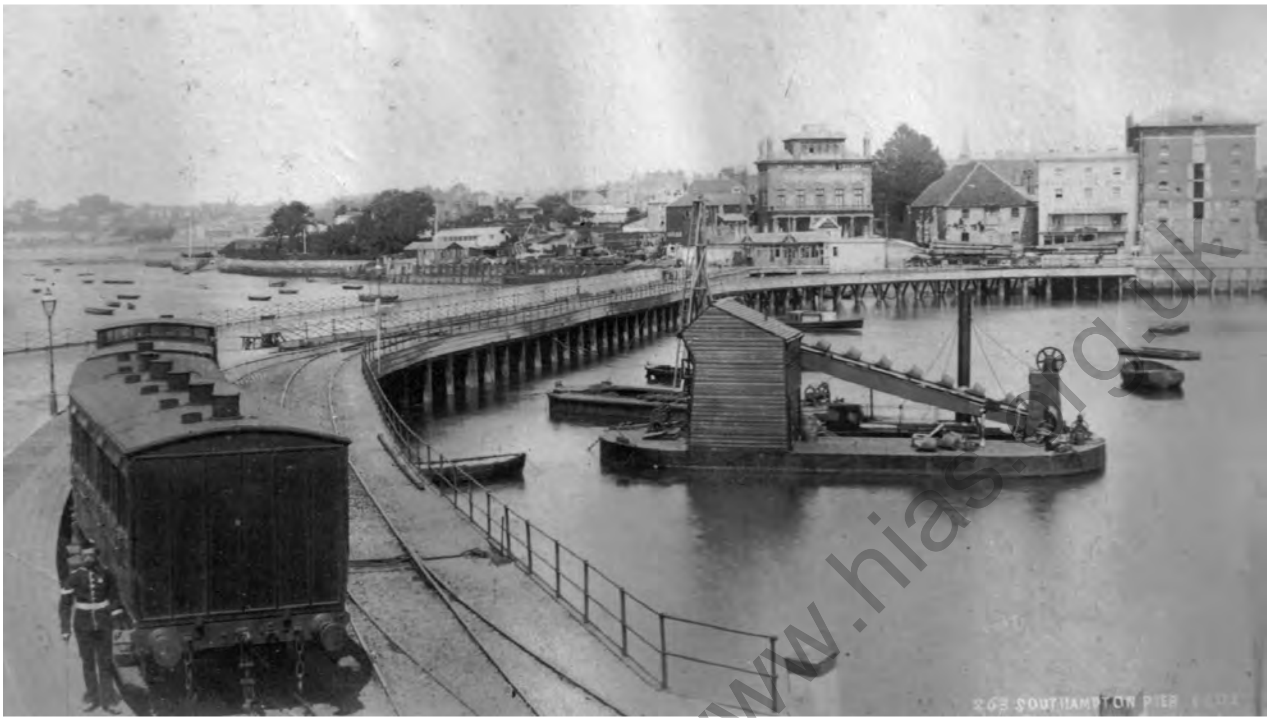


Figure 5. From the 1880s, note the alterations for steam hauled trains; additional track to allow a run-round facility, the extra pier structure to provide direct access, and the single storey entrance building.

In 1847 the Town Quay was connected by a tramway to the Terminus Station, and in order to avoid the Dock Companies premises it was laid along Canute Road and the Platform. To save space in negotiating corners they used turntables (large enough for one wagon at a time) at either end. The motive power was horses at Harbour Board expense. In 1851 it was leased to the LSWR who took over the operation. In 1870, an angled connection across Canute Road was laid to facilitate direct services to the Town Quay and Royal Pier. To access the Pier required an additional structure on the eastern side of the existing pier to accommodate the railway line. On the Pier the railway had a single platform, though a loop was provided. About this time a pontoon was installed for the regular IOW service. The rail connection was formally opened on 25th Sept. 1871 with carriages conveyed from Waterloo on the 0536 train to Southampton Terminus. In regular service the standard formation to the Pier was, one 1st class carriage, one 2nd class and a brake van for luggage, (all 4-wheeled stock) drawn by three horses.

Figure 6. An 1880s view clearly showing the separate structure for the railway line and some of the entrance building. A train is in the station and four paddle steamers are in evidence.

With traffic from the Town Quay increasing it was becoming apparent that mechanical traction was needed, and in early 1876 the LSWR applied for permission from the town council to use steam engines. This was given initially for one year with the following conditions.(which were presumably satisfactorily observed as operation continued):

a. Speed to be limited to 5 mph.

Figure 7. Train arriving at the station. Note the pipework on the locomotive to condense the exhaust steam.

Figure 8. Locomotive *Southampton* taken into LSWR stock in 1898 and numbered 109. It spent some time at Bournemouth until withdrawn in 1913. Sold in 1915 to Kynock Ltd. for use in their munitions factory at Longparish.

b. A man to be provided with a red flag and bell where the public highway is crossed.
c. Engines similar to those used in the docks, with powerful brakes, and also that the exhaust must be discharged into the water tanks and not the atmosphere whilst on the public road.
d. Maximum weight of locomotive was not to exceed that of a loaded truck (13 tons).

So the LSWR ordered from Shanks & Sons of Arbroath at a cost of £995, an 0-4-0 tank engine named *Southampton*, which entered service on 21st of September 1876 and was successful. A second locomotive named *Cowes* followed within a year from the same builder. Also a second hand engine was acquired which retained the name *Ritzbuttel* which it had been given whilst working in Germany. These three locomotives worked the lines exclusively until 1898, by which time the LSWR had purchased the docks and begun using some of their own locomotives through to the Town Quay and Royal Pier.

Various acts of Parliament in 1863, 1877 and 1882 had covered improvements to the Royal Pier and Town Quay. However, proposals to drastically rebuild the Pier were approved under 54 & 55 Vic 1891 Ch XCV. These went ahead, with the new structure (Figure 9) being opened by the Duke of Connaught on 2nd June 1892.

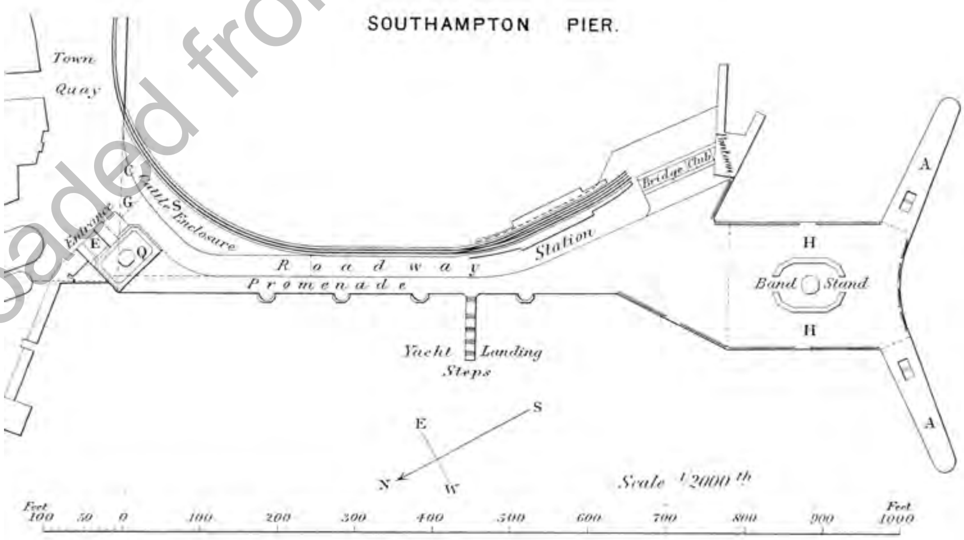


Figure 9. Plan of the 1892 reconstruction which indicates the initial use of the old pontoon. Apart from the bandstand and the platform awnings there are no other structures as I assume the 'Bridge Club' must be the flexible connection to the pontoon.

Items of interest are a new gatehouse, while the general line of the old pier is shown by the roadway. The cattle enclosure was created by in-filling on the eastern side between railway and roadway to the point where they met. The original small pontoon was retained, while, on the new section was a bandstand with a surrounding shelter where later a pavilion would be erected. The railway station now had two platforms, both with awnings, and at the same time electric lighting replaced gas over the whole pier. The pontoon was for commercial traffic allowing goods, cattle and sheep to be landed and driven into town,

Figure 10. Early 1900s view as the refreshment rooms are visible behind the bandstand. Note the liberal use of the town crest on ironwork and bandstand. Some of the railings remained until the end, but by then the paintwork was overall grey. Some photographers were not above adding figures and I do wonder about the two in the foreground!

Figure 11. Railway station and Steamer booking office circa 1902

the enclosure being intended for livestock awaiting shipment, though in the many postcard views I have seen, it is always empty.

A detailed description of constructional details may be found in a lecture given to the Institution of Mechanical Engineers at Portsmouth in July 1892, by James Lemon the then Mayor of Southampton. A few extracts follow:

"The fabric is on cast iron screw piles 8 inches (200 mm) diameter and 1 inch (25 mm) thick, except for the promenade, where the diameter is 7 inches (178 mm) with a thickness of ¾ inch (20 mm), the average length was 40 feet (12 m) to give some 5 feet (1.5 m) in solid ground after passing through the mud. The bracing was of two kinds, horizontal and vertical diagonals only topped by main girders, with transverse girders supporting the wooden decking. The pier arms had landings at two levels under the main deck to allow for low and very low tides. At all landing places the main fabric was protected by wooden piles braced independently so as to protect the iron structure during every-day use. The carriageway used steel trough decking leveled with concrete and surfaced with gravel. In all some 1600 tons of metalwork were used and the total cost was £40 000. The engineers were Mr. James Lemon & Mr. E. Cooper, the contractor Mr. Henry I. Saunders, electrical engineering design was by Mr. J.G.W. Aldridge and work by Mr. F. Shalders."

The next few years saw several improvements; a larger pontoon was installed, a toilet and a store block were added on the east side close to the pontoon. In 1910 the bandstand was moved southwards and a pavilion erected in its place, tea rooms were built to the west of the pontoon. Also in 1910 the town tramway system finally arrived at the pier entrance from Holy Rood.

Figure 12. Town side of the 1892 entrance. A post 1911 view as the tram tracks have arrived

The First World War had one major influence in that the rail connection became disused; some sources suggesting the service was suspended on or shortly after the outbreak of war. At some time, the track was severed just to the north of the platforms, possibly through damage by an errant vessel, though a date has not been found. It should be mentioned that the original engines were displaced after the LSWR bought the dock company and locomotives from the dock fleet were used (without condensing apparatus). Also later, some of the LSWR steam rail motors were used to give a connection from the Terminus Station, instead of through coaches from Waterloo.

Figure 13. Aerial view circa 1920. Note the extension to the pavilion for what is probably a roller skating rink, and, at the left of the picture, part of the 1914-18 wartime train ferry pier.

