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Hampshire Industrial Archaeology Society

Journal



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Cover photo:
Crux Easton Wind Engine – the completed wind engine on 29 September 2002 .
Was this how it looked in 1891?

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The Contributors

Ruth Andrews

Ruth Andrews grew up in Manchester, where the numerous cotton mills caused her to develop an awareness of the industrial past, although at that time she was more interested in natural history. While the latter led her into a career as a biology teacher, marrying a transport enthusiast encouraged her to pursue industrial archaeology as a full-time hobby. This, despite the constraint of living in Hampshire where the mills are of a rather different type. She is an active member of HIAS and Hampshire Mills Group.

Martin Gregory

Martin Gregory's interest in the history of technology goes back over 40 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 over 30 years and is the present editor of the Journal.

Len Tavender

Sometime engineering apprentice, draughtsman and worker in mechanical inspection. Trained in field archaeology, occasional model-maker. Author of several minor works of railway history. Owes a debt to the following scholars: Christopher Hawkes, F. W. Maitland and Michael Longridge.

John Reynolds

John Reynolds was born in 1927 and educated at the Thames Nautical Training College, HMS Worcester. While there he was privileged to receive practical instruction on board the Cutty Sark – then moored at Greenhythe – and to live ashore in an eighteenth century mansion modelled on Palladio's Villa Rotunda. He subsequently served his time with Messrs Alfred Holt and Co. On leaving the sea the author followed the career of architecture, and was latterly engaged in the care of Hampshire's historic buildings.

E Keith Lloyd

Keith Lloyd was born in a gamekeeper's cottage near Upton-on-Severn in 1942, the youngest son of a Royal Navy stoker. He was educated at Worcester R.G.S. and the University of Birmingham. His Ph.D. thesis was in combinatorial mathematics. He was appointed a lecturer in mathematics at Southampton University in 1967 and retired from there as a senior lecturer in 2001, but he is continuing to do research on mathematics and other subjects. His far-too-many other interests include transport (he was president of the Transport Ticket Society in 1988/89), philately and China. He has also published historical material on J. Howard Redfield (1879-1944), a man who worked as a civil engineer but who also did important mathematical research which was overlooked for many years.

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

Journal

Editorial and Acknowledgements

Welcome to the eleventh issue of our *Journal*. This 2003 issue shows that HIAS continues to prosper. All the contributions are written by members of the society and show the wide range of members' interests.

The restoration of the Crux Easton wind engine is a project in which members of HIAS and the Hampshire Mills Group have made a major contribution at all stages. Ruth Andrews chronicles over ten years of work by volunteers, which has resulted in the full restoration of the wind engine and its associated building. Martin Gregory has added a few historical notes on wind engines of the period. Len Tavender writes about redundant railway carriage and wagon bodies which were once a familiar sight in rural areas but which are now much rarer due to planning laws and our 'throw away' society. John Reynolds takes us back to the carriage of pilgrims on the Hajj by sea; a trade of which he had first hand experience and which has now been totally replaced by air travel. Keith Lloyd provides an account of the life and work of Peter Nicholson, architect and mathematician in an era before specialisation, in which a man could make significant contributions in many areas of knowledge.

Our thanks are due to all who have contributed to compiling this edition of the *Journal*. Particular thanks are due to Angela Smith for the design and layout for this volume. Acknowledgements and thanks for the provision of illustrations are made as follows:-
Ruth Andrews (front cover, Figs 3, 6 – 10); M S Cross (Fig 19); Mick Edgeworth (Fig 5);
Martin Gregory (Figs 12 – 18); E Keith Lloyd (Figs 37, 38, 41, 42); Alistair L Macdonald (Figs 39, 40);
Ordnance Survey (Fig 2); Lyn Peet (Figs 1, 4); John Reynolds (Figs 32, 33, 36); *Ships in Focus – Blue Funnel Line* by John Clarkson, Bill Harvey and Roy Fenton, published 1998 (Figs 28 – 31, 34, 35);
Nigel Smith (Fig 11); Len Tavender (Figs 20 – 27); Angus Taylor (Fig 43).

Martin Gregory
April 2003

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The Restoration of Crux Easton Wind Engine

The wind engine at Crux Easton is an oddity: an example of late nineteenth-century engineering which probably owes its survival to its remote location. Its restoration was made possible by the dogged persistence of a number of enthusiastic amateur industrial archaeologists and a successful Heritage Lottery Fund grant application. The aim of this article is partly to record the progress of that restoration, but also to investigate the historical context of the installation.



Figure 1: Remains of the J. W. Titt 'Simplex' wind engine and adjacent derelict well house in 1976.

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The wind engine was erected in 1891 or 1892 alongside an existing brick well house (Figure 1). It was supplied by John Wallis Titt of Woodcock Ironworks, Warminster who, from 1875, conducted a thriving business selling agricultural machinery. He designed, built, and installed several types and sizes of wind engines for clients as far away as Chile and Siberia. The one at Crux Easton is a 20ft (6m) diameter 'Simplex' self-regulating geared wind engine mounted on a 32ft (10m) hexagonal steel tower. It originally had forty eight 5ft (1.5m) sails forming the wind wheel, and it would have been connected to a pump mechanism inside the well.

In 1892 the field containing the well was part of the estates of the Earl of Carnarvon. His agent, J. A. Rutherford, wrote to J. W. Titt: *"Dear Sir, The wind engine and pumps you erected at Crux Easton have worked steadily and well since completion and are, I think, in every way a sound job"*. In 1894 J. W. Titt received a second testimonial referring to Crux Easton but this time it was from the tenant farmer S. G. Wake, who wrote: *"Dear Sir, Your wind engine, for pumping and grinding corn on this farm, has done good service. Besides pumping water it grinds frequently 8-10 sacks of corn per day. It is a cheap and most valuable improvement to this place."* These letters do not indicate whether the well itself was altered at this time, but they may imply that some ancillary machinery was added within a couple of years of the original installation.

The well itself, which is over 5ft (1.5m) in diameter, was sealed with a concrete cap in the late 1940s or early 1950s, after a cow carelessly stepped backwards over the edge and had to be rescued. When this concrete was broken up in March 2002 it exposed two intact pump rods, presumably still attached to the submerged pumps which are estimated to be about 400ft (122m) below. The water level has been measured at about 300ft (91m), but of course it varies. The pump rods now support the remains of their associated brackets, rather than the other way round. The crankshaft and layshaft, which would have connected the pump rods to the wind engine, are missing. A delivery pipe is visible leaving the well. It has been excavated outside the building and appears to lead to a site adjacent to a modern field tap, where four cast iron supports may indicate the former position of a small tank. It is thought that the water was originally pumped to a reservoir opposite the Portchester Estate cottages, and it may have supplied Crux Easton Farm (now the Manor House). It was also discovered that three lengths of the steel tower ladder had been cut up and used to reinforce the concrete cap. Several other pieces of scrap metal, including the cast iron frame of an unidentified farm or milling machine and fragments of the 6ft (1.83m) diameter belt pulley, added to the reinforcement. The belt pulley originally occupied a well-preserved pit in front of the in-situ wall bearing supporting the horizontal drive from the wind engine. Incidentally, when this pit was cleared in August 2002, it contained a thin metal plate inscribed "WAKE LITCHFIELD", which presumably once belonged to S. G. Wake, the aforementioned tenant farmer.

The restored well house retains features which probably date from 1891–1894. The roof tie beams show signs of the bearings which would have supported two layshafts whose cast iron bearing boxes are still in place in the north and south walls. It is presumed that the layshafts would have been connected to the ground floor belt pulley and would have driven the milling machinery.

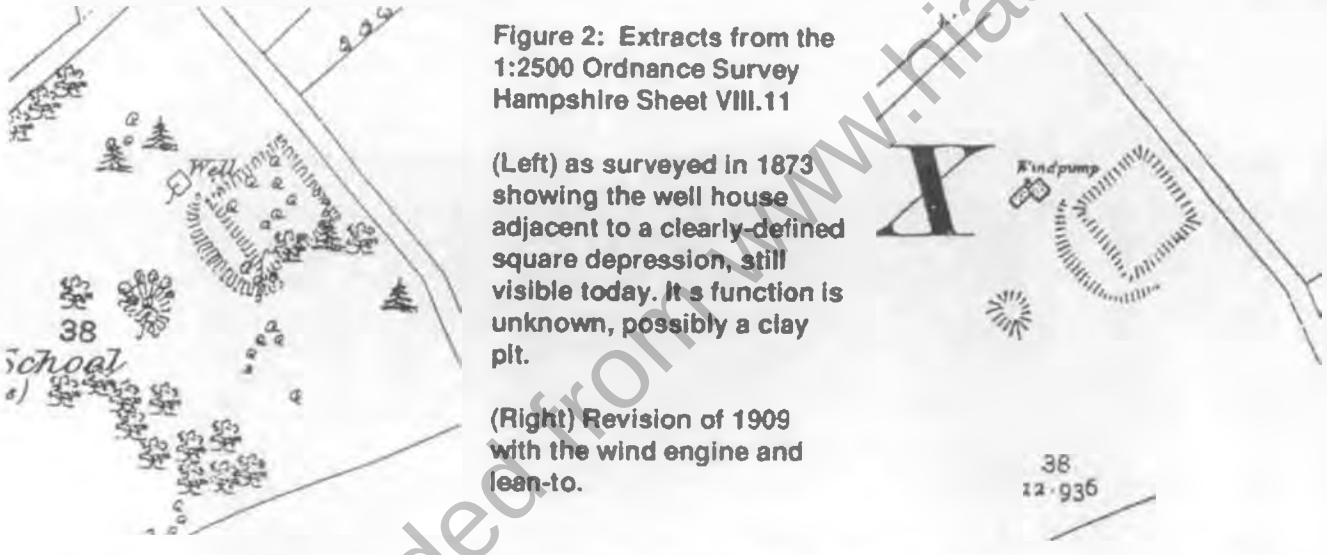


Figure 2: Extracts from the 1:2500 Ordnance Survey Hampshire Sheet VIII.11

(Left) as surveyed in 1873 showing the well house adjacent to a clearly-defined square depression, still visible today. It s function is unknown, possibly a clay pit.

(Right) Revision of 1909 with the wind engine and lean-to.

The wind engine first appears on the 1909 map. There is, however, archival evidence that the well house, and presumably the well itself, predates the wind engine. For example, it is marked on the 1873 map (Figure 2), and estate records at Highclere refer to a "mansion and well meadow". Examination of the present building reveals several structural changes which suggest the re-use of an existing building. The present first floor level does not seem to be the same as the original, and it now partly obstructs a bricked-in doorway on the south wall. The overall height of the building has been increased and the roof line may have been altered. On the ground floor, there are horizontal timbers embedded in the north and south walls at head height which bear traces of wear from revolving pulleys and shafts. It is tempting to speculate that these are either re-used timbers or that they are associated with earlier uses of the building.

During restoration work, a mechanical digger was used to uncover the exterior of the walls prior to the installation of a "French Drain" (soakaway). Two of the first items uncovered by the digger were a winding handle and a small well cover which would certainly not fit the existing well. It also exposed a heap of spectacularly patinated fragments of thick glass bottles. Excavation by volunteers has established that this glass is the remains of several hundred early eighteenth-century wine and utility bottles. At this period, bottles were frequently identified by glass seals bearing the owner's name, and sometimes a date (Figure 3). Research has established that Edward Lisle lived at Crux Easton Manor from 1678, and that his ancestors had been lords of the manor for over three centuries. It is noteworthy that he was a keen agriculturalist. He kept copious records of agricultural practice in the district, and carried out field trials of new strains of turnips and grains, as well as experimenting with crop rotation, clover, and sainfoin. He intended to publish his notes in book form, but

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Figure 3:
Two of the common seal types found, which show that the bottles were the property of Edward Lisle, and were made in 1723.

"Observations in Husbandry" was eventually published posthumously in 1757, by his son Thomas, rector of nearby Burghclere. Edward Lisle died in 1722, but one of his sons was also named Edward, so it is unclear which of them commissioned the bottles. The present manor house is marked as "Crux Easton Farm" on nineteenth-century maps; the site of the original manor house is unknown, although it is rumoured to be in the well field under a set of humps to the north-west of the well house. This area will need further investigation as will the square depression which is clearly shown on the 1873 map. Trial boreholes at various places inside the depression have shown no trace of the black organic muds which would be expected in a pond or reservoir. The area is now tree-grown, as it also appears to be on the 1873 map.