Otherwise things returned to normal until the late 1920s when, in association with work on the New Docks, land reclamation both between the Pier and Town Quay and to the west (Mayflower Park) took place. This enabled the road past the Pier to be widened and a new entrance was constructed some 175 ft (53 m) southwards on what was now solid land. All remnants of the railway on the Pier had now been removed and the area used for parking as cars which were now being carried on the IOW service.

Figure 14. Mid 1920s. Note the gazebo at the bottom of the picture. A section of the railway track is missing and one of the platforms has been removed.

The End

In 1939 war came again and only the ferry traffic remained, the pavilion becoming naval offices for the duration. In the air raids, a parachute mine landed

Figure 15. Mid 1920s promenaders enjoying the sun, a view which could have been Bournemouth or Brighton.

Figure 16. 26th November 1929. On a typical dull November day, the old entrance is still in use, though its replacement is nearly completed. Note the difference in location.

Figure 17. In the 1930s the German liner *Bremen* passes en route to the New Docks. Note the reclaimed land which will become Mayflower Park, also the railway track across the entrance which was the connection between the Old and New docks.

on the north corner of the pier head creating a hole which was not repaired until after the war. Peace came, but the level of excursion traffic did not return; firstly, several of the paddle steamers requisitioned for the duration were returned past renovation, and although stop gap vessels were used for a while, the introduction of an ex-LCT (landing craft tank) in 1947 to carry cars indicated the future. Although the *Balmoral (2)*, built 1949, was a traditional diesel screw vessel, the next new build, in 1959, was a dedicated car carrier handled at a new pontoon between the Pier and Town Quay in an area which had been used during the war to load LCT vessels by a ramp. With the sale of *Balmoral (2)* in 1969 the pier lost its regular traffic though occasional calling vessels still berthed in the summer months.

Back to the Pier, in 1947 the Harbour Board requested the Town Council to take the Pier over but this was rejected. In 1949, fees for the Red Funnel services were raised, the ferry company protested, and in its evidence stated that during 1948 the *Medina* had made 631 voyages. Over the years the pavilion had many alterations, including an extended entrance on the north side. Minor changes engulfed most of the bandstand and, in 1963, operation of the building was leased to the Mecca organisation for a few years.

After the war various items were displayed in a shelter attached to the entrance building including: the Supermarine S-6 racing seaplane (now in Solent Sky Museum), an optical system from the Eddystone Lighthouse and some large stones dredged from the river.

In 1968 ownership of the Pier and Town Quay, along with navigational responsibilities, passed to the Dock Board and closure came on January 2nd 1980. So the Pier slowly deteriorated until 1987 saw a fire which damaged the pavilion, followed on 30th July 1992 by a more serious fire which finished off the pavilion and tea rooms along with some of the decking.

What remains today? The road section has been used for material storage and car/lorry parking associated with the IOW car ferries which have reclaimed more land over the years. The one thing remaining intact is the entrance building, surviving demolition proposals in 1980. It has at odd times been a restaurant, a night club, and is currently an Indian restaurant. Though there are some structural alterations at the rear, its future seems assured for the moment. Regarding the Pier itself, this would appear to be beyond recovery, though plans are afoot to redevelop the area which will remove the terrible eyesore that this once grand structure has been allowed to become.

Figure 18. In the early 1950s, note the surfaced area for dancing, in front of the pavilion. The *Medina* is on ferry service at the pontoon and the *Bournemouth Queen* is ready for an excursion.

Figure 19. In service with Red Funnel from 1947-1962, *Norris Castle* unloads cars at the pontoon

Figure 20. The Pier is by-passed by cars, though passengers still board via the Pier circa 1965. It will not be long before new facilities remove all trade from the Pier

Notes

1) The Ferries: there is recognisable continuous line through amalgamations and name changes since 1820 to the present operator Red Funnel Ltd. At one time they laid claim to the longest title, being known as the "Southampton, Isle of Wight and South of England Royal Mail Steam Packet Company Limited"

2) The Harbour Board (HB): a body set up by Southampton Council in 1803 to collect tolls from shipping, to manage the safe passage of vessels inside of Calshot and to operate the Town Wharf. The Board comprised commissioners who were appointed by the Town and Shipping interests. Later they absorbed the Board set up to manage the Royal Pier, but this was not a major step as several commissioners held office on both Boards.

3) The Dock Company: this originated as a private company, was bought by the London and South Western Railway Company (LSWR), becoming part of the Southern Railway, on nationalization it became part the Docks and Inland Waterways Executive, then the British Transport Docks Board. Privatised, it is part of Associated British Ports, though now under foreign ownership.

References

Adams, R.B., *Red Funnel and before*.
Marden, D., *Southampton's Quayside Steam.*
Moody, B., *Southampton's Railways.*
Pannell, J. P. M., *Old Southampton Shores.*
Patterson, A. Temple, *A History of Southampton 1700-1914*

A Note on Influences on Polish Railway Station Design

Ray Riley

Introduction

The subject of railway station design has been largely the province of architects (Biddle, 1973; Insall, 1967; Lloyd, 1967), with the consequence that publications have tended to be descriptive. Because of their significance in construction history, the early Victorian train sheds have received considerable attention (Mainstone, 1975; Sutherland, 1988-9), but not so the small and mundane, thousands of wayside stations not being worth much thought. As far as this writer knows, no attempt has been made to focus on the reasons for particular designs, even if some of the designs, of the great London termini for instance, are well known. Rather than undertake this exercise for the United Kingdom, an analysis of Polish stations is offered, since arguably the history and indeed the culture of the country differ from those in Britain, and are reflected in station design. Six influences on design are recognised, although there is inevitably overlap; nor are all the influences specific to Poland.

Background

In common with other central European countries, the Polish railway system developed later than that in Britain, the first line, which linked Krakow in the south to the capital Warsaw, being opened in 1848. The reason for this tardiness was simply the late arrival of industrialisation. Lines proliferated in the 1850s and 1860s, particularly in the coal mining and iron producing areas in Silesia in the south. That the important textile centre of Lodz, heavily reliant on export markets, was not linked to the network until 1866 is indicative of the slow progress made. By the last two decades of the nineteenth century the system was largely complete, and included a narrow gauge network, especially comprehensive in the Prussian controlled areas. The narrow gauge network had a route 'mileage' of 2734 km in 1985. (It should be remembered that towards the end of the eighteenth century Poland was partitioned between Austro-Hungary, Prussia and Russia, a situation that endured until 1919 when Poland became independent). At the end of the nineteenth century and up to the First World War standard gauge lines were laid to the spa towns in the mountainous regions in the south. Under communism some of the larger stations were modernised in the 1960s and 1970s. Towns mentioned in the text are mapped in Fig. 21.

Figure 21. Map showing the locations of the stations mentioned in the article.

The Influences *1. Economics*

Irrespective of whether they were private companies offering a service in order to make a profit, or state concerns with social and economic motives in mind, railways built large stations in large towns and small facilities in small towns. Not only were the large town stations sizeable, but also they made an architectural statement, for it was widely believed that visually impressive structures would encourage passenger traffic. Just as in Britain, for instance, the London termini fitted the model, so in Poland Warsaw, Krakow, Wroclaw (Breslau), Lublin, Gdansk (Danzig) and Poznan (Posen) conformed to the rule. However, there are exceptions to every rule, and unaccountably some elaborately large buildings were constructed in relatively small towns. Two in particular were strikingly out of kilter: Skierniewice (Fig. 22) and Aleksandrow Kujawski. Both are long, multi-storey stations with many large rooms on the ground floor, far in excess of passenger needs, and indeed of the administrative staff. Doubtless the station master had some accommodation on the first floor, but it is unlikely that such would have been offered to other railway workers. In fact, in both cases, the stations are the largest buildings in their respective towns, larger than the town halls which were normally accorded size to emphasise civic dignity and authority. Neither were important junctions, which might have explained the conundrum. Skierniewice, which lay on the original Krakow-Warsaw line, was a junction for Lowicz, a modestly sized town, while Aleksandrow Kujawski was the junction for the small spa town of Ciechocinek. No satisfactory reason for what seems to be economically unjustifiable has yet been advanced.

Figure 22. The enormous station at Skierniewice, 1848, far in excess of operational requirements. (photo 1995)

Figure 23. Klodzko, a junction for lines penetrating the Sudeten mountains. The central and gable ends are unusual, while the stucco has been painted a pleasing pink. (photo 1995)

Instances abound of middle-sized stations located in middle-sized towns; a good example is that of Klodzko (Fig. 23), where the building is redolent of a large house, in fact a common sight, one deriving from the mind-set of local builders used to putting up houses rather than special structures.

Figure 24. Ciechocinek, 1867, an unusual single storey building with large waiting rooms. (photo 1994)

The seasonal nature of resort towns, which typically double their population during the summer holidays, and in mountain areas in the winter ski period too, caused their stations to be larger than expected, at least if size is measured by the number of permanent residents. The railways had a vested interest in encouraging passenger traffic and considered that large stations would impress the middle class tourists of the later Victorian and Edwardian times. Ciechocinek (Fig. 24), north-west of Warsaw, was a fashionable but small spa, whose station reflected the importance of the visitors. In any case the lines to the mountain resorts and spas were expensive to construct, even if they were usually single track, so relatively costly station buildings were submerged within high overall costs. Wisla Uzdrowisko (Fig. 25) and Ladek Zdroj (Fig. 26) are relatively large stations in small mountain spa towns.

At the bottom end of the scale, small houses without a platform canopy serve as stations for villages, the smallest being no more than two rooms, one for the ticket office and the other for passengers. Costs were not always minimised, however, for in mountain districts where winter temperatures seldom rise above 0 °C, the waiting room typically has a huge self-standing stove dispensing real warmth. On the other hand, toilet facilities were not provided. Wisla Oblaziec (back cover, lower picture) is such an example.

Figure 25. Wisla Uzdrowisko, 1932, in the Sudeten mountains. Fencing has been added between the tracks. (photo 2004)

Figure 26. Ladek Zdroj, 1912, a middle sized station for a small spa town. (photo 1995)

Almost all the narrow gauge stations are small, a good many verging on the rudimentary, since most of the lines served sparsely populated rural areas, mostly carrying agricultural workers in the days before bus services came upon the scene. Inevitably stations were basic. The station building at Milejowka (Fig. 27), for instance, resembles a roadside kiosk, lacking a platform. Occasionally no building at all was provided, the station comprising a platform slightly above track level and a station sign, as at Ozorkow (Fig. 28). Some terminal stations on narrow gauge lines were of the same size as on small standard gauge lines, especially when they served small towns unconnected to the standard gauge network. An instance is Rawa Mazowiecka (Fig. 29), with a population of 20 000, whose needs were met by a narrow gauge line linked to a main line some l 5 km distant.