Besides being interesting in themselves, the bottles helped to date the present well house, as the glass fragments extend under the footings of the wall, and the heap appears to have been disturbed and moved upslope away from the building, perhaps during construction work.

Excavation in the area has also located a brick floor several feet below the present floor level of the well house, and to the north of it. This buried floor was disturbed by the emplacement of the concrete plinth supporting the wind engine, so it may indicate the position of an earlier well house.

The extensive area of paving to the west of the well house is the floor of a single storey shed, clearly visible in the 1920s photograph (Figure 4). The central area is badly broken, and incorporates timbers which may indicate the position of machinery; a saw bench or a portable oil engine have been suggested.



Figure 4: This 1920s photo shows men climbing the wind wheel, a few sails still in position, and the lean-to shed which possibly housed a saw bench or oil engine.

Modern interest in the wind engine began to accelerate in 1983. By this time it had been reduced to a picturesque rusty skeleton, which was beginning to disintegrate. In 1989 an application for listing was made, and in 1991 a Grade 2 listing was obtained. By this time the tower appeared to be in imminent danger of collapse, the well house was no longer weatherproof, and its wooden floor was unsafe. Research and enquiries over the next few years led to a growing conviction amongst members both of Southampton University Industrial Archaeology Group (SUIAG, now Hampshire Industrial Archaeology Society, HIAS) and Hampshire Mills Group (HMG) that the structures were sufficiently old and unique to be worth conserving. So in 1994 Crux Easton Wind Engine Conservation Trust was formed. It became a charity, number 1045447, in 1995. Also at this time Basingstoke and Deane District Council were persuaded to pay for the tower legs to be strengthened. This proved to be an excellent temporary repair which stabilised the tower for the next eight years.

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Meanwhile, the Trust began the laborious process of formulating a lottery application. This was submitted by Gifford & Partners of Southampton in April 1999, and a Heritage Lottery Fund grant of about £155 000 was allocated in August. A complete specification of the required work for the wind engine had been made, largely thanks to vast amounts of midnight oil burnt by the SUIAG and HMG volunteers' project manager John Christmas. The specification was based on engineering drawings of a similar but not identical J W Titt wind engine, which came from the Wiltshire Records Office in Trowbridge. Giffords subsequently became the consulting engineers to the whole project, both wind engine and well house. The lottery grant stipulated that significant additional funding had to be supplied by the Trust, but that this could be in the form of "man-hours", rather than money. This initially caused some consternation, but it soon became apparent that there would be plenty of work available to satisfy the requirement. By 15 August 2002, some 1668 hours (that is, over 238 days) of volunteer labour had been contributed, and the final total will be a lot more. In the wake of the successful lottery application, grants were also made by Basingstoke and Deane District Council, Hampshire County Council, and Vodafone Charitable Trust, totalling about £35 000.

The original contractors for the restoration of the well house went into receivership soon after starting work. This inevitably caused a long delay which was compounded by a six month closure of the site during the foot-and-mouth crisis in 2001. Finally, the contract was taken over by Knowles & Son (Oxford), who did the bulk of the work. This included: bracing walls, stabilising cracks in the brickwork, repointing, replacing floor timbers and roof tiles, installing electricity, concreting the ground floor, uncovering the well, erecting stairs, and fitting a new door on the first floor. This work has enabled the well house to become a small museum housing local information, a display of artefacts, and photographs. The well has been covered with a substantial grille, which allows visitors to peer down into the depths without suffering the same fate as the cow.

When the building was derelict, it was used as a nest site by various species of birds, including a pair of barn owls. A newly-constructed owl box with external access has been installed, but the owls have taken up residence in a quieter barn. It is hoped that they will return when the building work has finally ended.

The structure of the wind engine has a lot of parts which are essentially similar in function to those of a windmill. The cap assembly has two major castings, a stationary curb ring which is bolted to the head ring of the tower, and a rotating cap. The curb ring incorporates the main worm rack for turning the cap into wind, and has three truck wheels and six centering wheels to allow the cap to rotate. The cap has integral brackets carrying the fantail staging arms, tail and head bearings for the windshaft, and a bridge holding the upper vertical shaft bearing (Figure 5). These two major castings are loosely held together by a further cap-retaining ring with four wrought iron C-clamps. The six-bladed wooden fantail is connected to the rotating cap through two worm gears and a bevel gear. The wind wheel consists of eight wrought iron radial arms fixed to a central hub on the windshaft. These arms support the outer and inner rings carrying the sail pivots and bearings, so that the 48 sails are arranged in an annulus. The sails are opened and shut by a control ring attached to a system of rods and levers, which also allows them to be forced open in strong winds, and to be parallel to the wind when not in use ("self-regulating"). The tower girders are riveted on to an attractively shaped and detailed head ring, and the tower contains three frames which support plummer blocks for the rotating vertical shaft. At the base of the tower the girders are attached to a six-section foundation ring with holding bolts. The vertical shaft

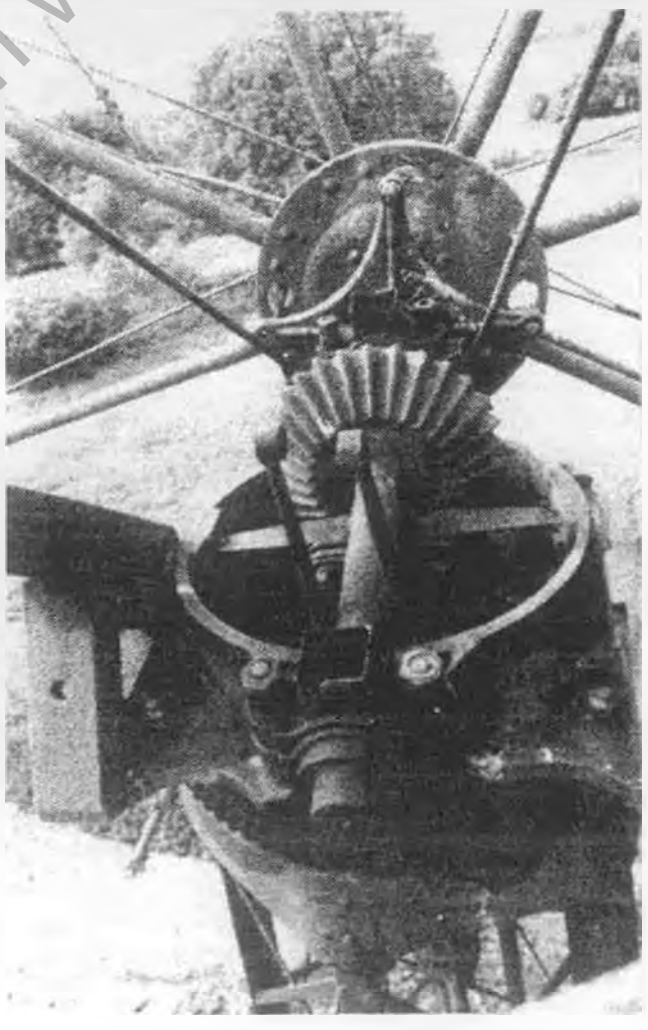


Figure 5: The windshaft in situ showing, from top of photo, the wind wheel hub, control arm star, bevel gear and control arm rods protruding through the cap. Also visible are the stationary curb ring and the head ring and tower assembly.

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tail bearing is supported on a pedestal, which also holds the bevel gears and a horizontal drive shaft connected to the pump mechanism.

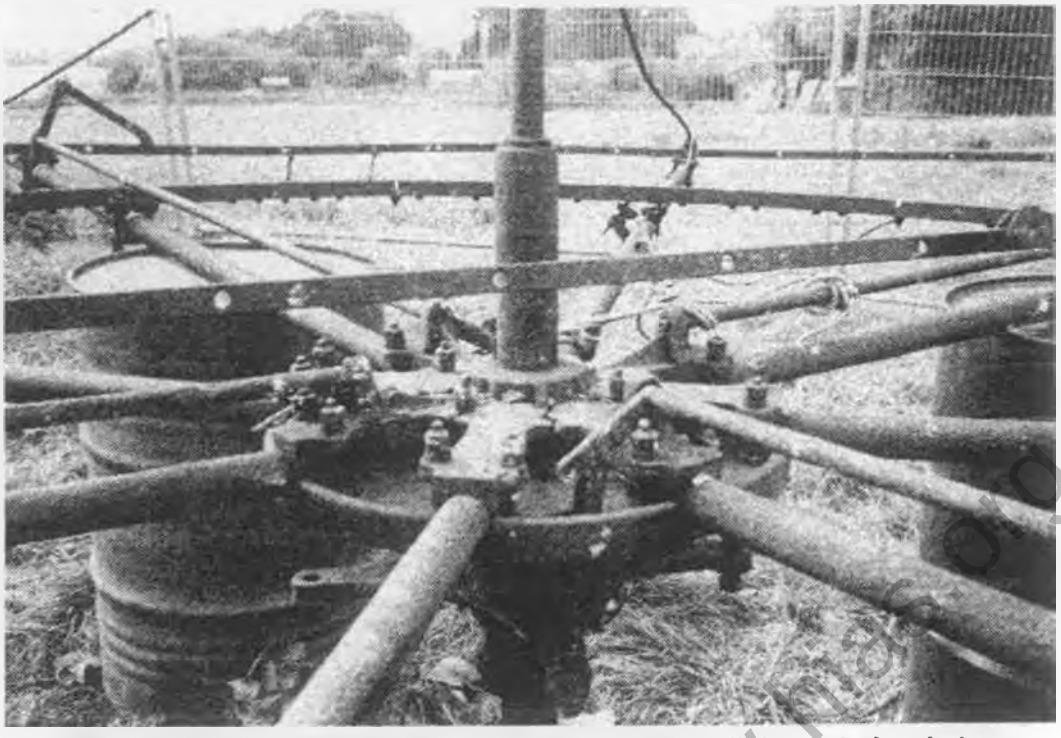


Figure 6: The windshaft and wind wheel placed on oil drums before being recorded and dismantled.

The contract for the restoration of the wind engine was awarded to the British Engineerium Trust, at Hove. In August 2000 the work of dismantling and recording finally began. A mobile extending hydraulic platform ("cherry-picker") was used, and several pieces of the fantail supports, balance weights, and windshaft bearings were removed to lighten the structure and enable the whole of the wind wheel and windshaft to be lifted off the tower by crane. The wind wheel was rotated and lowered on to four oil drums so that it could be measured, recorded, and photographed (Figure 6). After several days' work, it was dismantled by the volunteers. Meanwhile the 1995 temporary repair to the tower was removed, and the tower and remaining headworks were lifted off the cast iron foundation ring and lowered to the ground. The six sections of the foundation ring were levered off their holding bolts. These bolts were subsequently found to be in excellent condition, and after the crumbling brick and concrete foundations had been repaired they would be ready for re-use.

Now dismantled, the wind wheel was sufficiently compact to be transported to the Engineerium in one journey. A delay then ensued as the metalwork proved to be in a worse state than an initial aerial inspection had suggested. It became evident that a substantial previous repair had been made to the cap and that additionally the centering ring of the cap had fractured, and was no longer attached to the cap. This meant that a lot of extra restoration would be needed, and further applications to the Heritage Lottery Fund would be needed to cover the extra costs, of some £45 000.

Apart from delaying the work, this repair is interesting because it illustrates how the wind engine performed during its working life. Before 1904, the only repair recorded in the J. W. Titt daybooks (now in the Wiltshire Record Office) describes *"coupling up a broken pump rod, taking four short lengths of old pump rod and replacing with new, and testing pumps with engine"*. This occurred in 1902, so apparently the wind engine ran successfully for at least 10 years. At some time before 1920 the cap assembly underwent a major rebuild which must have been carried out back at the works in Warminster, although there is no record of this. It is thought that this rebuild resulted from the sails fouling the tower due to excessive wear on the front end (head) bearing. Additionally, the wind engine seems to have been running back-winded for long periods causing the windshaft bevel gear key to foul the cap casting. These and various other defects presumably resulted from a combination of intrinsic design faults and a lack of maintenance. When the cap assembly was dismantled, it was apparent that the repair itself had again become excessively worn. (For a more detailed assessment of the condition of the wind engine prior to restoration and an explanation of the proposed repairs, see the report by the British Engineerium dated September 2000).

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By June 2001 the metalwork of the headworks was being repaired and where necessary recast, using new patterns which had been made at the Engineerium (Figure 7). Volunteers were able to assist by filing away excess metal from the new castings (fettling) and drilling bolt and screw holes. Among the items which had to be replaced were 96 sail pivots and their bearings, plus the two L-section steel rings which formed the wind wheel. The sails themselves were completely missing, having been made of wood and canvas. The control ring, which would have been attached to the mid-points of the sails to bring them into working position, also needed replacing. However, many of the original fixings that attached the sails to the control ring were re-usable, as were the four control ring arms and the twenty cast iron brackets which clamped everything in place.



Figure 7: Original cap casting after restoration and fitting of new neck bearings. Note the brackets for the fantail supports and the stationary curb ring on the trolley behind.

It was not until 2002 that more work for the volunteers became available at the Engineerium. This time it was the massive job of painting all the headworks and wind wheel metal (Figure 8). The wind wheel had been reassembled (outdoors, because of its size) to check that it fitted together correctly and therefore had to be disassembled before its components could be handed to the painters. The painting was carried out inside the museum part of the Engineerium so that temperature and humidity could be controlled; this had the added benefit that the painters were able to explain about the wind engine to the museum visitors, many of them groups of schoolchildren being introduced to the joys of steam. Both the original de-rusted metal and the new castings were coated in pale green primer, scarlet undercoat and blood red traditional enamel top coat. This last was exceedingly difficult to apply smoothly, especially on the pitted surfaces of the original metal. The colour of the paint has been described as blood red because, when one of the volunteers suffered a cut, it was not immediately obvious which of the red splashes on the tile floor were blood and which paint.



Figure 8: Painting work in progress at the Engineerium.

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The design of sails and wooden fantail blades was based on drawings from the J. W. Titt archives, since very little of the originals had survived (Figure 9). It was known that the canvas sails had been stretched round metal frames, fragments of which had been recovered from all over the well field. These had been found during a visit from a local metal detector club who were invited to assist in surveying the site. However the method of fixing the canvas to the wooden sail edge was unclear. Eventually it was decided to use a double pocket of canvas stretched round the metal frames and attached to the sail edges with copper tacks. The sails were then transported back to Crux Easton and painted with undercoat and top coat of traditional oil-based white paint, which was extremely slow drying; indeed some of the sails were still wet when they were installed in the wind engine.

By August 2002 the headworks had been completed and assembled at the Engineerium, and it was possible to demonstrate that the new worm gear linking the fantail to the rotating cap would work satisfactorily. The tower was reassembled on its side on a jig so that it could be rotated as work progressed. The six original cast iron sections of the foundation ring were re-attached and the upright drive shaft was inserted through its support brackets. Also the head ring was refitted. During assembly, the intersections of the T-section tower steel had been held together with bolts to allow adjustments, and these were now replaced with traditional hot rivets. Four original and two new cast iron staging brackets were fixed to the tower to support the new wooden staging, which was then attached. All the metalwork was primed and painted in black flexible paint, before a new access ladder was fitted. The original one had been cut up to cover the well. A second short length of revolving ladder was also made and fitted to allow access to the cap.



Figure 9: The sail design was based on original drawings, since only a few fragments of the original metal parts of the frame had survived.



Figure 10: The wind wheel begins to take shape

With the official opening set for 25 September 2002, it now became imperative to get the wind engine back on site. On 16 September 2002, the windshaft and fantail assembly returned to Crux Easton and was craned into position on a 12ft (3.7m) scaffolding tower, so that the volunteers could reassemble the wind wheel (Figure 10). This was an exceedingly awkward operation. The assembly became heavier as the radial arms were lifted into position and bolted on to the hub using the original cast iron brackets. Positioning the four arcs of the outer ring of the wind wheel was comparatively easy as they fitted into slots in the radial arms. The inner ring had to be assembled on the grass and lifted into position complete with its sail pivot bearings attached, because it would have otherwise been impossible to reach them. Fortunately at this time a portable scaffolding tower arrived, which enabled the thin radial bracing arms and stay rods to be positioned and adjusted. The completed tower had now also arrived on site. On 18 September 2002 it was re-erected. A new brick base had been constructed and the assembled tower was lowered by crane back on to the holding bolts. A careful check was

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made to ensure that the tower was upright and that the head ring was horizontal. Then the headworks and wind wheel assembly was craned into position, and bolted on to the stationary curb ring using purpose-made extra strong bolts. This whole operation inevitably took longer than anticipated, and there were visions of having to hire the crane for another day but, fortunately, the work was completed just as the sun began to set.

During the next few days, 16 sails were inserted by the volunteers so that the control ring which alters their angle could be put into position and clamped to the four control arms. The remaining 32 sails were then installed and all were reconnected to the control ring. In the absence of any original sails, this part of the re-assembly had to be done by trial and error, and a lot of drilling, bolting, and fixing was carried out aloft. Finally, there was just time to check that the fantail worked and that the control ring could be operated from ground level, causing each sail to rotate 45 degrees into its working position. The vertical part of the control arm is incomplete, and it is proving difficult to determine its precise mode of operation from the original drawings, so more work will be needed in the future.

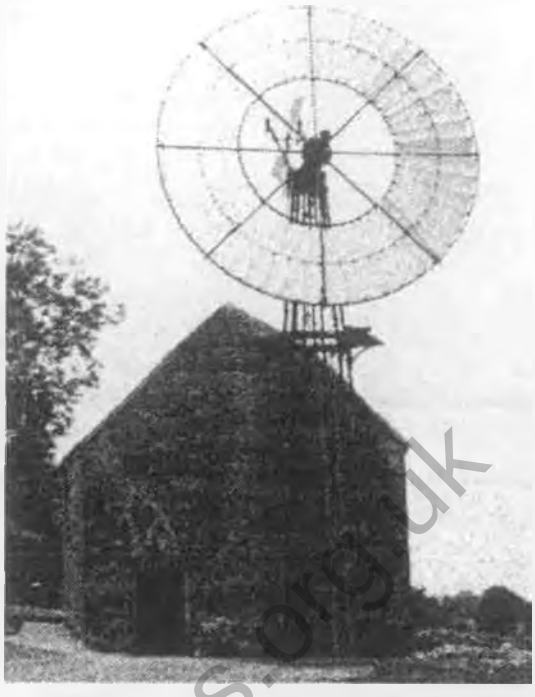


Figure 11: The restored wind engine on 25 September 2003

On 25 September 2002 the official opening of the newly restored wind engine was performed by Sir George Young, MP for North-east Hampshire, in the presence of some 150 invited dignitaries, guests, and workers (Figure 11).

It is a long term aim of the Trust to restore the pumps and reconnect them to the wind engine, but as this will involve removing and replacing the original pump rods and all their supporting brackets this will be an extremely expensive and time-consuming exercise. In the meanwhile, there is still plenty of work to do around the site.

For those who wish to visit Crux Easton Wind Engine, it is situated at OS map reference SU 425564, one mile off the A343 between Highclere and Hurstbourne Tarrant. It can be viewed from outside, and keys to the well house are available from the Manor House (formerly Crux Easton Farm). More information is available from the website, at http://windengine.tripod.com.

Ruth Andrews

A note on Wind Engines

The multi-sailed wind engine or wind pump was developed primarily in America in the nineteenth century. Several manufacturers patented annular windmills or wind turbines in the 1860s. A popular early machine was the Eclipse 'solid wheel' windmill of 1873 which was awarded a gold medal in the American Centennial Exhibition in Philadelphia and first prize at the Paris Exposition. Figure 12 shows a typical wind engine of 1900 and Figure 13 shows the headgear with its gearing and connecting rod to a direct acting pump. This 16ft (4.9 m) diameter wind engine would develop about 220 W (0.3 h.p.) in a 10 mph (4.8 m s^{-1}) wind so the available power was very low. The power output rises as the cube of the wind speed, so in a 40 mph (19 m s^{-1}) gale the engine should develop 14 kW though the control gear would have shut it down well before that!

Such wind engines had an annulus of concave steel blades fixed to a ring framework attached to the wind shaft. They were governed by a simple tail vane that was used to keep the engine facing the wind when working and parallel to the wind when out of use. Figure 14 shows the arrangement. The main shaft is mounted to one side of the tower bearing so that when the wind velocity increases, the force on the rotor tends to push the rotor away from the wind whilst the force on the vane tries to push the rotor back into the wind. The vane is hinged to the wind engine and its angular position is controlled by a spring and a control wire or rod. In light winds, the tail vane is almost perpendicular to the rotor and the wind forces on it cause it to keep the rotor facing the wind (A). When the spring is tightened the vane makes a larger angle with the wind shaft so that balance occurs when there is a larger wind velocity, and hence a larger force on the rotor; the wind engine develops more power (B). In very strong winds and when the wind engine is not required to work, the vane is pulled round so that it is parallel to the rotor (C). In this position the vane keeps the rotor edge-on to the wind.

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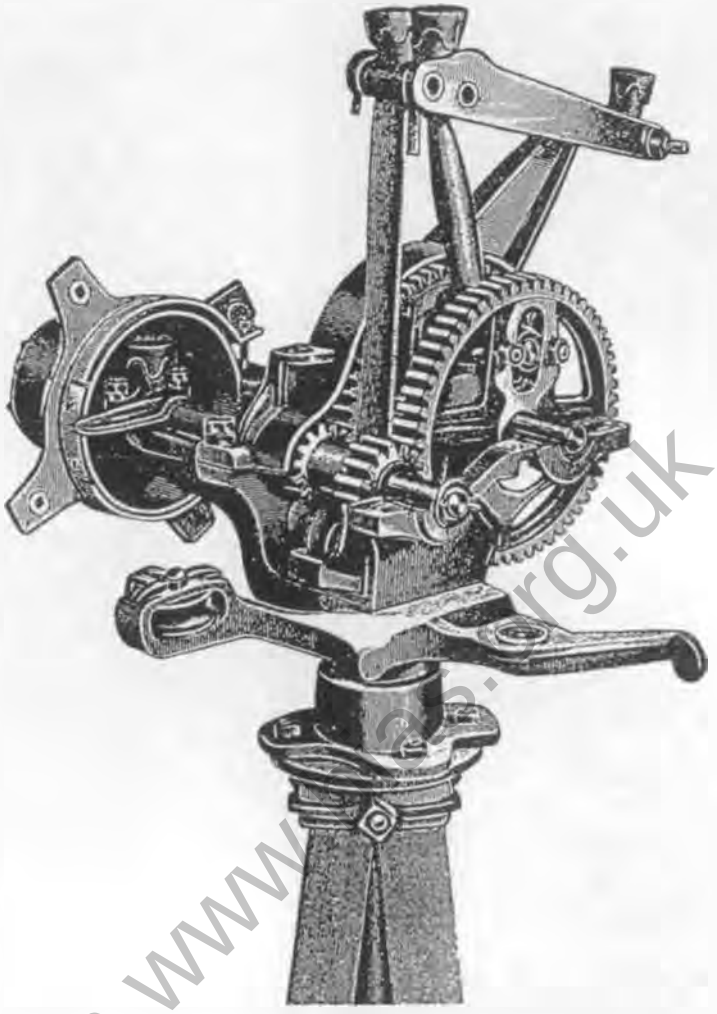


Figure 12 (left): A typical simple wind engine c 1900

Figure 13 (above): The headgear of typical geared wind pump c 1900

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So popular were these wind pumps with farmers and railways opening up America that 22 new companies started making wind pumps in the 1860s rising to over 400 new companies in the 1880s. A scientific analysis of the wind engine was carried out in 1882-3 by Thomas O. Perry of the U. S. Wind Engine and Pump Co. Perry mounted a 5 ft (1.5 m) diameter wind engine rotor on the end of a 14 ft (4.3 m) horizontal arm which was whirled round a vertical axis at pre-determined speeds, by a steam engine. He measured the effective 'wind speed' at the end of the rotating arm, and the rotational speed and torque developed by the wind engine rotor. He investigated over 50 different types of rotor and found that concave steel sheet blades set at 35°–45° to the plane of the rotor were most efficient. He also found that a few wide blades were more efficient than many narrow ones and that the total blade area should not exceed 75% of the area of the annulus swept out by the rotor.