Figure 27. Milejowka narrow gauge station near Piotrkow Trybunalski, a railway structure pared down to its bare essentials. (photo 1995)

Figure 28. The truly basic marrow gauge station at Ozorkow, 1891. (photo 1994)

Figure 29. The well maintained narrow gauge station at Rawa Mazowiecka, 1895. (photo 1995)

Figure 30. A narrow gauge 0-8-0 built in 1955, about to depart from Rawa Mazowiecka to link with the mainline at Rogow. Standard gauge freight wagons are carried ‘piggy back’ on narrow gauge flats. Fortunately there are no bridges on the line. (photo 1995)

2. Politics

To British eyes this may seem an unusual influence on railway station structures, but in common with many European countries, the Polish system was largely provided by the state, giving political issues considerable importance. The political division between Austro-Hungary, Prussia and Russia has been mentioned above, but the point here is the substantial difference in standards of living that existed in Russian controlled Poland compared with the areas of the other two powers. Prussian cities such as Gdansk, Poznan and Wroclaw, together with Austro-Hungarian Krakow, generated imposing structures in line with the wealth of the controlling powers.

Figure 31. Lublin station, rebuilt in 1877, a good example of baroque architecture. (photo 1991)

Figure 32. The elegant station at Sosnowiec, 1859. 'Dworzec Kolejowy' means 'Railway Station'. (photo 1994)

Warsaw was the only great city in Russian Poland, with the possible exception of Lublin and Lodz, effectively a large industrial centre little concerned with passenger traffic. Much of Russian Poland was agricultural, with wealth for the most part in the hands of large landowners, nor did the Russian administrators have much incentive to develop the economy of their colony. That track in Russian Poland was 5 ft gauge, necessitating costly transfers at border points and further hampering change. The consequence was that very few stations in Russian Poland were either outstanding or larger than expected. An exception was Lublin (Fig. 31) with its crenellated facade, exploded pediments and twin entrance towers. On the other hand, the station at Lodz was architecturally bland and smaller than the city's population would seem to merit (by the end of the nineteenth century it was the second largest city in Poland). Inevitably there were exceptions, other than Lublin, one of which, the huge Skierniewice, has been mentioned above. A second is Sosnowiec (Fig. 32), just within Russian Poland in Silesia, boasting (for Poland) classical overtones. Why Sosnowiec was so treated is unclear; perhaps its border location is the answer, the Russian authorities making a point.

Figure 33. The water tower at Wloclawek, 1862. The tank is clad to prevent ice forming in winter. (photo 1994)

While not an essential feature of all stations, large water towers were built at many points in Russian Poland, their location ensuring that engines hauling troop trains should never be inconvenienced by water shortages. Indeed, the shape of the Russian network was in part determined by the use of railways to move troops to border points (Westwood, 1964). In this sense the Russian system predated the German autobahn, whose military significance was at least as important as economic. The water tower at Wloclawek is shown in Fig. 33.

It was communist policy to refurbish, and to construct new buildings as proof of the validity of the doctrine. Perhaps the best known example is the rebuilding of the Old Market in Warsaw, destroyed in the Second World War, using old plans

Figure 34. The rebuilt Warsaw City station, 1949. (photo 1994)

and photographs to recreate an eighteenth century environment. Unfortunately railway stations did not fit easily within this framework, demolition of the old and erection of the new being preferred. This was the fate of Warsaw Central, Poznan, Katowice (the major nodal point in Upper Silesia) and Czestochowa (an important junction of lines from Krakow and Katowice to Warsaw). The new stations are of ferro-concrete and glass, with ample space for shops, snack bars, restaurants and large numbers of ticket points. They are arguably soulless places. A pleasing contrast is Warsaw City (Fig. 34), a single storey building in white artificial stone and glass.

The narrow gauge system was retained by the communist regime since it provided a useful complement to rural bus services. No new lines were constructed and the original stations remained in use. In a more cost-conscious political system, closure would have been much more rapid. Under market conditions, car ownership has risen, rendering narrow gauge passenger services unjustifiable.

3. Aristocratic Association

Lines passing through land belonging to the aristocracy were sometimes graced by architecturally elegant stations, even though they handled only a small number of passengers. No doubt the clout possessed by the aristocracy in government decision-making was the root cause. Such stations may have been few in number, but at least their aristocratic association does explain their discordant nature. Prime examples are Radziwilow (Fig. 35), named after the family, one of whose members managed to flee to the USA after the Second World War, and married Tsa Tsa Gabor, no less, Pruszkow (Fig. 36)

Figure 35. Radziwilow, 1845. Unaltered since traffic never increased. (photo 1995)

and Grodzisk Mazowiecki (Fig. 37). All three were located on the first line between Krakow and Warsaw. Even narrow gauge stations close to stately homes were accorded the treatment; Wilanow (Fig. 38), on the southern edge of Warsaw, is adjacent to one of the largest aristocratic homes in Poland.

Figure 36. Pruszkow,1845,. There are similarities with nearby Radziwilow, not least the use of buttresses. (photo 1995)

Figure 37. The classical Grodzisk Mazowieki, 1845, redecorated in 1995 to celebrate the 150th anniversary of Polish railways. (photo 1995)

4. Materials Available

Brick was the standard material used in the construction of the majority of stations until the rebuilding of the 1960s and 1970s, when ferro-concrete was employed. When poor quality brick was used, the strategy was to stucco it with a coat of mortar to improve the weathering quality. Ageing has resulted in a notably grey and even drab aspect in both urban and rural areas where the ravages of smoke pollution were largely absent. Trzebinia (Fig. 39) is an urban example; Radziwilow (Fig. 35) and Pruszkow (Fig. 36) are rural examples. Here and there stations have been emulsion painted by PKP, the state railway company, the bright colours if anything making an almost discordant statement. Lodz Fabryczna (Fig. 40) is now one of the cleanest buildings in the city.

A feature of platform canopies, even in the Silesian industrial districts, was a reliance on wood, not only for the beams and other roof supports, but also for columns. Since the country was heavily wooded, timber was routinely employed in industrial buildings, wooden framed textile mills still being constructed in the 1860s (Riley, 1998). Such an example is Wisla Uzdrowisko (Fig. 41). Wood was used for station buildings themselves in mountainous regions, presenting an image redolent of a woodman's hut; canopies were not provided. Wisla Oblaziec (back cover) is a case in point.

Figure 38. An unusually decorative narrow gauge station at Wilanow, 1892, on the edge of the eponymous estate. (photo 1995)

Figure 39. Even in the sun the stucco at Trzebinia, 1847, is hardly impressive. The canopy is original. (photo 1998)

Figure 40. The white-painted stucco Lodz Fabryczna, 1866. (photo 1994)

5. International Architectural Influence

By the time railway stations were being built, architecture had already achieved an international dimension, with the consequence that many early British stations, for instance, were given classical, Italianate and baroque styling. The same held for the larger Polish stations, above all in the Prussian and Austro-Hungarian controlled areas. Sosnowiec (Fig. 32) has classical overtones, while Wroclaw (Fig. 42), Gdansk (Fig. 43) and Lublin (Fig. 31) are baroque in manner. Smaller stations tended to reflect local vernacular architecture.

Figure 41. Timber is used for both columns and roof supports at Wisla Uzdrowisko, 1932. (photo 2004)

6. Established Practice

It is not always possible to separate Polish from continental practice, but setting this on one side, Polish stations certainly differ from those in the UK. Perhaps the most obvious characteristic is the absence of overall train sheds; in fact, excluding the rebuilt Warsaw Central, only Wroclaw is so endowed (Fig. 44). Sheds were considered to be an unnecessary expense. Island platforms are given a single number, making it impossible to predict which of the two platforms will be used. At a good number of stations the name board is at right angles to the train, helpfully restricting the information to the train crew. Low platforms are continental practice, but pedestrian bridges are uncommon, and since the tracks are not always fenced off, people simply walk across the track to get to the platform they need; at the more rural stations passengers do not always use the exit but alight and walk off as they please (tickets are checked on the train). Most stations on narrow gauge lines give directly on to the track, and as with tram systems, the onus of safety is firmly placed on passengers and indeed pedestrians, as at Starestwo (Fig. 45). The largest stations have restaurants in addition to snack bars; at Wroclaw the waiters are resplendent in dinner jackets and the food is excellent. Toilets are to be found at the majority of stations, but curiously enough they are frequently located in a separate building, guarded by formidable ladies insisting on a fee. Such 'manned' toilets exist at stations where there may only be 10 or so trains a day - a relic of communism when everyone had a job.

Figure 42. Baroque styling is much in evidence at Wroclaw Central, 1856. (photo 1996)

Conclusion

It maybe difficult to isolate the decision-makers in railway station design - the railway authority, architects, local builders, received architectural practice, or even Polish culture - but they were all subject to overriding influences. The six advanced here are doubtless subjective, but to treat stations as a function of influence is arguably more analytical than simple description.

Figure 43. Even the rail side of Gdansk station, 1852, is resplendent with eclectic touches. (photo 1990)

Figure 44. The gable ends of the Wroclaw train shed. (photo 1996)

References:

Biddle, Gordon, *Victorian Stations*, David and Charles, (1973)

Insall, Donald, 'Railway Station Architecture', *Industrial Archaeology*, **4**(4), 293-310, (1967)

Lloyd, David, 'Railway Station Architecture', *Industrial Archaeology*, **4**(3), 185-29, (1967)

Mainstone, Roland J, *Developments in Structural Form*, Penguin, (1975)

Riley, Ray, 'Lodz Textile Mills; Indigenous Culture or Functional Imperatives?', *Industrial Archaeology Review*, **20**, 91-104, (1998)

Sutherland, R J M, 'Shipbuilding and the Long Span Roof', *Transactions of the Newcomen Society*, **60**, 107-26, (1988-9)

Westwood, J N, *A History of Russian Railways*, Geo Allen & Unwin, (1964)

Station dates are taken from Glowny Urzad Statisticzny, *Historia Polksi w Liczbach*, **5**, Transport Lacznosc, 84-90 (1995)

Figure 45. The narrow gauge station at Starestwo has a pedestrian pavement between it and the track, while residents drive their cars over the track to access their property. The similarity to an urban tramway is obvious. (photo 1995)

The Victorian gunboat *Handy**

Stephen Dent & Ian Sturton

Lying in a creek at the back of Portsmouth Harbour is a remarkable survival of the Victorian navy: the 'flat-iron' gunboat *Handy*. The gradually decaying hulk of the gunboat, originally built in 1882-3, has for some years rested on the mud at Pound's Yard, surrounded by many more recent naval vessels being broken up for scrap at the end of their active lives. In 2006, with the yard due to be redeveloped, Warship's Assistant Editor, together with a photographer, received permission from the owner, Harry Pound, to visit the yard while working on the new edition of the book *Send a Gunboat* by Antony Preston and John Major.