Similar wind engines also appeared in England. John Wallis Titt of Warminster was early in the field as evidenced by the Crux Easton wind engine of 1891–2. In 1903, the Royal Agricultural Society carried out some full scale trials of wind engines at their permanent showground in Ealing (now the Park Royal industrial estate). Twenty two wind pumps were erected by seventeen manufacturers or agents and measurements of the quantity of water pumped under various wind conditions were recorded during March and April. All had their pump relief valves set

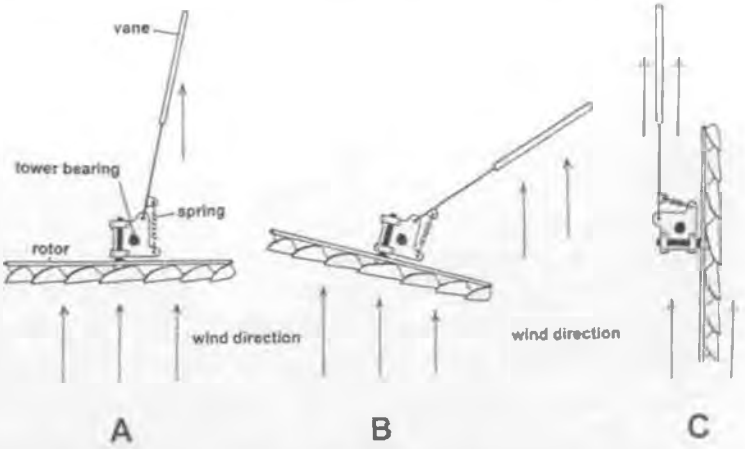


Figure 14: The operation of the tail vane governor

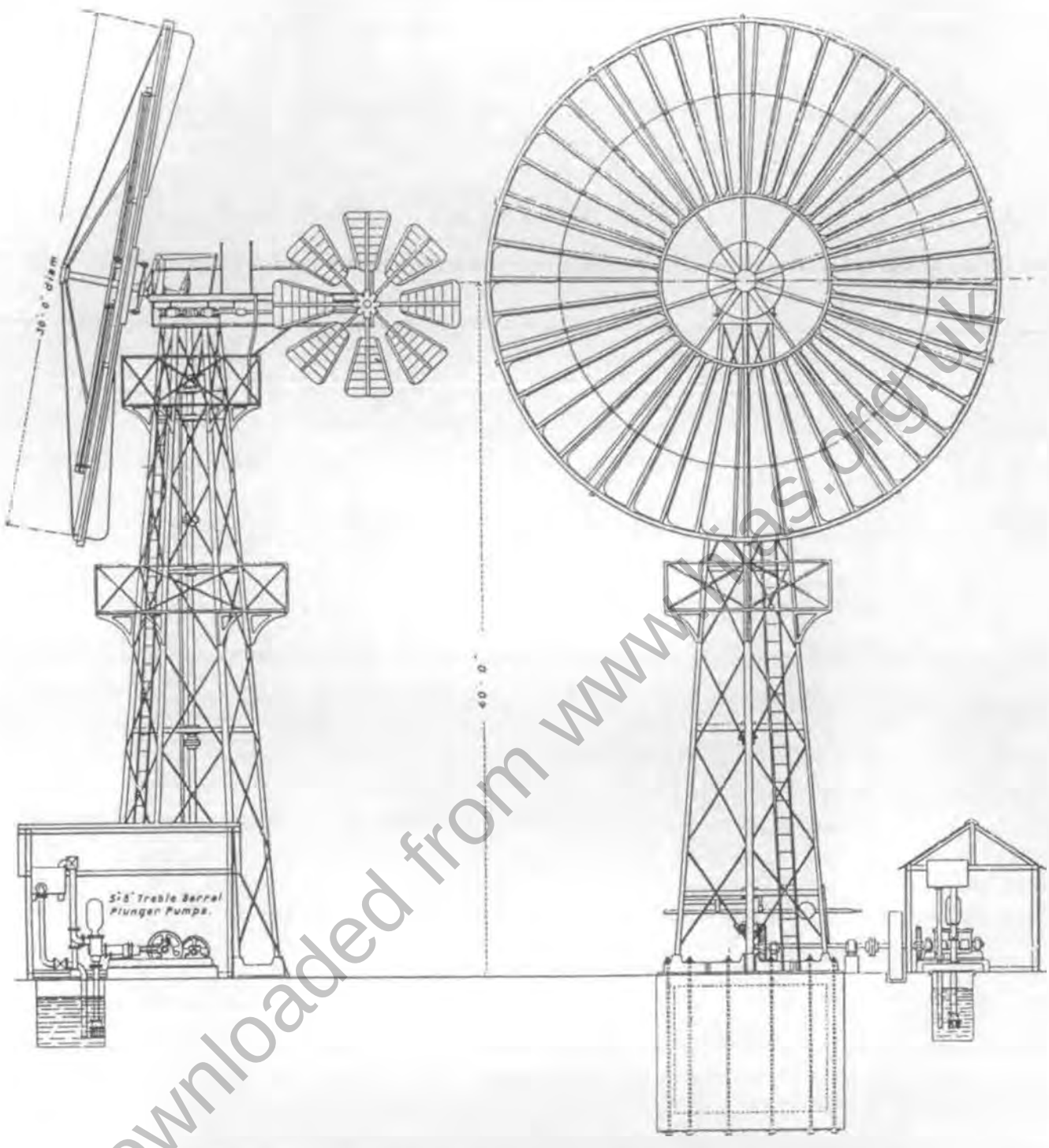
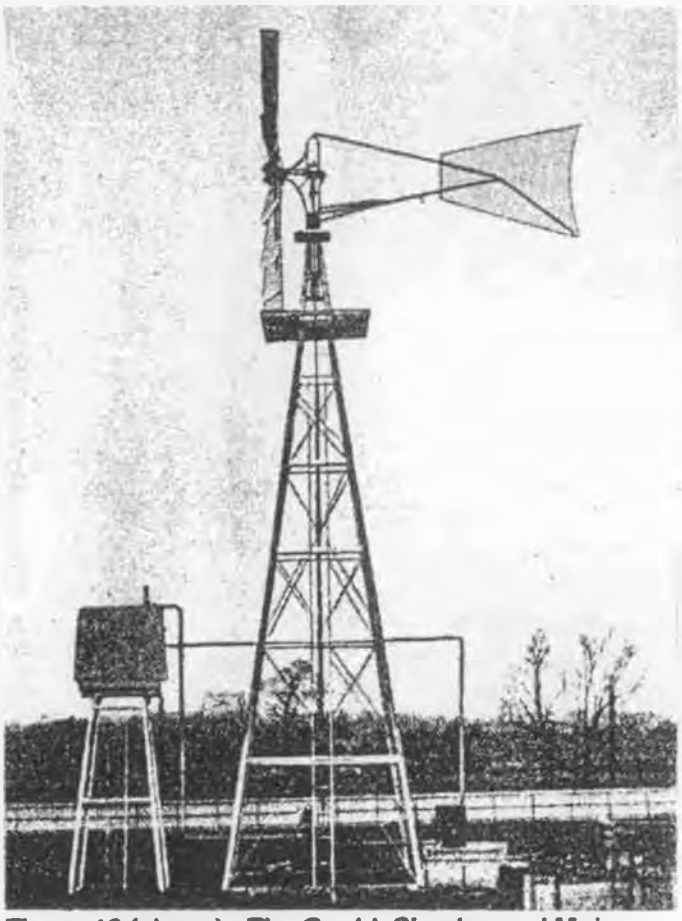


Figure 15: J. W. Titt's 'Simplex' wind engine for the R. A. S. trials, 1903

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to give an effective head of 200 ft (61 m) of water. J. W. Titt entered three pumps, two with fixed blade rotors and tail vanes (Entry nos. 8 and 16) and a 'Simplex' pump (Figure 15), (Entry no. 19) similar to that at Crux Easton. Number 8 was direct acting with the pump operated by a crank on the wind shaft, while number 16 had gearing between the pump crankshaft and the wind shaft such that the rotor made 2.5 turns for each turn of the pump crankshaft, similar to the arrangement in Figure 13. The 'Simplex' pump had a rotor of diameter 30 ft (9.2 m) carrying 40 tilting canvas sails which almost filled the annular area In contrast, the fixed blade rotor engines were 16 ft (4.9 m) in diameter and had 24 blades covering 60% of the annular area; a much more efficient design than that of the 'Simplex' which was, by 1903, nearly 20 years old.

Only one other entrant, Robert Warner & Co. of London, displayed a wind engine (Entry no. 9) with pivoted sails like the Titt 'Simplex'. All the others had fixed blade rotors and a tail vane governor. Many of them, such



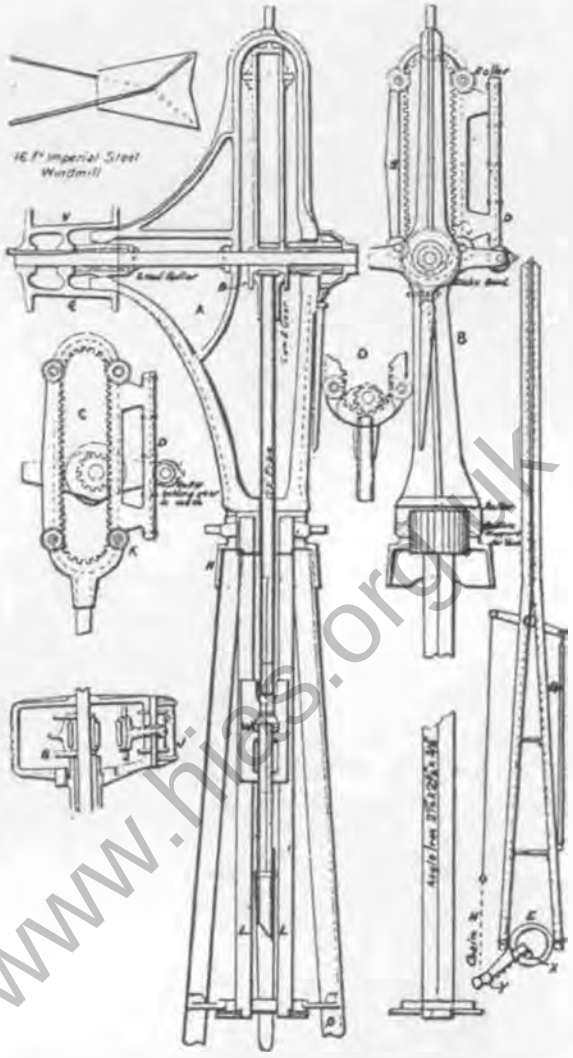


Figure 16 (above): The Goold, Shapley and Muir wind pump at the R. A. S. trials, 1903

Figure 17 (right): Details of the Goold, Shapley and Muir wind pump for the R. A. S. trials, 1903

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as that of Duke and Ockendon, were American machines, often mounted on locally manufactured towers. The winner was a Canadian engine (Entry no. 3) manufactured by Goold, Shapley and Muir of Brantford, Ontario (Figure 16). Their engine featured a mangle-wheel drive to provide uniform motion to the pump rod and an efficient double acting pump (Figure 17).

The results of the Royal Agricultural Society trials were widely reported in the engineering press. The performances of the engines were logged regularly. The judges noted *"the adjustment of the engines to the direction of the wind, the speed governing and general performance in addition to the numerical data."* Any engine which broke down so that the manufacturer had to be called, was disqualified. Figure 18 shows a table of the quantity of water pumped by the various engines. The wide variation in the prices of the engines is noticable. The Titt 'Simplex' (Entry no. 19) pumped the most water but was much the most expensive at £365. In the opinion of the judges, the matching *"of the pumping machinery to the wind engine was not considered suitable for ordinary use."* For all its size, its sail area was four times that of the winner, the 'Simplex' only developed a maximum power of 1.4 kW (1.9 h.p.). It also showed poor governing with the second greatest fluctuations in speed for a given wind pattern; more than three times the variation shown by Titt's fixed blade rotor engines. The fantail rotor was less effective at keeping the wind engine into the wind than the simple vane. It was less highly rated by the judges than Titt's other geared engine (Entry no. 16) which was awarded second prize yet cost only £74. Of the remaining entries, two were not got into working order during the competition, and two wheels and one tower buckled in a wind of 45 mph (22 m s^{-1}). One other was disqualified because the tower was too flimsy.

The judges were keen on safety and commented adversely on wind engines which did not have a brake to stop the engine in a gale and for maintenance. All the engines had control wires or rods down the towers to adjust the position and spring tension of the vane. (Those engines with pivoted sails had a control rod to move the control ring on the rotor). The judges were worried about what would happen if the control wire or rod broke and how the rotor was stopped for maintenance or in a gale. None of J. W. Titt's engines had brakes. On his fixed rotor engines the position of the vane was governed by a wire attached to a weighted lever rather than a

Performances of Wind Pumping Engines, showing quantity in Imperial Gallons of Water Pumped, as registered by Meter.

1903, Mar.	Wind Velocity	No. 3 The Goold, Shapley and Muir Co., Ltd. £70 16 ft. Gallons	No. 7 Messrs. Thomas & Son £77 16 ft. Gallons	No. 8 Mr. J. W. Tutt £81 7s. 6d. 16 ft. Gallons	No. 14 Messrs. R. Warner & Co. £79 16 ft. Gallons	No. 16 Mr. J. W. Tutt £74 10s. 16 ft. Gallons	No. 17 Messrs. Henry Sykes, Ltd. £108 16 ft. Gallons	No. 2 Messrs. E. and R. Roberts, Ltd. £53 10s. 12 ft. Gallons	No. 4 Messrs. John McBain & Son £52 12 ft. Gallons	No. 5 Messrs. E. P. Saunderson & Co., Ltd. £74 10s. 16 ft. Gallons	No. 6 Mr. R. L. Capell £90 8 ft. Gallons	No. 9 Messrs. R. Warner & Co. £179 20 ft. Gallons	No. 10 Messrs. J. S. Millar & Son £50 14s. 6d. 12 ft. Gallons	No. 11 Messrs. P. & W. Macfellan, Ltd. £120 18 ft. Gallons	No. 13 Messrs. J. S. Millar & Son £51 1s. 6d. 12 ft. Gallons	No. 15 Messrs. T. C. Williams & Co., Ltd. £95 — Gallons	No. 19 Mr. J. W. Tutt £363 30 ft. Gallons	No. 20 Mr. C. Cable £38 13 ft. Gallons	No. 21 Messrs. Duke & Ockenden £51 13 ft. Gallons	No. 22 Messrs. E. P. Saunderson & Co., Ltd. £119 20 ft. Gallons
Price																					
Diam. of Wheel		16 ft.	16 ft.	16 ft.	16 ft.	16 ft.	16 ft.	12 ft.	12 ft.	16 ft.	8 ft.	20 ft.	12 ft.	16 ft.	12 ft.	30 ft.	13 ft.	13 ft.	
4	15	—	3,137	—	3,503	—	—	3,112	—	—	—	3,681	—	—	—	1,606	—	1,875	—	—
5	5	—	1,030	—	343	—	—	323	—	—	—	323	—	—	—	612	942	649	—	—
6	10	—	2,752	—	3,950	—	—	2,382	—	—	—	8,569	—	—	—	—	20,800	1,617	—	—
7	12	—	3,019	—	4,207	—	—	3,476	—	—	—	4,155	—	—	—	—	2,393	1,610	—	—
9	12	—	—	—	—	—	3,151	—	—	1,649	—	—	—	3,101	—	—	—	—	1,120	—
10	8	—	—	2,214	—	—	2,045	—	—	566	—	—	—	1,687	—	—	2,640	—	—	1,327
11	6	1,428	—	1,181	—	—	895	—	—	161	—	—	—	577	—	—	800	—	—	292
12	8	2,545	—	1,913	—	—	1,733	—	—	422	—	—	—	2,000	—	—	3,822	—	—	805
13	9	3,608	—	2,309	—	—	2,268	—	—	—	—	—	—	2,484	—	—	7,345	—	—	1,202
14	3	—	—	—	—	15	—	—	—	0	0	—	1	—	8	—	0	—	59	—
16	15	—	—	—	—	3,772	—	—	—	1,916	401	—	2,887	—	2,907	—	13,285	—	1,250	—
17	22	—	—	—	—	3,349	—	—	—	2,390	793	—	—	—	4,422	—	25,781	—	1,419	—
18	20	—	2,094	—	3,140	4,135	—	2,828	—	960	723	—	—	—	—	—	24,668	—	1,538	—
19	20	—	4,746	—	5,653	4,208	—	—	—	—	798	—	—	—	—	—	22,034	—	1,610	—
20	18	—	4,520	—	5,250	—	—	—	2,794	—	—	—	—	—	—	935	23,077	—	621	—
21	18	—	3,912	—	4,874	—	—	—	2,717	—	—	—	—	—	3,554	—	19,410	—	—	—
23	22	—	4,625	—	3,640	—	5,244	—	2,512	—	—	—	—	—	4,497	—	24,039	—	—	—
24	12	—	—	—	—	—	2,781	2,374	—	—	—	3,418	2,034	—	—	—	8,194	1,732	—	—
25	15	—	—	—	—	—	4,210	4,009	—	—	—	4,113	3,188	—	—	—	18,880	2,180	—	—
26	25	—	—	—	—	—	5,446	4,163	—	—	—	3,827	4,167	—	—	—	21,377	—	1,440	—
27	8	2,891	—	—	—	1,248	—	—	—	—	—	1,661	—	1,628	—	—	6,011	—	937	—
28	24	10,047	—	4,447	—	3,470	—	—	—	—	—	—	—	4,954	—	—	21,831	—	1,562	—
30	22	7,622	—	4,399	—	3,361	—	—	—	—	—	—	—	4,585	—	—	21,509	—	1,666	—
31	7	3,160	—	1,850	—	1,373	—	—	—	—	—	—	—	1,448	—	—	5,646	—	667	—

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Figure 18: Table of the quantities of water pumped by various wind pumps in the R.A.S. trials, 1903

spring, an arrangement which was not 'fail safe'. During the 45 mph gale in April the control wires on both of his simple engines broke and men had to be sent up the towers to secure the vanes and wheels; a hazardous procedure. On the other hand, in the same gale the control wire on the winning engine broke causing the spring to pull the rotor edge on to the wind, and to apply the brake so that it stopped. This 'fail safe' mechanism received very favourable comment from the judges.

Little further development seems to have taken place on these simple wind pumps. Most had ball or roller bearings on the wind shaft by 1910, by which time internal combustion engines were becoming reliable and available. The very low useful power of these wind engines coupled with the fickleness of the wind led to them falling out of use. Not until the last 20 years has the wind engine come back into favour.

Martin Gregory

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The Re-use of Railway Vehicle Bodies

Those in need of shelter may bivouac, with or without reference to *Scouting for Boys* (1900), or bed down in a barn ("Carruthers" spent a night in a moored barge[1]). For prolonged rough sleeping, a discarded vehicle is often resorted to, and while disregarding Noah, an old barge, roofed over and thus not inverted, was Peggotty's brother's solution in *David Copperfield* [2] (although the associated illustration implies that the vessel was inverted and thus had a curved overhead). The ignominy of a famous stage-coach being down-graded to hen-coop inspired a well-known painting[3], but so practical a man as Joseph Locke, railway contractor, found a use for the body of a London & South Western Railway first-class coach in September 1842. Since the vehicle was only four years old, there may be an indication that it was frail[4].

In the years following, many time-expired vehicles were taken off their wheels and made into lamp-rooms, inspectors' huts and so on for the use of railway staff (the Scottish called them 'bothies'[5]), and coal merchants also used them for yard offices[6]. The coaches built in the 1850s and later were soundly built of hardwoods, especially teak and mahogany, and if kept painted had an indefinite life. Forty years was quite easily attained and they were only superseded because of the requirement for improved riding at increased speeds.

With the availability of good quality structures in increased quantities (the L&SWR had 305 coaches in 1848 rising to 4390 in 1923[7]), purchasers for use outside the railway fence began to appear. However, examples surviving from the period before 1870 are rare now, although they were fairly common in the 1930s, perhaps disproportionately in the area of the old South Eastern Railway[8]. Garden shed or cricket pavilion they might be, but it seems to have been after 1890 that the idea of converting a coach body into a house arose. The Great Eastern Railway seems to have set a pattern of selling coach bodies for £5 [9]. The vogue for summer-time camping (as by the Thames at Sunbury[10]) seems to have merged with the newly-developed pursuit of caravaning[11], which was a resort of evangelists, besides being the officially despised way



Figure 19: Camping huts at Standlake, Oxon, circa August 1962. Unidentified GWR vehicle, although there is stated to have been a broad-gauge body on the site.

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of life of Gypsies[12]. It is relevant that in the 1900s agriculture was going through big changes. The old 'high farming', mixing livestock and arable, had collapsed under the effect of imported wheat. Dairy farming, being much less labour-intensive, was increasing[13]. The 'camping huts' of Figure 19 fit such a picture. Thus farm labourers were being attracted to the towns (unknowingly they became ready for the recruiting sergeants of 1914). Landowners were casting round for new sources of income and only townsfolk could supply them. Not that buying a plot of land was without obligations as to the form of house to be put thereon. Conveyances of land for building originating in the Edwardian period had, and still have, a standard prohibition of a caravan or shed on wheels or temporary building or erection.



Figure 20: Cottage no. 10 *Whyleigh* at West Wittering, Sussex. (Nat. Grid square SZ 7996) October 1999. Former London, Brighton & South Coast Railway vehicle.

Only transfers of land which consisted of small parcels of agricultural land seem to have permitted the building of temporary (for which read sub-standard) dwellings. In southern counties this was nearly the limit of activity, and the cottage *Ferndale*, described below, is an example. In the midlands, actual estates (known later as shack-and-track) allowed for development of wooden houses of sometimes very simple construction (e.g. 18 x 10 ft. comprising two rooms)[14] and there is a well-known example of such an 'estate' close to the Severn Valley Railway, in which every building is based on a railway coach body. Two existing southern colonies of such bungalows are at Selsey and Wittering in Sussex. Wittering (Figure 20) is distinctive in that the convention there was to site two coach bodies parallel and a few yards apart and to roof over the space between to provide a main room. Through the work of local historians[15] we can say that these were not cheap. A contractor charged £64 to convey two coach bodies from Chichester to Bracklesham, a distance of a little over six miles, while a



Figure 21: Cottage at Bovington, Dorset (Nat. Grid ref. SY 842881). April 1969. Origin of vehicle unknown.

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bungalow complete with well was offered for £140. This corresponded to something like £25 000 at current values, a clear reflection of the market at which such property was aimed. Selsey, St. Helens (IoW) and Bovington (Figure 21) have or had scatters of individual bodies. In urban areas, it was in some places possible to ground a body as a dwelling on the understanding that a permanent building would soon be substituted. Thus, in 1925 a Mr. W. Clapcott was permitted to convert a railway carriage into a house at Fancy Road, Poole[16], with a ten-year limit. The location given was significant; it was off the Ringwood Road on the eastern fringe of Canford Heath, then a wild area. Local authorities no doubt monitored their permissions with varying efficiencies.



Figure 22: Cottage *Ferndale* near Fareham, Hants. 28 September 1972

The result was that in the 1970s there was a scatter of inhabited coach bodies, mainly four-or six-wheel coaches of the 1880s which had been taken out of service in the 1920s and whose original dwellers were, by then, very elderly. Thus they became available for purchase, or more usually were demolished in the course of development. *Ferndale* (Figure 22), for instance, was a house made up of the body of a Cambrian Railways saloon coach, 31 feet long, one of nos. 154–7 built in 1887, grounded near Fareham, Hants[17] and gradually elaborated with shell patterns and asbestos-cement outhouses. It was probably brought from Ludgershall near Andover, where the GWR concentrated the many coaches it had acquired in its amalgamation with the Welsh railways in 1923. *Ferndale* was swept away during the construction of the M27 road in 1972. Its existence may have had to do with a personal aftermath of the Great War; a possible parallel is in print describing the inhabitant of an ex-RN motor boat aground in the Hamble river only a few miles away[18]. Far from its home territory, what appears to have been a North London Railway third-class coach of c.1860, having five compartments in a length of 27 ft. 8½ in. was fitted out as a Methodist chapel at Challow station near Swindon [19].

Amongst the survivals were a number of broad-gauge coaches. One was recognised early on at Hanwell, Middlesex, where it was serving as the changing room for a football ground[20]. Another was a roomy 'lobby' at Taunton [21] and may have survived until the station was modernised in the 1930s. A first-class coach, Bristol & Exeter Railway no. 7, was discovered in a bungalow at South Cerney, Glos. and placed in storage, so that it can now be examined at the Bristol Industrial Museum [22,23,24]. An extraordinary cell-like, closed-up third-class coach of c. 1850, 18 ft.7 ½ in. x 9 ft. 6 in., lay in the undergrowth at Yatton station, Somerset, until 1962 [25]. Other survivals, in pairs, may well lie under the roofs of cottages in Cornwall.