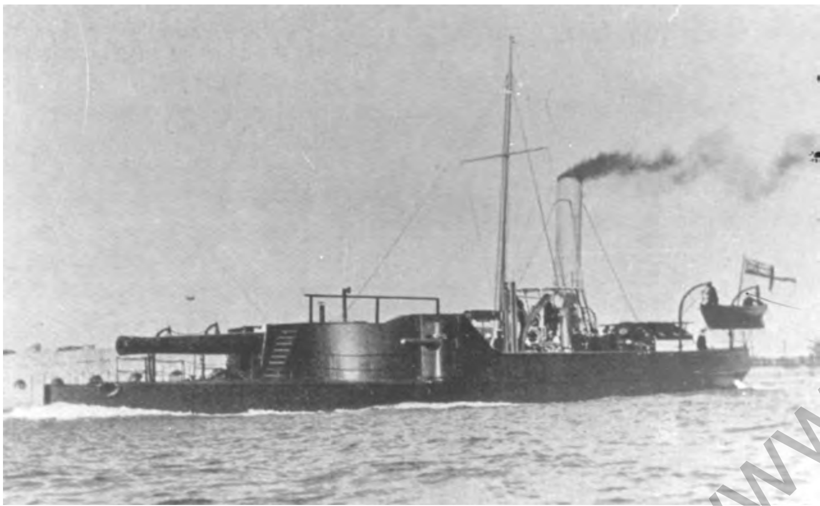


Figure 46. *Excellent*, ex-*Handy*, mounting a 12 inch gun, leaving Portsmouth Harbour in about 1895. (Peter Brook Collection)

Handy was originally built by W. G. Armstrong, Mitchell & Co Ltd. of Newcastle upon Tyne, for the purpose of testing guns and mountings produced by Armstrong at Elswick. Completed in 1883, at 115 ft long, 37 ft wide and 8 ft draught, she displaced 523 tons and was similar to, but rather larger than, the numerous 'flat-iron' gunboats of the *Ant*, *Gadfly* and *Bouncer* classes. Her compound engine powered a single screw and gave her a speed of 9 knots. Bought by the Admiralty the following year, *Handy* was used for the same purpose as for which she had been built, serving as tender to the gunnery school HMS *Excellent*, whose name she took in 1891.

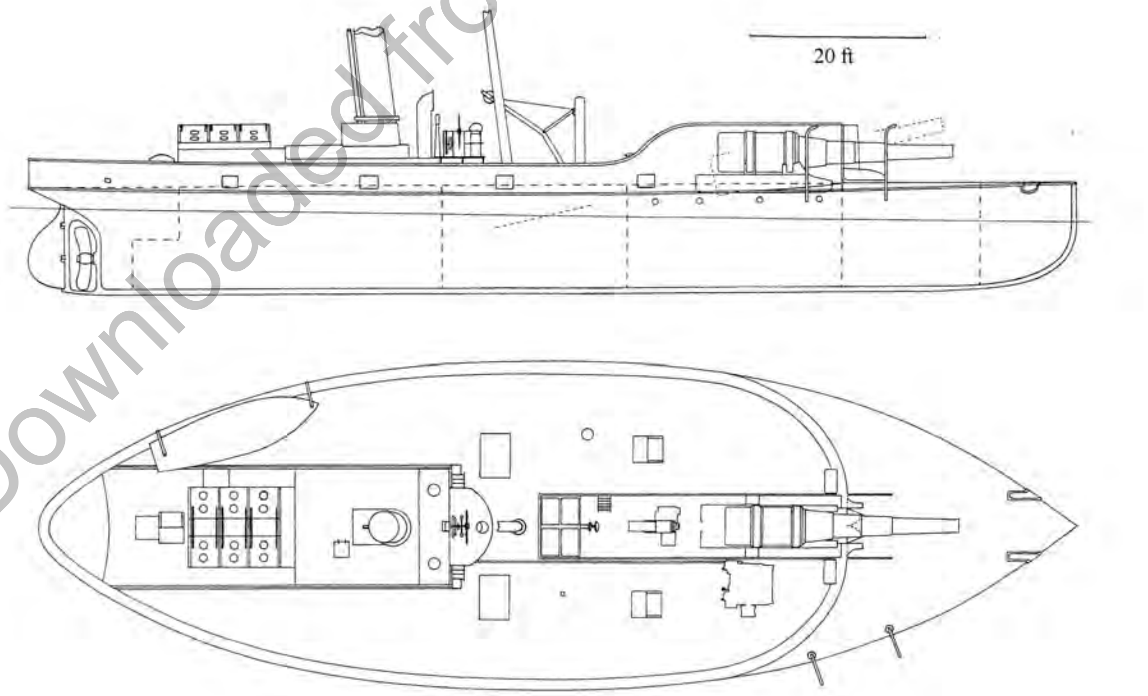


Figure 47. Plan and profile of gunboat *Handy* as built. Based on plans Nos. 5571 and 5571A held by the Municipal Industrial Museum, Newcastle-upon-Tyne. . Gun outside of breastwork (probably 13.5 inch BL of 1880s) not drawn to scale (note on No. 5571). Heavy dashes denote bulkheads, light dashes gun in loading position.

She carried a wide variety of guns and mountings during her career, from 13.5 inch down to 4 inch, and during the First World War served off the coast of Belgium as part of Rear-Admiral Hood's bombardment force, after it had become apparent that heavier guns were needed than those which were currently being used. At the time she mounted a 9.2 inch gun on an open platform – the 9.2 inch she carried prior to the war was a Mk. X in a Mk. VS mounting, the same as those on the battleships of the *King Edward VII* class (see *Warship* 2002-2003) and the armoured cruisers of the *Black Prince* and *Achilles* classes.

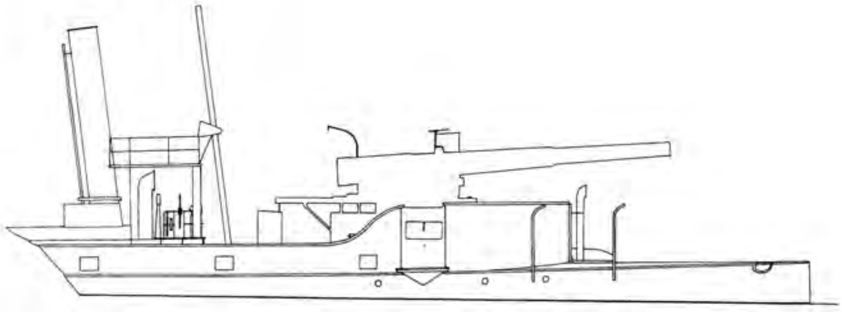


Figure 48. Schematic waterline profile of forward part of gunboat *Excellent* (ex-*Handy*) as during the First World War, with 9.2 inch gun.

Renamed *Calcutta* (December 1916) and then *Snapper* (August 1917), she was sold in April 1922 to Dover Harbour Board, which converted her for use as a floating crane. At this time she acquired another new name; *Demon*. Although almost certainly the longest lasting of all of the 'flat-irons', *Handy* was hardly unique in having a lengthy and varied career. Part of this may be attributed to their extremely stout construction, which as well as being necessitated by their carrying unusually heavy guns for vessels of their size was also a feature of many warships of that era. The 'flat-irons' also owed their longevity, ironically, to the fact that they had quickly been made obsolete by the development of mines, torpedoes, and torpedo boats, which had taken away their original coast defence role and meant that many were soon relegated to assorted subsidiary duties or sold into commercial service. For this, their shallow draught, their great manoeuvrability (the original twin-screw 'flat-irons' could turn in their own length, thanks to their screws being able to be reversed against one another) and stability resulting from their hull form, as well as their inherent sturdiness, meant that they were ideally suited. While some fell victim to the 'Fisher Axe' in the early years of the twentieth century, many survived in some form or other into the 1920s and beyond.

Figure 49. A port side view of *Demon* (ex-*Handy*) as she is today. Note the line of the breastwork on the deck forward, and the deckhouses (engine room skylight and boiler cover) placed on the deck.

Pound acquired the old vessel in the early 1970s, demolishing the crane but retaining the hull and machinery. However since then the deckhouses have been removed and stacked on the fore-deck, and the machinery taken out and placed on the quayside in the yard. Although *Handy* no longer floats, much of her hull and many of her fitting still survive, testament to the toughness of her iron construction. In store at the 'Explosion!' Museum of Naval Firepower across the harbour in Gosport are two gun mountings

Figure 50. The starboard bow showing the name *DEMON* painted on. M275 in the background

thought to date possibly from her time as a trials vessel.

Pound's Yard occupies the site of the former Tipner Naval Ordnance Depot, which had been taken over from the Ministry of Defence at around the same time as *Handy/Demon* was acquired. The yard, which contains a number of Grade II Listed Buildings, including the late eighteenth century powder magazines, the cooperage, shifting room and perimeter wall, is to be redeveloped, possibly as a new football stadium for Portsmouth FC. In the light of this the gunboat's future must lie in the balance: surely it would be a tragedy if the will – and the funds – cannot be found from somewhere to preserve this vessel which, while small and unspectacular, has survived for over 120 years and been part of the histories of Tyneside, Portsmouth, Dover and the Western Front.

Figure 51. Detail of the stern showing rudder, propeller and surviving bulwarks

Figure 52. Looking aft at the boiler and engine rooms. Nearer the camera can be seen the curved supports for the single scotch boiler. Alongside the boiler room are the three coaling holes in the deck above the bunkers. The engine room is the narrower space towards the stern.

The layout of *Handy* as built. An annotated sketch plan in the Discovery Museum, Newcastle, based on the original plans, shows the internal arrangements of *Handy*. The officers' and crew's quarters were forward, both accessed from the upper deck, with the former to port and the latter to starboard; then the magazine and shell rooms (to port and starboard respectively); then their respective handling rooms with hatches to the upper deck; and then the boiler and engine, in one compartment with coal bunkers to each side.

A single scotch boiler provided steam to a two-cylinder compound steam engine by Ross and Duncan. The cylinders were 21 inch (533 mm) [hp] and 38 inch (965 mm) [lp] diameter by 24 inch (610 mm) stroke. The engine developed 315 ihp driving a single propeller of 9 ft (2.7 m) pitch.

Figure 53. Parts of the engine lying alongside. The engine bedplate, with crankshaft bearing housings cast in, carries the four columns to support the cylinders (hp on the right, lp on the left). The lp columns are cast in with the surface condenser which connects them across the stern of the engine. The lp cylinder is on the ground at the left.

* Adapted from an article of the same name in *Warship* annual for 2008.