All the bodies so far mentioned were of four- or six-wheel coaches. During the 19th century, American-style coaches running on two four-wheel bogies were brought into this country by the Pullman Co. These structurally rigid coaches were long-lived and could be grounded with little difficulty. Figure 23 shows a Pullman coach, the deterioration of which reveals the diagonal truss members within the body. These run under the windows and give the body its strength. The picture shows how cutting doorways through the structure weakened it and caused it to distort severely. But the British bogie coach generally had a lightly-built body, 50 to 70 feet long, pierced by numerous doorways which made it necessary to provide a strong iron or steel underframe to prevent

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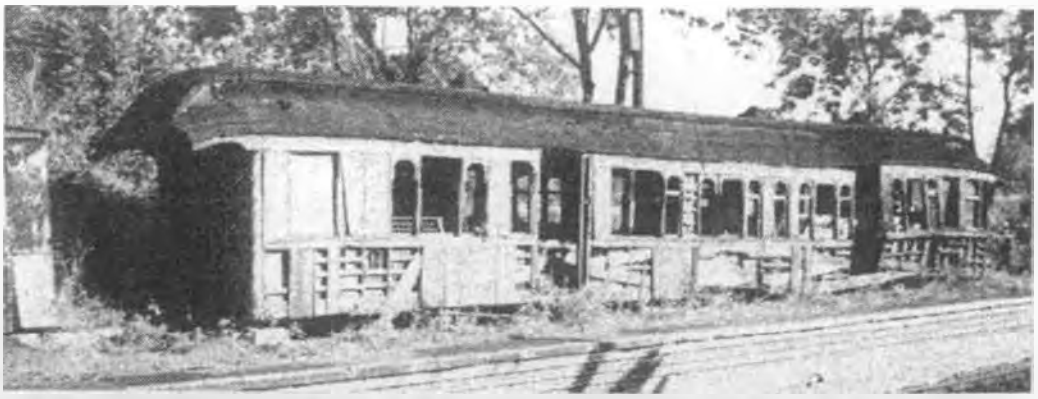


Figure 23: Body awaiting hoped-for restoration at the Midland Railway Centre, Butterley. 6 October 1991.

it sagging in the middle. When such a coach was discarded, the underframe could often be re-used as a wagon (many Great Western coaches had their frames taken to carry motor-car bodies from factories in the Oxford area). Thus the re-use of the body of a bogie coach was unusual. Nevertheless a Great Western 'semi-Royal' coach was successfully grounded alongside the Great West Road, the A4, at Theale, Berks where it served apparently as a bunk-house for a transport café until about 1970. Figure 24 shows what is apparently an early LSWR bogie coach which had a wooden underframe, so that it remained intact until its demolition in c. 2000.

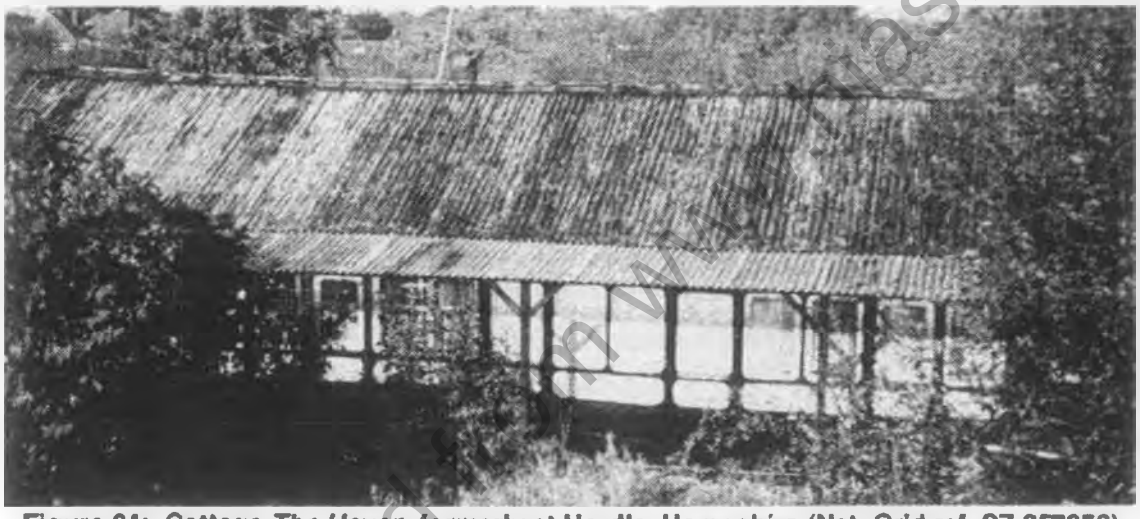


Figure 24: Cottage *The Haven*, formerly at Hordle, Hampshire (Nat. Grid ref. SZ 257956) November 1997

Freight vehicles had hard usage and few were sold off for use as sheds, etc, until after the First World War. There seem to have been extensive groundings in the Newcastle area, including one or two instances of open wagons being roofed over, possibly as sheep or pig pens. Figure 25 shows a van body in a Yorkshire farmyard. It bears the faded initials of the London & North Western Railway although it was built for the Ministry of Munitions in 1918, as is evidenced by the inspection hatch in the door, a characteristic of vehicles for '8 chevaux, 40 hommes' traffic in France. This sort of van was said to have been delivered to the nearest point on a main line (and there taken off the rails) for £5 each. Such bodies lasted until the 1970s but have since largely disappeared. One colony existed near Bishop's Waltham,

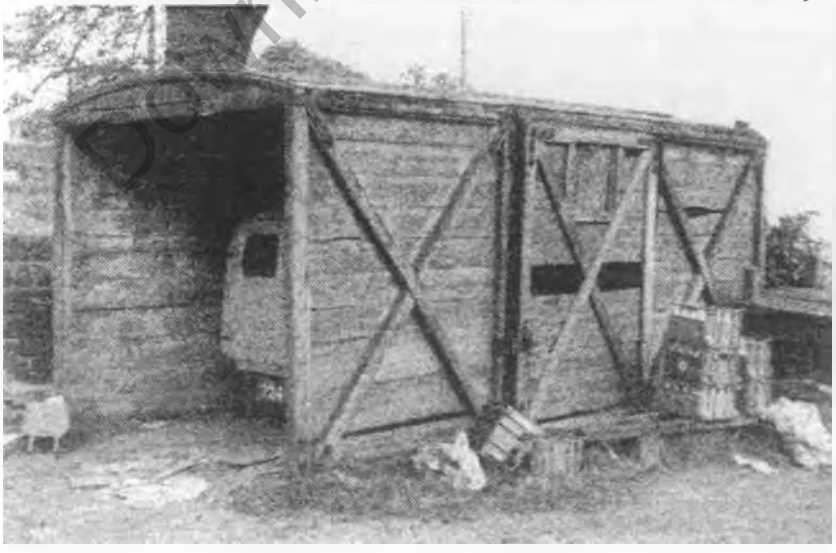


Figure 25:
Shed at West Bretton, Yorkshire.
(Nat. Grid ref. SE 289138)
3 September 1969

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Figure 26 (right): Shed at Woolstreet Farm, Lower Upham, Hampshire, made of banana van no SR 50488. (Nat. Grid ref, SZ 530190) 13 September 1969.

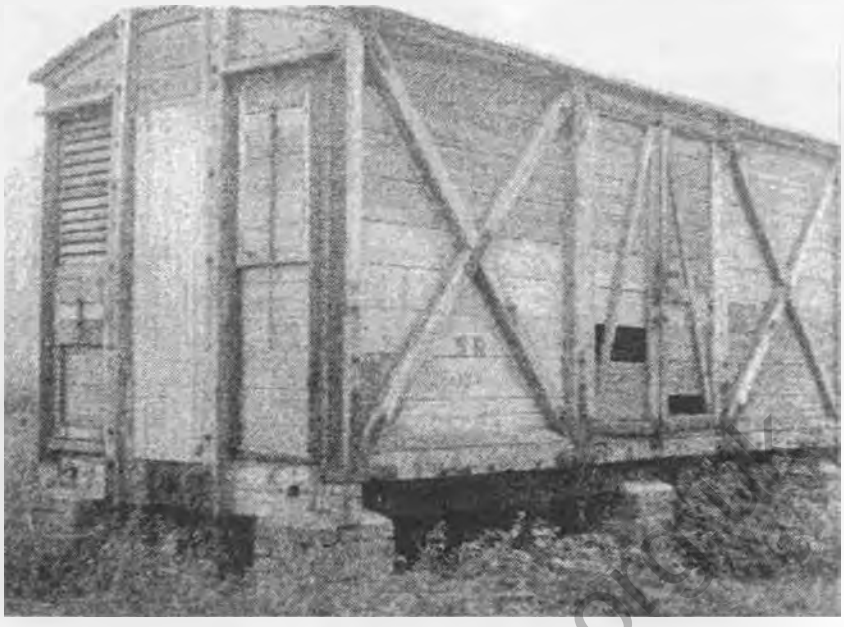
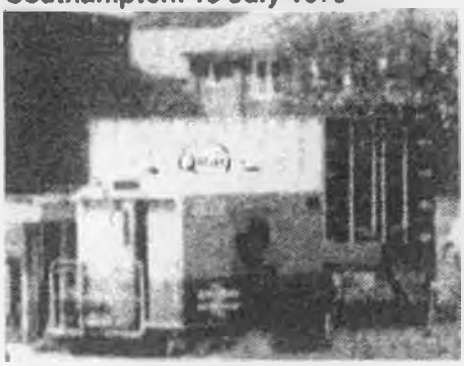


Figure 27 (below): Cabin at Millbrook Freightliner depot, Southampton. 13 July 1970



Hants (Figure 26) and obviously emanated from the Southern Railway works at Eastleigh. A very public body was a Great Western van of the type universally but inaccurately known as an 'Iron Mink', which, being cut in half, à la John West rather than in the style of Damian Hirst, served for many years as a pair of bus shelters at Stratton St. Margaret near Swindon. Many vans became surplus to requirements after the Beeching recommendations were accepted in 1963. Though often only twenty years old, they were sold off and are still widely dispersed in the landscape, usually as fodder stores, although they seem unlikely to be usable much longer. The process continues; rail freight containers have been used as farm stores since the 1940s, and standard shipping containers find a market now in the same way. At a lower level of re-use, railway tank cars yielded a supply of useful tanks, which found a ready market amongst farmers in the 1980s. An instance of a re-use which had a significant background is shown in Figure 27, a photograph taken at Millbrook Freightliner depot in 1970. When British Railways started to run permanently-coupled container trains, it was arranged that the goods guard should ride in a container module at the rear of the train. No. 99Z02 was one of these modules, but almost as soon as it had been built, negotiations with the railway unions resulted in the decision that guards would no longer be employed on freight trains, and Millbrook depot gained a memorial of the fact. The cabin remained at the depot until c. 1995.

Len Tavender

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[9] *Ibid.*, p 58

[10] Contemporary diaries; the camping ground was probably owned by precursors of the Metropolitan Water Board, see *Archive* **17** (Lydney, Lightmoor Press, 1998) p 7

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Alfred Holt and the Pilgrimage to Mecca

In a time of confrontation between Islam and the West, it is perhaps opportune to recall a period of more than one hundred years during which British merchant ships were instrumental in enabling pilgrims from the Far East to make the journey to Mecca. For the whole of that time one shipping company in particular was actively involved with the pilgrimage from South East Asia. By coincidence, that company's disappearance in the general restructuring of the shipping industry in the 1970s followed closely on the decline of the pilgrim trade.



Figure 28: The *Agamemnon* of 1866 (2279 tons), the first Blue Funnel ship.

The Blue Funnel Line, properly titled The Ocean Steamship Company, was the 'Great Adventure' of two brothers, Alfred and Philip Holt, sons of a respected Liverpool merchant family, Unitarian in religion and Liberal in politics. Alfred, the elder of the two, had served an apprenticeship as a railway engineer before turning his attention to the marine engine. He at once set out to improve the performance and economy of ocean going steamships with the introduction of compound engines and high pressure steam. Following some initial trans-Atlantic crossings, the brothers set their sights on the Far East where trade was still dominated by the sailing ship. The new company commenced operations in 1866 with three iron steamships, the *Agamemnon* (Figure 28), *Ajax* and *Achilles*, built and engined to Alfred Holt's designs. They were immediately and dramatically successful, making the long voyage via the Cape to Mauritius without a stop, and maintaining their predicted service speed of 10 knots. Three years later the Suez canal was opened and, while some older companies were slow to exploit the new route, Holts adopted it with enthusiasm. They had sent a representative to discuss the project with de Lesseps during construction and the first merchant ship to pass through the canal was probably the little *Cleator* (391 tons) powered by one of Holt's prototype engines.