References

Anderson, Richard M, 'Flatirons: the Rendel Gunboats', *Warship International* vol.**13**, no.1, INRO, Virginia, (1976)
Brook, Peter, *Warships for Export: Armstrong Warships 1867-1927,* World Ship Society, Gravesend, (1999)
Campbell, NJM, 'British Naval Guns 1880-1945, no.7', *Warship* no.**24**, (ed. R. Gardiner) Conway Maritime Press, London, (1982)
Evans, David, *Arming the Fleet: the Development of the Royal Ordnance Yards, 1770-1945,* Explosion! Museum of Naval Firepower, Gosport, in association with English Heritage, (2006)
Gardiner, Robert (ed.), *All the World's Fighting Ships, 1860-190,5* Conway Maritime Press, London, (1979)
Hepper, David, *British Warship Losses in the Ironclad Era* Chatham Publishing, London, (2006)
Preston, Antony, & Major, John, *Send a Gunboat* , Longman, Green & Co. Ltd, (1967), revised edition published by Conway Maritime Press, London, (2007)
Warlow, Lt. Cdr. B, *Shore Establishments of the Royal Navy*, Maritime Books, Liskeard, Cornwall, (2000)
National Historic Ships Register: http://www.nhsc.org.uk

Thanks to D K Brown, Wyn Davies, the Discovery Museum, Newcastle.

Lighthouse Optics

Keith Morton

1. Centuries ago

Sailing towards a landfall in winter, at night with low cloud and rain – the last know position was at midday the previous day using a chronometer, sextant and a plotting table – are we really on track with no helpful indication of where land or rocks might be? You could not have been in a worse situation in the early days of trading by sea. In the early days it was not unknown for the wives of captains of fishing smacks to light a candle in a window to show where the entrance of a harbour might be, to assist them in their safe return.

2. The first lighthouses

The first improvement over lights in windows saw the first purpose built buildings in the form of towers. The light was only a simple fire on top and to pay for this service, ships would be required to pay dues that were based on their tonnage. One might think that every headland and rock should have a light but clearly this was not practical and would have been most expensive, so lights were only established adjacent to the important and frequently used harbours and where shipping lanes passed close by. These early lighthouses were all privately owned and if they were able to collect the ships' dues then they would stay alight; if not they would soon fade. Hence some organisation was required to maintain the operation of lights so, as early the sixteenth century, legislation was passed to provide an Authority to manage and take responsibility for the provision and maintenance of lighthouses. It was not until 1836 however that Trinity House was granted absolute authority to procure all exiting privately owned lighthouses. The Authorities that were established in the United Kingdom were:

Trinity House for England, Wales and the Channel Islands,
The Northern Lighthouse Board for Scotland and surrounding Islands, and
The Irish Lighthouse Board for Ireland.

A similar pattern of authorities also evolved throughout the remainder of the world.

3. The positioning of lights

The purposes of lights are several fold:

to mark a headland,
to mark rocks or sandbanks,
by the use two lights – one higher than the other – to mark a bearing or a track for ships to follow either into or out of a harbour.

The higher the light is positioned above Mean Sea Level [MSL] the further it can be seen, but clearly there are limits – one consideration is the overall height of a structure to support the light. More important from a practical and visibility point of view is effect of low cloud which can easily obscure the light, making it useless at the time that it is most needed. The type of cloud giving rise to this problem is know as Orographic Cloud which is formed by damp air rising up over cliffs and headlands, usually on the prevailing wind. Many early lights were positioned on top of high cliffs before this problem was realised and had to be rebuilt later on the lower slopes so that the light was now below the top of the cliffs. Such an example of this is on the Isle of Lundy, where the old light was built on the highest point of the island and needed to be replaced by not one, but two, lights one at each end of the island. Closer to home, the original light at the most southerly point of the Isle of Wight was on top of St Catherine's Down some 700 ft (200 m) above MSL – the replacement light built to replace it near the shore line was still too high and the lighthouse had to be further shortened before is could provide a reliable light as we see today.

Generally lights are no more than 200 ft (60 m) above MSL which would give a range to an observer at sea level of 16 nautical miles (NM) [1 NM = 1.85 km]. However, this range is increased by 6 NM if the observer is above sea level such as on the bridge of a ship which may be some 30ft (10 m) sea level, giving a total range of 22 NM.

4. The range of the light

One factor affecting the range is the height of the lamp above MSL. As light travels in straight lines, a simple calculation which takes into account the curvature of the surface of the Earth, the height of the lamp, and the height of the observer, gives the range. Life is not that simple as there has to be sufficient transmitted light available to reach the observer for the observer to see it. It does not need to illuminate the observer, it just has to be perceptible to his eye.

Other factors which take their toll on the amount of light received include pollution in the atmosphere – this is very dependant on the weather since, if a depression is dominating the weather at that time, then this will cause all the particles in the air – dust, smoke, water vapour, etc. – to be sucked up into the upper atmosphere leaving clear air at the surface. Conversely, if high pressure is dominating the weather, then this will cause all the particles in the air to sink down into the lower atmosphere and we have the well known anticyclone gloom. In such a situation the light received by an observer is very much reduced which obviously reduces the range at which the light can be observed. Other effects during anticyclonic conditions are caused by radiation fog and sea fog which often occur when the air temperature is at its lowest at around 0500 h. In thick fog, a light is rendered totally useless and then we have to resort to fog horns – another subject.

5. Sources of light

The first lights were simple fires which were not very effective and were also very labour intensive in that coal or wood had to be carried to the top of a tower. However, the last lighthouse to use such a method was in use as late as 1822. The next venture was candles, and here a quantity of candles arranged on a chandelier gave a significant amount of light. Then came oil lamps; of course oil lamps have been around the thousands of years, but such early lamps consisted of a shallow dish containing vegetable oil with a single wick. The introduction of mineral oil which was much cheaper than the previously used vegetable oils, enabled a significant step forward and lights using flat wicks were used as early as 1763. The real improvement came in 1868 with sperm whale oil and, later, mineral oils and the use of multi-wick lamps – such lamps lasted until the end of the nineteenth century.

In 1782 a Swiss physicist named Aimé Argand invented a new lamp which was to revolutionise lights in lighthouses as it produced a very bright and steady flame. The lamp consisted of two concentric tubes between which was inserted a cylindrical cotton wick. Air was drawn up through both the inner and outer tubes which greatly increased the combustion to produce the cleaner and brighter flame. These lamps were further improved by the addition of a glass chimney and later Fresnel further improved the intensity of the light with burners having two, three or even four concentric wicks.

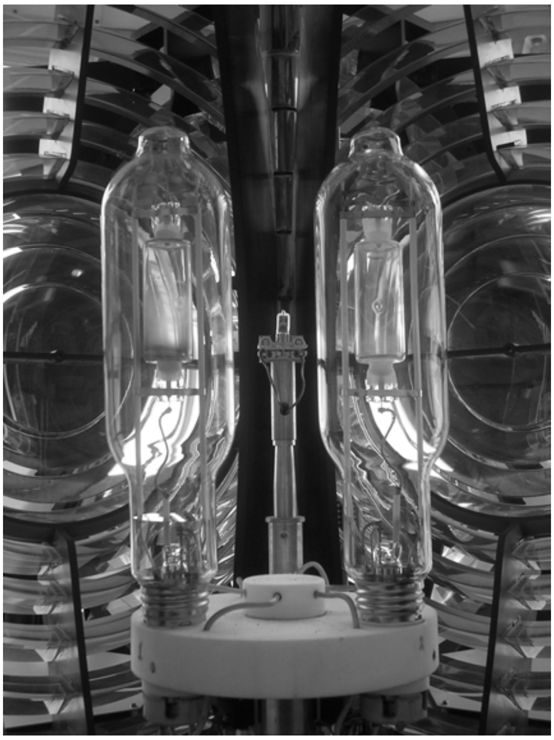


Figure 54. A pair of nodern electric discharge lamps.

During the eighteenth century, discoveries led to the production of coal gas and this in conjunction with the incandescent mantle developed by Dr. Carl Auer von Welsbach in the 1870s saw the introduction of artificial lighting on a wide scale. This was first introduced to lighthouses in Scotland, and then some in England, where a supply of coal gas was readily available.

The next major step was the development in 1901, by an American named Arthur Kitson, of a burner in which, instead of the oil being vaporised at the wick and burnt in an open flame, the vapour was produced under pressure and used to light an incandescent mantle. Liquid petroleum was heated by other jets which turned it into a vapour before being burnt in an incandescent mantle. Start-up was achieved by a spirit flame to heat the vaporiser to the required temperature. The light output of these burners was up to six times greater than the wick type of lights and so they were generally adopted as the standard in most lighthouses, where, apart from some modifications, they lasted until 1975.

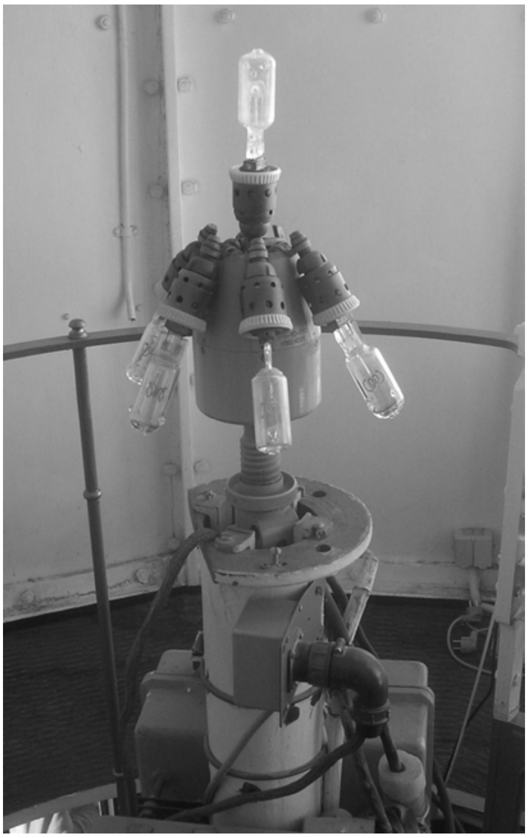


Figure 55. A typical lamp with changeover mechanism.

Lights at remote locations continued with oil until 1896 when acetylene gas was developed for lighting. It was not without some difficulties and, not until 1906 with the introduction of dissolved acetylene, could lights be powered by acetylene. Even in these early days, automation was being considered and Gustav Dalen developed a burner that made it possible for lights in lighthouses to be left unattended. The device took dissolved acetylene and air and passed them through a mixer and regulator before arriving at the burner head, - the combustion of these gases resulted in a hot non-luminous flame which caused the mantle to become incandescent. For lights to be unmanned there had to be some means of turning off the light during daylight hours so an additional device was developed known colloquially as a 'sun valve' which used the different expansion rates of dissimilar metals to operate a valve to turn off the gas supply when the sun shone on it during the day time. To enable the light to be ignited at sunset a small pilot light was kept burning all day. The other problem that had to be solved was to cover the situation if and when a mantle became damaged, allowing the flame to escape outside the mantle. The solution was to use the escaping flame to burn through a small wooden retaining peg which, when severed, would trigger a clockwork mechanism to bring another mantle into service. Acetylene gas was delivered to site in metal cylinders which weighed about 2 cwt (100 kg). At other locations, acetylene gas was generated locally by adding calcium carbide to water and collecting it in a small gas holder – an example of this is at Hurst Point Lighthouse where acetylene gas was used right up to complete automation in the mid 1990s.

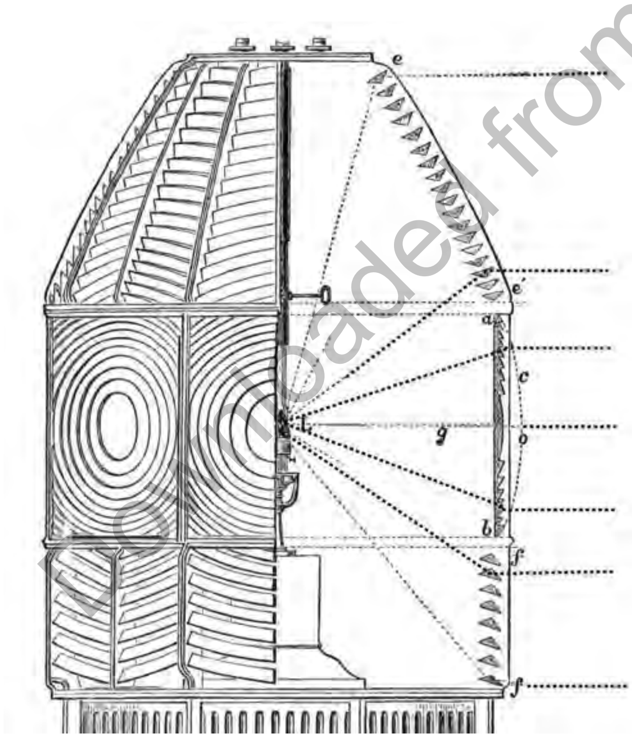


Figure 56. A section of the catadioptric optic of the light installed at Skerryvore in 1844.

The final evolution was electricity. In 1857, Professor F. H. Holmes demonstrated the first electric generator to Trinity House and it was installed in South Foreland in1858. Others quickly followed at Dungeness in 1862 and Souter Point in 1867. These early lights were arc lamps which were used until the development of gas filled electric filament lamps. Mains electricity was not used until 1922. From the mid 1980s, solar power was to become the norm at all remote sites.

6. Reflectors and Optics

The initial concern was to concentrate the light in a horizontal plane to show a belt of light all round and, later, to concentrate to light additionally in a vertical plane to provide a concentrated beam. If a beam is rotated, then to a distant observer it will only be visible for a short period and will be recognised as a flash. So, depending on the number of beams and the frequency of the flashes, this pattern or *character* can be used to identify a particular lighthouse. Where a character is only one or two flashes with a long pause making it difficult to identify, then a shielding device was used such that in the eclipse period, a dim light was provided; this is known as an occulting light.

The first attempts at directing the light were with simple polished reflectors with a parabolic shape developed by William Hutchinson in 1763. With them any light not travelling in a forward direction would be reflected from the mirrored surface into the desired direction. This system which uses only mirrors, is known as the Catoptric system and by 1790 the effectiveness of these reflectors was improved with the interior of the reflectors being silvered.

Newer designs moved to Dioptric systems which use only lenses to refract the light as it enters and emerges from the lenses. The first system of this type was installed by a T. Rogers at Portland Lighthouse around 1789. The greatest improvement to this design occurred when, in1822, Augustin Fresnel constructed a lens system in which the centres of curvature of the different rings vary with their distance from the axis, the only spherical part being the centre part or bulls-eye. This type of lens produces a narrow beam and was intended only for rotating lights. It was first demonstrated in Sweden in 1783 but it was not until 1806 that the first revolving light was installed in the UK at Flamborough Head. The first optic to Fresnel's design using both lenses and mirrors was used in France at Cordouon Lighthouse in 1823. Later before Fresnel's death in 1827, he designed a totally internally reflecting or Catadioptric prism system to take the place of the silvered mirrors. The first UK installation was at Skerryvore, Scotland, in 1844 (Fig. 56).

Further designs followed with the invention, by Sir James T. Chance in 1862, in which double reflections from the internal surfaces of the Catadioptric prisms were used to reflect stray light which would otherwise be lost, back through the focus of the light source. In the early days of optical lights some 13 sets of optics were manufactured in the UK by a company named Cookson's who were instructed by Léonor Fresnel the brother of Augustin. By 1851, Cookson's had ceased production and optic design and production was taken over by Chance Brothers in Birmingham, and Wilkins and Letourneau in London, who demonstrated their optics at the Great Exhibition of 1851 (Fig. 57). Chance Brothers went on to become the only manufacturer of lighthouse glasses in the UK, and examples of their work can be seen in all parts of the world.

Figure 57. The Chance Brothers optic exhibited at the 1851 Great Exhibition. (woodcut from the Great Exhibition Catalogue)

Many types of lenses were produced to suit the many different applications but all derive from Augustin Fresnel's work. He divided his dioptric lenses into orders or sizes depending on their focal distances – a division that is still used today. In general the higher the order the higher the total light output. At some locations where an exceptionally high intensity of light was required, the output was doubled by mounting one set of lenses on top of another and was known as a bi-form lens. An alternative method of doubling the power was to mount two sets of optics side by side; this configuration became known as the spectacle lens.

Light intensity is a measurement to define the power of a light. For lights detailed in the "Admiralty List of Lights", power is given in *lighthouse units* where 1 lighthouse unit equated to 1000 pentane candles. The intensity of the light beam transmitted depends initially on the luminance of the light source and the projected area of the optical panel. In practice, owing to the variability of the early light sources and the losses through the glassware, it was found that only about 50% of the theoretical value was achieved, though with additional mirrors, the output could be increased by a further 30%.

7. Characteristics of the light

To enable a navigator to determine his position in relation to the lights that he is observing, each lighthouse is given a distinctive character to distinguish it from all other lighthouses by varying the time duration and number of flashes allocated to each lighthouse. Landfall lights are the most important and hence are the most powerful and their character should be significantly different from any others within a range of 100 miles, - the character should also be easily recognisable by the mariner without the necessity to time the duration and intervals between the flashes accurately. The basic characteristics used are as follows:

FIXED [FX]	a continuous or steady light,
FLASHING [Fl]	a single flash with the duration of darkness being greater than that of the light,
GROUP Flashing [Gp Fl]	a group of two or more flashes in quick succession separated by short eclipses with a larger interval of darkness between groups,
OCCULTING [Occ]	a continuous light eclipsed at regular intervals with the duration of the light being greater than that of darkness,
ISOPHASE [Iso]	a light that shows equal periods of light and darkness,
ALTERNATING	a light which has the foregoing characteristics and which alters in colour.

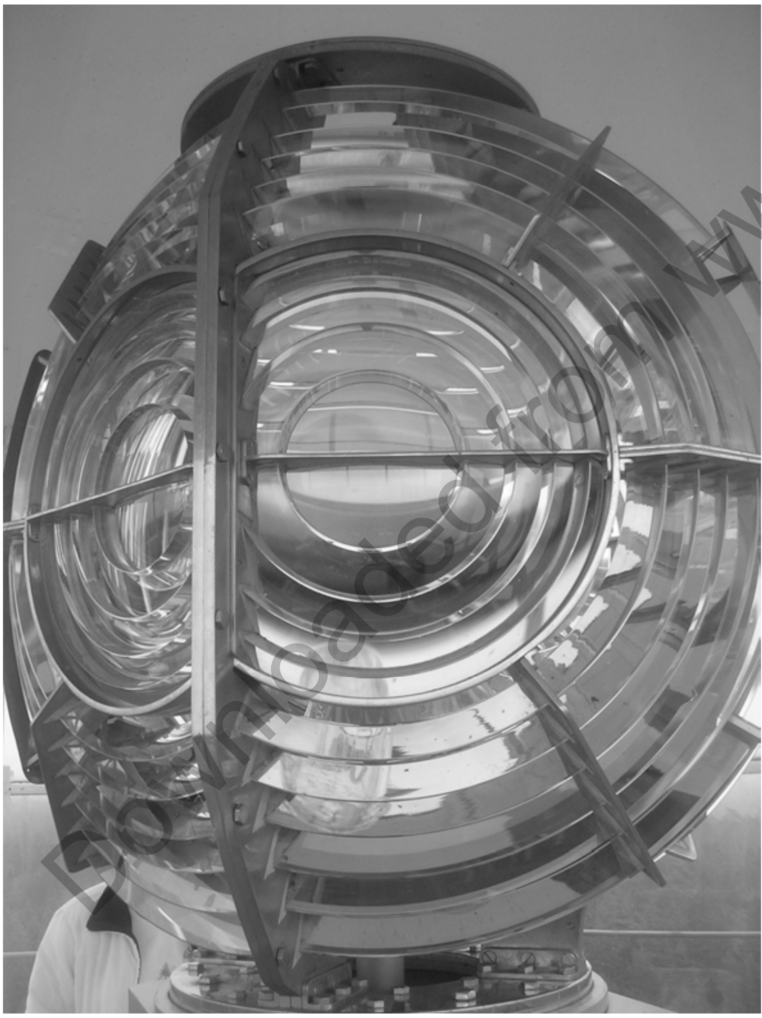


Figure 58. A typical modern two panel optic showing the dioptric centres surrounded by catadioptric prism reflectors.

The standard colours used are WHITE, RED and GREEN as these give the greatest distinctiveness and hence clear identification. Other colours are not used as they can be confused under certain atmospheric conditions. The main light is always white and the red and green colours are produced by additional coloured glass or shades fixed to the lantern framework. Sector lights – normally either red or green – are achieved by only shading part of the main light and are used to mark shoals or small groups or even individual rocks within a narrow sector from the main light. The coloured light marking the danger and the white light showing the channel. A sector light can also be used in conjunction with anther light to indicate a turning point in a safe channel and also the channel itself.

Coloured lights are not normally used to indicate main channels as the absorption of the red glass reduces the power of the light by as much as 40% and the green glass by 75%. Where alternating colours are employed the lights are equalised by the use of intensifying lenses or prisms.