In the course of time the Blue Funnel Line would develop other trade routes to America, South Africa, Australia and elsewhere. However, this account will concentrate on the company's original service to the Far East via the Straits; a service which earned it, in its early years, the nickname of 'The China Company'. The principles which were to guide the Blue Funnel Line throughout its existence were determined at the outset by Alfred Holt and his brother. It was a family firm almost to the end, with an unrivalled reputation for probity in business which earned it great respect in the East. Its ships, all named after Greek heroes, were built to an exceptionally high standard, well in excess of A1 at Lloyds. The firm carried its own insurance and claimed that no Blue Funnel Line ship sailing in the company's livery was ever lost through stress of weather. Holts business interests came to cover a wide field, extending to ownership or part-ownership of many related enterprises. The company played a leading role in setting up and operating the conference system, designed to regulate the conduct of trade in the Far East in the best interests of the companies involved.

When the Blue Funnel Line began its pioneering long haul service to the Far East the immediate concern was to secure cargoes. Many steamships were already operating in Eastern waters, though few made the long

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journey home. They worked alongside a motley fleet of sailing vessels engaged in local trade, some European owned, some sold on to local owners, some 'country ships' built and owned in the East. One staple trade which had existed for at least a thousand years was the transport of Moslem pilgrims to Jeddah, the port of Mecca, for the annual pilgrimage or Hajj. They came from the Indian subcontinent, from the east coast of Africa, from Malaya and the East Indies and from as far away as China and Korea, wherever Arab trading colonies had become established.

All faiths recognise the urge to go on pilgrimage but only in Islam is it a statutory duty, one of the 'Five Pillars' by which the true believer conducts his life. He is required to visit the Holy City at least once in his life, at the appointed time of year, where he performs a series of rituals at a sequence of holy sites. He may be excused on grounds of poverty, age or infirmity, but the incentive to go is strong and many save for a lifetime to make the journey. Those who complete the pilgrimage return with the title of *Hajji* and become persons of status in their own communities, whilst those who die on the road are assured of a place in Paradise.

The founders of Islam could hardly have foreseen the explosive speed with which it would spread, carried by conquest and trade from Spain in the west to China and beyond. Pilgrims from the Mediterranean and Middle East could make much of the journey overland, joining one of the two great caravans which set out each year from Cairo and Damascus. Those from India and South East Asia were faced with a sea voyage, and might have to endure all sorts of hardships and privations on the way. In the days of sail their difficulties were greatly increased by the fact that the date of the pilgrimage did not relate to the seasons. For the Arab seaman navigation in the Indian Ocean was governed by the prevailing winds. Dhows made the eastward crossing on the south west monsoon between April and June, or in August and September, and returned between November and March with the north east monsoon. The date of the Hajj, however, was dictated by the lunar calendar of Islam and moved through the seasons in a thirty-six year cycle. As a result, the duration of the round trip could vary greatly, so that often only the rich and their dependants were able to contemplate such an undertaking.

With the appearance of European vessels in Eastern waters local merchants were quick to recognise their superiority and to adopt Western techniques. The fleets trading to the Middle East soon came to be composed not only of the traditional dhows (or booms) but also of 'country ships' built and rigged in the Western manner, and of old European ships (including East Indiamen) sold on to Arab owners. European, especially British and Dutch, officers were in demand with generous pay, opportunities for early command and private trade all acting as incentives.

Pilgrims travelling with the fleets found themselves facing not only the normal perils of the sea, but also the risk of attack, at first from the crusading zeal of the Portuguese, and later from pirates. Two other threats were always present; fire and disease. One John Iver, a Scot sailing as mate on a country owned ship, has left an account of her loss by fire in 1754: *"May God preserve me from the like sight for ever"*. How many thousands of pilgrims lost their lives through fire at sea will never be known. One famous incident, happily concluded without casualties, involved the ex P and O liner *Khiva* (2609 tons). In 1893 she caught fire in the Red Sea with 900 pilgrims on board. Her German master, unable to extinguish the flames, managed to keep them under control long enough for her to be run ashore, where she became a total loss. The risk could vary with the type of pilgrim carried. One curious branch of the trade carried on by the little Halal Shipping Company of Aden, ferried West Africans across the Red Sea from Suakin. These simple folk trekked across the width of the continent, below the Sahara, taking years and sometimes generations to complete the pilgrimage. As late as the 1950s they would come on board with bows and spears, which had to be impounded, while their carelessly sited cooking fires could constitute a serious hazard during the short sea crossing to Jeddah. A grim reminder of the danger of fire was provided there for many years by the blackened hulk of a French pilgrim ship burnt out and stranded on a coral reef beside the anchorage.

Less obvious but just as real was the threat of disease. Cholera and dysentery, both endemic in India and the East Indies, could spread like wildfire in the crowded and insanitary conditions so often prevailing below decks. Even seasickness could make life incredibly unpleasant for those on board. From the 1830s onwards the Hejaz was swept by recurrent cholera epidemics which wiped out tens of thousands in Jeddah, Medina and Mecca itself. The disease quickly spread through the Mediterranean to the seaports and cities of Europe, to Britain and America, carried onwards relentlessly by ships returning from the East. During the second half of the nineteenth century the root cause of the problem was established at a series of international conferences, and a solution was anxiously sought. *"Europe"* it was said *"cannot remain like this, every year at the mercy of the Pilgrimage to Mecca"*. The steamship, which had been welcomed in the East as offering, for the first time, a fast and reliable means of transport for pilgrims, was now helping to spread contagion.

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Old and obsolete vessels had found a ready market among local owners and, with ever increasing numbers of pilgrims wishing to travel, some ships were desperately overcrowded. At their worst, conditions on board could be appalling. Press reports started to arouse public concern with letters to the Times giving graphic accounts of the way in which pilgrims, particularly those from India, were being exploited. One, signed "A Sea Captain", describes how they could be trampled in the stampede to get on board, and how those lucky enough to secure a place below decks might find themselves, in bad weather, confined under battened hatches without light, water or any sanitary provision. Others, left on deck, were in constant danger of being swept overboard.

By international agreement and through legislation by the individual governments involved, measures were at last put in hand to curb the worst excesses of the trade. In 1885, Lord Dufferyn, then Governor General of India, commissioned a report from Thomas Cook and Sons. This convinced him of the need for urgent action and the following year he took the extraordinary step of appointing Cooks as agents for the Pilgrimage. Although well intentioned the scheme failed, largely through opposition from the Moslem community who saw it as a threat to their religious autonomy. Progress was made, however. Quarantine stations were set up, most notably at Tur and at Kamaran island in the Red Sea. Health checks were enforced at ports of embarkation and rules were laid down for the provision of doctors on board. The Indian Passenger Ship Act was passed in 1887 and a set of rules for pilgrim ships was produced by the Ottoman government in 1888. The British Merchant Shipping Act came into force in 1894 and the India Pilgrim Ship Rules in 1933. This legislation proved effective, the last major epidemic in the Hedjaz occurring in 1912. In general, inconvenience resulting from these regulations was borne stoically even when not fully understood. Since time immemorial water from the holy well, Zem-Zem, located in the courtyard of the Great Mosque, had been carried home as a treasured memento of the Pilgrimage. In time of cholera, however, bringing water on board was forbidden, whatever its source, and this could cause discontent even among the Malays, the most equable and tolerant of pilgrims.

The menace of cholera had a profound effect on the West. The spectre of the Plague Ship, laden with the dead and manned by the dying was suddenly a reality, not simply a poetic invention. It was realised that the squalor existing in the slums of European seaports and cities provided an ideal breeding ground for disease. This realisation led to the great advances in sanitation and water supply undertaken during the second half of the nineteenth century. Even in rural Winchester, the enclosure of 'the Brooks' (polluted streams flowing through the lower part of the city) and the re-location of the hospital to high ground outside the city walls may be seen as direct results of the pilgrimage to Mecca.

The involvement of some long established companies helped to raise standards in the trade. First in the field was The British India Steam Navigation Company (B.I.) serving the subcontinent and also the east coast of Africa. P and O, while not carrying pilgrims under its own house flag, sold on many of its old liners to wealthy Bombay ship owners and a number of ex B.I. ships ended their days in the same way. These outdated vessels were expensive to run but local magnates contrived to make substantial profits, consigning some to the breakers after one or two seasons but operating others successfully for a number of years.

When Blue Funnel Line ships arrived in the Straits they thus found a varied collection of sailing ships and elderly steamers already engaged in the pilgrim trade. With the opening of the Suez canal in 1869 (significantly the same year in which the *Cutty Sark* was launched) Holts were able to initiate their fast cargo service between Great Britain and the Far East and, in doing so, introduce a new concept into the carriage of pilgrims. By utilising unused cargo space in the 'tween decks to accommodate deck passengers, they offered a relatively quick and comfortable passage for pilgrims in modern well-found ships. Unlike their competitors they did not spend idle time anchored off Jeddah, but continued their homeward voyage leaving the return journey to the next Blue Funnel ship passing through the Red Sea outward bound. In these circumstances deck passengers represented a useful and regular source of income, but not a primary one. Even so, the Company was at pains to ensure that they were not regarded simply as freight. This concern was demonstrated in later years by the personal interest taken by Lawrence Holt, nephew of the founder, and George Holt, great nephew, in the welfare of pilgrims while on board.



Figure 29: The *Antenor* of 1872 (2072 tons) which towed the *Jeddah* into Aden

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The attitude of some shipowners, by contrast, could be less enlightened, and Joseph Conrad's novel *'Lord Jim'* describes the conditions which could still exist during the latter part of the nineteenth century. The opening chapters are closely based on an actual incident which caused a scandal at home and abroad. Conrad's 'ancient rust bucket' the *Patna* was in fact the steamship *Jeddah* (1571 tons), Arab owned but with British officers. She left Singapore in August 1880 with 1000 pilgrims on board, but encountered heavy weather and lost all power when her boilers shifted. With Cape Gardafui close to leeward her master judged her position to be hopeless. Knowing her boats to be quite inadequate for the numbers on board, he abandoned ship with his wife and the white officers, leaving the passengers and crew to their fate. Rescued and taken to Aden, he reported the total loss of his command, with his boat the only one to have survived. By good fortune, the drifting *Jeddah* was overhauled next day by the Blue Funnel ship *Antenor* (2072 tons) (Figure 29), homeward bound with 600 pilgrims. A boat was lowered and the *Antenor*'s chief officer managed to get on board, where he found a scene of utter confusion. With six feet of water in the engine room he first organised bailing parties, then secured a tow and, with dusk falling and breakers visible to leeward, the two ships set out for Aden. Their safe arrival caused a sensation. At the subsequent inquiry held in Singapore the *Jeddah*'s officers were censured for gross misconduct. The *Antenor* was commended for bringing off a remarkable feat of seamanship which, perhaps, went some way towards redeeming a grim story. One happy outcome was that the resulting publicity undoubtedly helped to bring forward badly needed legislation.

The conditions under which pilgrims travelled in the late nineteenth century were so spartan that cargo ships proposing to house them in the 'tween decks (the upper tier of cargo space located above the lower holds) required only superficial modification. Before 1914 food was not provided, the shipping company supplying only a ration of water and a few pieces of firewood each day. Areas of open deck were set aside for cooking on one side of the ship, and for simple latrines on the other. With the passage of time, these makeshift arrangements were superseded, in Blue Funnel ships, by the provision of pre-fabricated shelters with concrete bases, taken on board at Port Said or Singapore and returned for storage ashore when the pilgrims had left the ship. Conditions were further improved in the 1920s by the introduction of permanent galleys equipped with cooking stoves and boiling pans for rice. Designated sanitary accommodation and shower rooms were also provided, usually under the fo'c'stle head, so arranged that the spaces could be put to other uses when not required. This did much to reduce the risk of fire, and also made it unnecessary for pilgrims to bring their own livestock on board. Instead a small flock of about twenty sheep would be housed together in a pen constructed by the ship's carpenter at the foot of the mainmast, to be slaughtered as required in accordance with Islamic law.

Tall davits allowed the number of life boats to be doubled with one boat hanging from the falls and the other resting in chocks on the deck below (Figure 30). Alternatively, where space allowed, the two boats would be stowed alongside one another on deck. These additional boats were stored either in Port Said or Singapore, and sent ashore at the end of the trip to await another ship. Like any wooden boats in the tropics, they would dry out and it was not unusual for them to be brought alongside awash to the thwarts, a discouraging sight entailing energetic pumping and baling before they could be hoisted on board. Once at sea they would be regularly dowsed with water during the daily ritual of scrubbing decks. On deck, if the season allowed, awnings were spread and wind chutes rigged. The latter were tall ducts of canvas hoisted over the ventilators to encourage the circulation of air below decks.