8. Calculating the requirements of a specific light

Height of the lighthouse - Let us assume that we have decided on a particular location for our lighthouse. Then, from a nautical point of view we need to decide at what range the captain of a ship would like to know his position before routing onto the adjacent harbour. Once we have established that then using the following formula we can establish height of our lighthouse assuming that the captain is standing on the bridge which is 10 m above sea level at a range of 15 NM, using an empirical relation

$$R_g = 2.03\ \text{NM m}^{-1/2}\ (\sqrt{h_o} + \sqrt{H})$$

where: R_g = geographical range in nautical miles (NM),
h_o = elevation, in m, of the observer,
H = elevation, in m, of the lighthouse optical focal plane,
2.03 NM $m^{-1/2}$ is a constant to allow for the refraction of the light as it passes through the atmosphere in typical climatic conditions. This refraction results from the normal decrease in the density of the atmosphere with height above the Earth's surface, which causes the rays to be refracted towards the surface, and has the effect of doubling the visual range.

Substituting these values, we find that the lighthouse focal plane needs to be 18 m above Mean High Water Level (MHWL).

Visible Range – In considering the light intensity required for any light, we first have to consider the clarity of the Earth's atmosphere. In ideal conditions there would be a transmission factor of 1, but in general it is more like 0.74. In the tropics the factor is likely to be 0.85 to 0.9 whereas in temperate climates around the UK, a figure of 0.6 down to 0.2 is more likely.

The threshold of illuminance is the lowest level of illuminance from a point source against a given background level of luminance that causes a visual response in the eye. It is generally accepted as 0.2 µlx (microlux) but for most practical purposes when identifying lights against a high level of shore illumination, a figure of 1 µlx is used.

Light emitted from a point source radiates out in all directions, hence the decrease in illuminance as the observer moves away from the light source is proportional to the inverse square of the separation. However, the beam from a lighthouse is collimated (parallel) so, with no divergence of the beam, only scattering and absorption in the atmosphere degrade the beam. Typically, a light to be observed at a range of 15 NM would require a light source of 20 000 candela (cd) at night, but would need some 70 000 000 cd in daylight.

Contrast - The ability to detect differences in luminance between an object and an otherwise uniform back ground is a basic visual requirement and is used to define the term *contrast*. The contrast at which an object can be detected against a given background 50% of the time is known as the *contrast threshold*. For meteorological observations, a higher threshold is used to ensure that he object is recognised. A contrast value of 20 (the luminance of the object light is 20 times the luminance of the background lighting) has been adopted as the basis for meteorological measurement of optical range.

Binoculars - Though it is generally assumed that observations will normally be made with the naked eye, mariners will often use binoculars since;

the characteristics of a light can be observed at a greater luminosity, particularly against background lighting conditions,

there could be in increase of about 30% in the accuracy when observing a bearing obtained from leading lights.

The most suitable binoculars for use at sea are 7 x 50 at night and 10 x 50 by day.

Optic Design Calculations - The following is a typical example of a design calculation for a new optic. The assumed requirement is for an optic to provide a double flash every 15 s with a spacing between the flashes of 3.75 s at a required intensity of 600 000 candela. The light source will be an electric lamp consuming 1 kW from a 100 V supply, and the size of the filament grid of the lamp is 100 mm high by 20 mm wide providing a luminance of 600 cd cm^{-2} at the surface of the optic.

Consider a design with two optics, each consisting of a bulls-eye and surrounding prism array. Such is called a Catadioptric system. The two optic systems are set at 90° to each other and rotated at 4 rpm. The surface area of the Dioptric, or bulls-eye, is 750 cm² [D] and the surface area of the Catadioptric, the prisms above and below the Dioptric, is 2300 cm² [K].

The first action is to decide the duration of the visible flash, taking into account the size of the filament and the distance from the bulls-eye lens (the focal distance) which in this case is 25 cm. The following formula gives the duration *t* of the flash:

$$t = \frac{60 \text{ s min}^{-1}}{2\pi} \times \frac{d}{Nf}$$

where t = duration of the flash in seconds
d = diameter of the filament in cm
N = speed of rotation of the optics in RPM
f = focal length of the optic in cm.

Substituting these values gives t = 0.19 s.

Now to calculate the theoretical total luminance I_o of the optic when stationary, we multiply the luminance at the surface of the optic by the area of the optic and a constant (0.6) to allow for the loss of light by absorption in the glass components and light which is not collected by the prism system.

$$I_o = (750 \text{ cm}^2 + 2300 \text{ cm}^2) \times 600 \text{ cd cm}^{-2} \times 0.6 = 1\ 100\ 000 \text{ cd.}$$

The actual intensity of the flash will be less than this by a factor of [$t/(t$ + 0.15 s)] for a flashing light. Using our duration for the flash (0.19 s), this factor is 0.56 so the observed intensity of the flash is 56% of 1 100 000 cd or 620 000 cd which satisfies the requirement for a flash of 600 000 candela.

Contributions supplied by:
Gordon Medlicott – Ex Trinity House Lighthouse Keeper
Roger Lea – Ex Trinity House Design and Installation Department

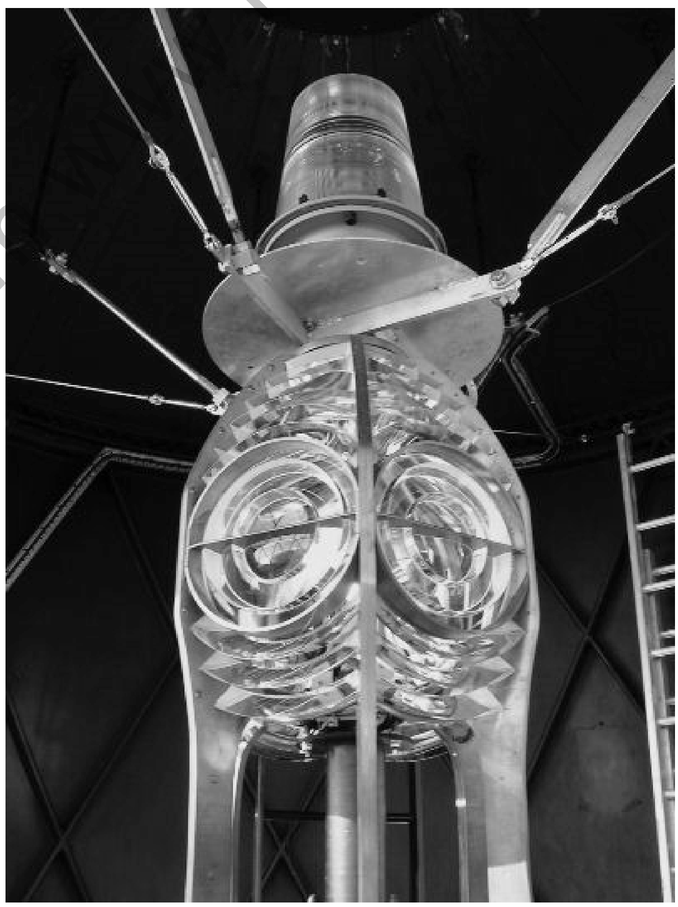


Figure 59. Modern four panel doptric and catadioptric optic with standby optic above.

Winchester's Water Works

Martin Gregory

Earlier articles in the *HIAS Journal* (1,2,3) have charted the development of some Winchester utilities in the nineteenth and early twentieth centuries. After separate beginnings in the 1830s, the water and gas undertakings merged to form a single company, 'The Winchester Water & Gas Company' which survived up to 1936 when the water undertaking was taken over by Winchester City Council and the gas undertaking by the Southampton Gas Company.

At the start of the nineteenth century, Winchester was mostly confined to the old town inside the vestigial city walls. By 1830 the town population was starting to grow and various small water companies emerged to supply their immediate localities. There are records of a 'Saint Faith's water company' in the Saint Cross area, a 'Saint Giles' water company' on Saint Giles' hill and, in 1839, a Winchester Waterworks in Romsey Road. At this time, the waterworks, with the small Roman Catholic cemetery above it, represented the highest expansion up the hill on the west side of the city. It was a small concern supplying only 30 houses in Romsey Road, Saint James's Lane and Saint James's Terrace immediately below it, down the hill.

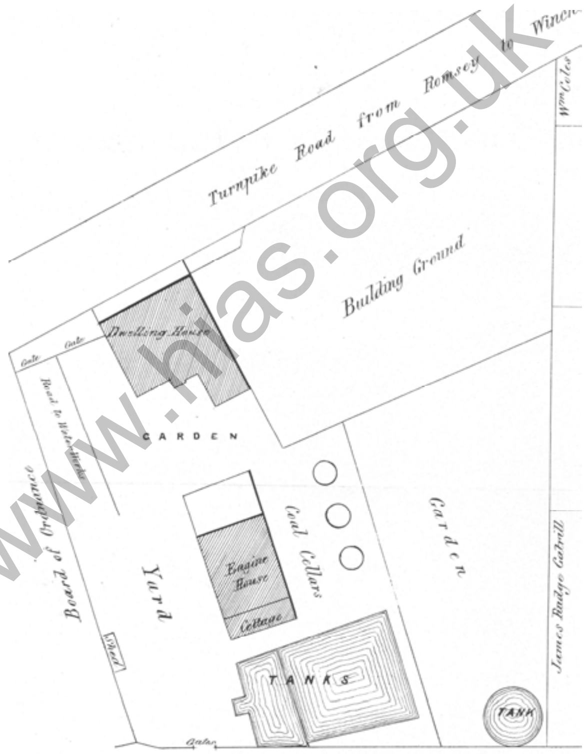


Figure 60. Map of the plant in 1854 from the auction particulars (HRO W/J5/69)

The wells sunk on the site proved to be a valuable source of water. In 1850 the Winchester Water-Works Company was formed with a capital of £15 000 as 750 shares of £20 each. A new well was sunk and mains were laid all over the city but few availed themselves of the supply so that the income of the company was very low, only reaching £650 per annum. It had laid 13 miles of mains but, of the 2500 houses capable of connection, only 700 were connected. This is the time of the 'muckabites' and 'antimuckabites' when the City of Winchester had no mains sewerage. The water company failed and was sold at auction on 12th May 1854 (4). The assets listed in the sale particulars included two steam engines, one of 16 hp and one of 10 hp, a well 190 ft (58 m) deep with a 14 inch (0.35 m) diameter rising main, a 'capital force pump to supply Houses and Premises North-West of the works and on the rise of the hill (comparatively small,- the great supply being by gravity)', three large covered tanks totalling 6000 hogsheads (1500 m^3), etc.

A prospectus was issued in 1855 for a new Winchester Water Works Company to take over the assets and raise £17 500 in £25 shares. The new company would 'secure to the Inhabitants of the Metropolis a never-failing supply of good water.' The assets taken over included 'a most valuable and extensive Freehold Property ….. with the necessary buildings, and a good family residence (for the Superintendent) let at a rental of £48 p. a.' (5). The Works contained 'two Steam Engines, of superior construction, and three large covered tanks as above. The main well was said to be 'inexhaustible'. I have not been able to identify these first two steam engines on the site.

Figure 61. Water stop tap cover for the Winchester Water & Gas Co.

The City of Winchester continued to expand westwards up the hill. The new county Gaol had opened in 1847 and the new hospital opened in 1868. These, plus new housing on Clifton Hill and Romsey Road required the water company to install larger pumps and, later, an extra reservoir further up the hill on Sarum Road. The Water Works Company, under its chairman Charles Wittman Benny (a noted local entrepreneur), was under-capitalised and struggling. In 1865, the Water Works Company was incorporated by Act of Parliament with the Winchester Gaslight & Coke Company to form the Winchester Water & Gas Company.

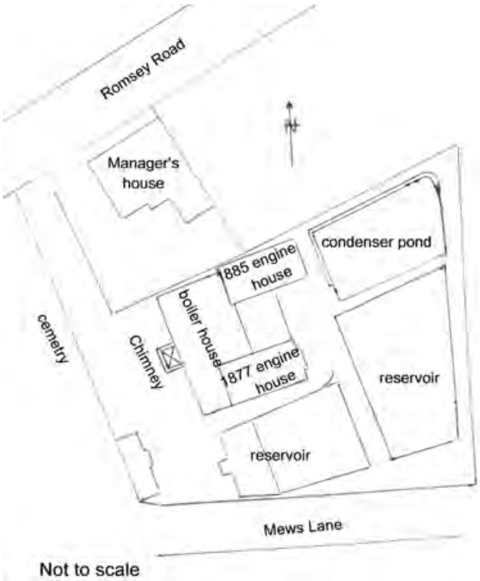
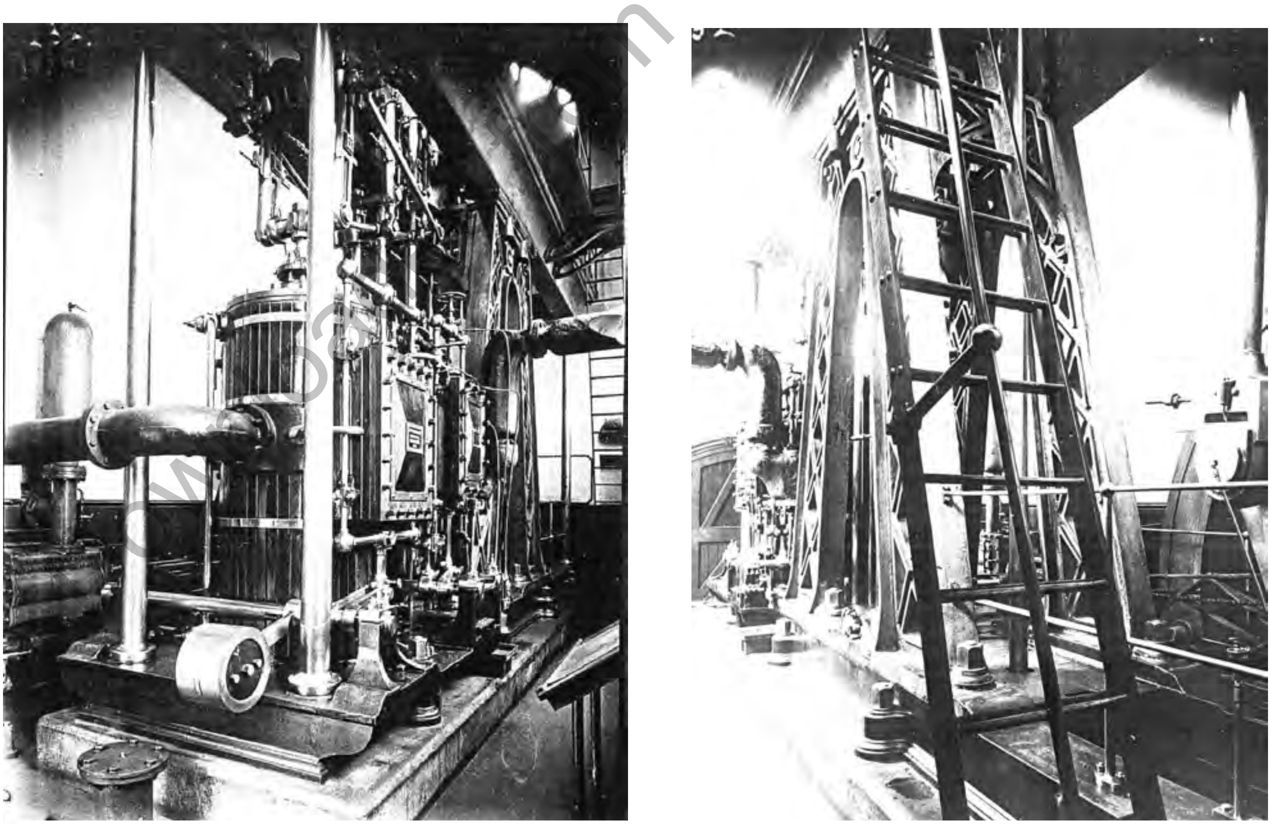


Figure 62. Sketch map of the layout of the Romsey Road station c1900.

The new company promptly spent money enlarging its plant on the Romsey Road site. A plan of 1867 (6) shows a 60 nhp steam beam engine by Easton and Anderson arranged to both raise water from the well and to pump water to the higher levels of the city. The engine house was surrounded by covered brick reservoirs and a cooling pond for the steam engine. Although both were parts of the one company, the water and gas operations seem not to have been integrated.

Winchester continued to expand and, in 1878, a start was made on mains drainage, so the demand for water increased. The site was becoming very cramped with all the available space around the pumping plant occupied by covered brick reservoirs and cooling ponds for the steam engine condensers. In 1877 the Easton and Anderson beam engine was replaced by a larger one by the same makers in a new engine house (the one that survives today). A Brighton consulting engineer, J. Paddon, was asked to draw up plans for further extensions in the early 1880s (7), as a result of which another new engine house was constructed for a second beam engine by the Lilleshall Company installed in 1885 (see front cover). The new well, called *Vice-Chairman*, is connected underground to the original well called *Chairman*. A new vaulted brick reservoir, 7 m deep, with an open condenser pond, 1 m deep, on its roof and a new chimney completed this re-organisation. Thus completed, the steam plant lasted until 1956.



Figures 63 & 64. Two views of the Lilleshall Woolf compound beam engine of 1885 (Winchester PWCM 5927 and 5928). The force pump to supply higher levels of the city can bee seen behind the engine in the left hand picture. It was driven by a belt and pulley from the engine crankshaft.

As Winchester spread to the hills around, storage at higher level was required and, in the 1890s, a water tower (now the Tower Arts Centre after being taken out of service in 1957) and ground level reservoir was built to supply the Teg Down area [8]. In the early 1900s the roofs and boiler house were rebuilt to provide a floor of offices over the boiler flues [9]. The first supply outside the city limits was to Kingsworthy in 1912. Twentieth century expansion led to other outlying villages being served and the main source of water being transferred to Easton. The Romsey Road site continues to be operational under Southern Water. The 1877 engine house and the offices over the end of the boiler house remain, though the reservoir area around the wells was sold for housing in 2007.

Figure 65. The water tower for Teg Down, now the Tower Arts Centre. The foreground is the car park on the base of the reservoir alongside the tower.

References

1. Gregory, Martin. *Garnier Road Sewage Pumping Station, Winchester*, HIAS Journal **13**, pp23-28, (2005)
2. Gregory, Martin. *The disposal of Winchester's Refuse, 1884-1974*, HIAS Journal **14**, pp 20-26, (2006)
3. Gregory, Martin. *Electricity comes to Winchester,* HIAS Journal **15**, pp23-29, (2007)
4. Hampshire Record Office (HRO), W/J5/69
5. HRO, W/J5/70
6. HRO, W/J5/33
7. HRO, W/J5/37
8. HRO, W/J5/51
9. HRO, W/J5/42

Figure 66. Engine house detail, showing cast iron window frame and multicoloured brickwork (lost in black & white!).

Figure 67. The surviving beam engine house of 1877 in 2007 at the start of redevelopment of the site.

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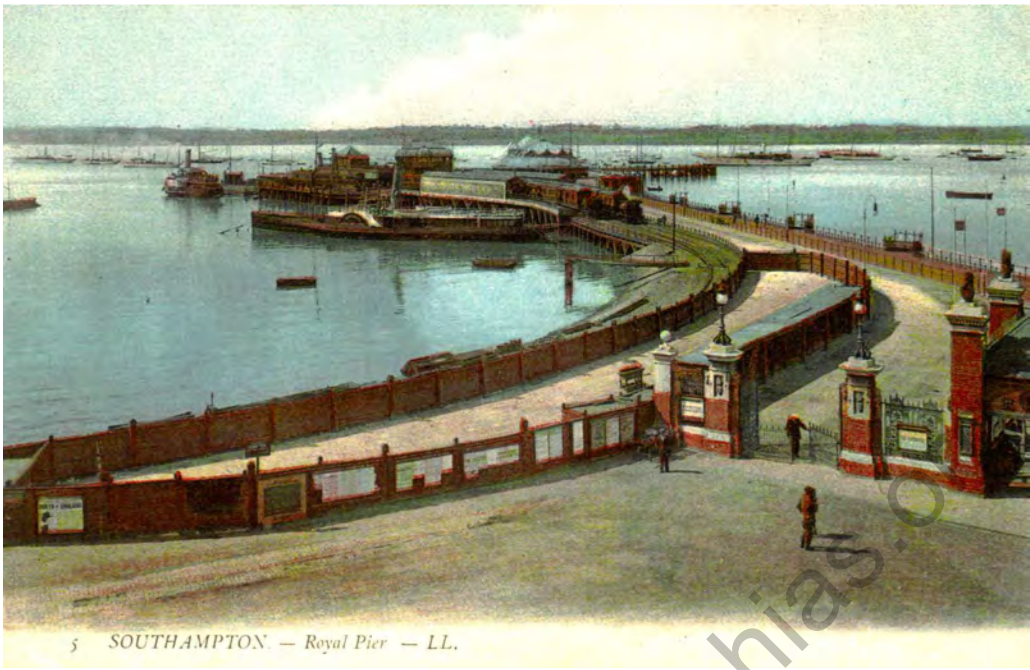

Southampton Royal Pier

A postcard from the early 1900s. Note the railway station with engine and coaches in each platform, which suggests a special occasion, perhaps a large group of Army Territorials returning from camp on the Isle of Wight. The two sets of coaches would join up at the Terminus Station. Also, the livestock pen is empty and in apparently pristine condition.

A Note on Influences on Polish Railway Station Design

A wooden station building in the Sudeten mountains, Wisla Oblaziec, 1932. The chimney for the large stove is prominent. A modern toilet has been provided beyond the building. (photo 2004)