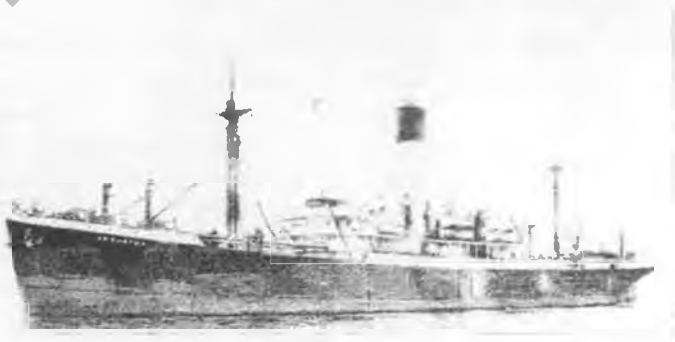


Figure 30: The *Adastrus* of 1923 (7857 tons), showing deadlights in the upper 'tween decks and additional lifeboats.

The 'tween decks allocated for accommodation were scrubbed out and painted, the hatches to the lower holds being battened down and secured with locking bars. In addition to the vertical iron ladders which allowed normal access to the 'tween decks it was the custom in Holt's ships to install removable timber companion ways leading up to porch-like booby hatches contrived in the corner of each hatchway. These helped to light and ventilate the spaces below, supplemented by portholes in the ship's side plating, sealed with deadlights when not in use. Inside the 'tween decks, wires were set up under the deckhead so that passengers could subdivide the space with hangings to form compartments for individual families, creating the appearance of an Arab souk.

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The number of pilgrims carried on a voyage could vary widely, ranging between 500 and 1500 souls. Determining factors included demand, which was itself dependant, very often, on the result of the rice harvest, the space available on the ship, and the season of the year. Until the Second World War, a proportion of those embarked were true "deck passengers" camping out on the open deck under the ship's awnings, while the remainder, including families and old people, were housed in the 'tween decks. In bad weather this was clearly unsatisfactory, and it became the Company's policy to ensure that some shelter was available for all if conditions required it. In hot weather, many preferred to sleep in the open, leaving the stifling 'tween decks to the women and children.

Daily inspections of the accommodation were carried out, giving the ship's doctor an opportunity to visit the sick and infirm, and to check for signs of unreported illness. It was not unknown for bodies to be concealed, in the vain hope that they might be buried ashore at the end of the voyage. Births and deaths were both fairly usual occurrences. Burials at sea were conducted reverently, the ship slowed, and the body lowered down to the water on a hatch cover.

Although Holts had been pioneers of the long haul route to the Far East via Suez, by the 1890s they were facing keen competition from faster and more modern ships. This was no doubt due in part to the inbuilt longevity of their ships, and in part to the Company's cautious approach to innovations such as the triple expansion engine and the use of steel in place of iron for hull construction. They regained the lead, however, in the early years of the twentieth century with the *Bellerophon* class of big flush deckers. Designed initially for a new round-the-world service via Suez and Panama, they proved a very successful class, remaining in production until 1916. With their long well lit 'tween decks, they were popular with pilgrims and also carried large numbers of Chinese migrants across the Pacific to America.

Over the years the Company developed a very distinctive house style, and Blue Funnel ships came to be easily recognisable by certain characteristics including a graceful sheer line, straight raking stem, and single tall upright funnel. The flush decks and 'goal post' masts of the *Bellerophon* class were not repeated, later designs usually incorporating a raised 'centrecastle' extending from the after end of number 2 hold to the forward end of number 6 hold. Apart from its obvious structural advantages, the centrecastle gave the benefit of double 'tween decks amidships, the upper level providing accommodation for pilgrims, with direct access through wide loading doors leading to the open well decks fore and aft. These features combined in the new 'A' class ships coming into service at the end of the second world war to produce what were, perhaps, some of the most handsome general cargo ships ever built.

The Company suffered very heavy losses in the Second World War. Out of a fleet of 77 vessels in service in 1939, only 36 survived in 1945. Numbers were made up to some extent with war built 'Liberty' and 'Victory' ships but these were not suited to some of the trades which Holts were anxious to re-establish with the end of hostilities. One of these was the carriage of pilgrims which had, of necessity, been suspended during the war years, but which was now in great demand once more. The older ships of the fleet took up the trade again (Figures 31 & 32) but times were changing, with new nations emerging in the Far East and higher expectations amongst the pilgrims themselves. To meet the challenge, the design of Holt's new "A" class ships (Figure 33) was modified in 1948 to incorporate improved cooking and sanitary accommodation for pilgrims.



Figure 31 (left):
On passage, m.v. *Eurybates*, 1946. Pilgrims at ease on No. 2 hatch.



Figure 32 (right):
Approaching Jeddah, m.v. *Adrastus*, 1947

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A major change in Company policy was to follow. It was decided to break with tradition and re-fit one ship, the old *Tyndareus* (11 347 tons) (Figure 34) exclusively for the carriage of pilgrims. She was one of Holt's last coal burners, built in 1916 with triple expansion engines giving her a speed of 12 knots. She had already led an eventful life. Mined and almost lost on her maiden voyage, she served as a trooper during World War Two which no doubt helped to determine her new role. Following conversion, which included the enclosure of the after well deck, with lifeboats doubled up on each side, she was able to carry 2500 pilgrims, although this complement was later reduced. For twelve years from 1949, she made two or three round trips to Jeddah annually, being laid up in Singapore between seasons. Newly painted for each season and with a reputation for cleanliness, she was popular with passengers. At first she shared her duties with other Blue Funnel ships, but in 1953 the political situation made it unacceptable for one company to serve both Malaysia and Indonesia. By agreement, the Malaysian trade was handed over to Swire's China Navigation Company while the *Tyndareus* dealt with Indonesia. At last, in 1960, she was withdrawn after forty-four years service and replaced in the following year by a very different successor.



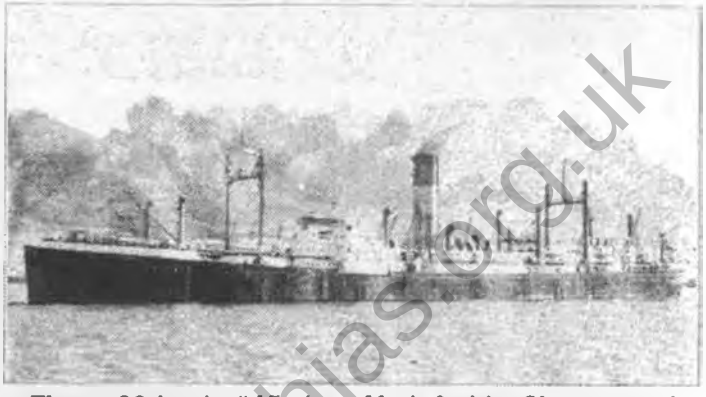


Figure 33 (top): "A" class Mark 2 ship *Clytoneus* of 1948 (8214 tons) showing 'tween deck deadlights. (Additional lifeboats would have been carried when on pilgrim service).

Figure 34 (bottom): The *Tyndareus* of 1916 (11 347 tons) in 1949 after conversion for sole use on the pilgrimage.

The *Gunung Djati* (17 516 tons) (Figure 35) was an elderly passenger liner, neither Holts built nor bearing an Homeric name and, with her two funnels, quite unlike any previous Company ship in appearance. Built in 1936 as the *Pretoria* for the German East Africa Line, she had passed into British ownership as a prize of war in 1945, becoming well known in the Far East as the troopship *Empire Orwell*. She was bought by Blue Funnel in 1958 and comprehensively re-fitted in Glasgow to accommodate 106 first class passengers and over 2000 pilgrims in conditions of comfort not seen before. Beds were provided for 200 of the pilgrims and a mosque was formed on "B" deck with a tell-tale arrow on the deckhead to point in the direction of Mecca. This relieved the second mate of one of his stranger duties of earlier days which had been to adjust a direction post set up on deck beside No. 2 hatch, the usual site for prayers. The name *Gunung Djati*, chosen in preference to the Company's first suggestion of *Dardanus*, was that of a missionary saint revered as one of those who brought the faith of Islam to the East. After a short but very successful period under Blue Funnel management, she was sold to the Indonesian government in 1962, continuing to operate as a pilgrim ship for a further twenty years.



Figure 35: The *Gunung Djati* of 1936 (17 516 tons), Holt's last pilgrim ship

With the sale of the *Gunung Djati*, Holt's long association with the Pilgrimage was effectively brought to a close, although the allied China Navigation Company maintained two ships in the trade from Malaysia until 1970. The advent of the jet powered airliner and the rapid expansion of cheap air travel over long haul routes meant that the mass transport of pilgrims by sea soon became uneconomic. A contributory factor in the decline was the growth of nationalism in the Moslem countries served, as evidenced by a reluctance to leave the

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Pilgrimage in the hands of a Western nation. From the shipping company's point of view, the trade was labour intensive, requiring much preparatory work and supervision during the voyage. This, combined with the progressive improvement in conditions on board, made the trade less and less attractive financially.

The Pilgrimage itself continues to grow and flourish. Saudi Arabia has made huge efforts to cope with the annual influx of pilgrims, undertaking massive building projects financed by oil revenues. Prominent among these was the development of Jeddah as a deep water port. Until the middle of the twentieth century there were no facilities for large vessels to berth alongside. Pilgrim ships lay at anchor between the reefs, cargo was discharged into primitive sailing lighters and pilgrims were ferried between ship and shore in the same way (Figure 36). During the weeks of the Pilgrimage the anchorage would be crowded with ships of different nationalities awaiting their passengers' return. The Royal Navy would usually contrive to maintain a presence in the area and it was not unusual for regattas to be arranged between waiting ships.



Figure 36: Pilgrims boarding at Jeddah, m.v.*Eurybates*, 1946

The latter part of the twentieth century saw the construction of the new port. Channels were blasted through the reefs and, by 1987, no fewer than sixty berths were available, together with an impressive terminal building for the reception of pilgrims. Although the numbers arriving by sea were already declining before the new facilities were completed, ships from Pakistan and less distant ports of embarkation made use of the terminal, which was designed to allow official welcoming parties to greet the new arrivals. English pilots responsible for berthing incoming ships recall the problems occasioned by sudden changes in trim when a thousand pilgrims moved en masse from one side of the ship to the other. They also recall widely differing standards of hygiene, reflecting the varying backgrounds of those on board. Once ashore, dressed in the uniform white robes of the pilgrim, all were equal in the sight of Allah, but inevitably some were held in higher esteem than others by the local population. Pilgrims from the Straits, Holt's former passengers, were mainly peasant farmers and were very well regarded; their brother Moslems from West Africa, much less so.

As rapidly increasing numbers of pilgrims began to use Jeddah's new international airport, so passenger traffic through the port dwindled away until, in 1985, the press announced that the "last Hajji ship" had been taken out of service. She was the *Shams* (8929 tons) operated by the Pakistan National Shipping Corporation. Until 1967 she had worked in company with the *Kareem*, formerly the B.I. liner *Mombassa*.

Some pilgrims will no doubt continue to arrive by sea, but few of these will hail from as far away as Malaysia or Indonesia. It is impossible not to admire the endurance and determination of the multitude of gentle and patient souls who made the journey from the Straits by sea. Certainly some old seamen from Liverpool look back with nostalgia on happy voyages made with pilgrims on board, and remember the bonus of one penny (later tuppence) a head paid as recompense for the extra work involved. It would be pleasant to think that Blue Funnel (Serompong Biru in Malay) is perhaps remembered in the East with some affection. A number of Malays went beyond the strict requirements of their Faith and made the Pilgrimage more than once in the Company's ships. In fact Holts reputation was such that when the service from Singapore had to be handed over to their old allies, the China Navigation Company, that firm felt it prudent to repaint their funnels "Blue Funnel" blue in order to maintain the confidence of their passengers.

This paper is based on memories of two voyages made in the 1940s on board the Blue Funnel ships *Eurybates* and *Adrastus*. Also incorporated are the results of later research, and the reminiscences of a number of elderly seafarers, of all ranks, to whom the author is deeply indebted.

John Reynolds

Mr Peter Nicholson: Architect and Mathematician

Introduction

My interest in Peter Nicholson (1765-1844) commenced more than twenty years ago when one of his books, *Essays on the Combinatorial Analysis* (1818), turned up in a secondhand bookshop in Lodge Road, Southampton. My particular area of professional interest is combinatorial mathematics (including its history) but I had never heard of this man. According to the title page, he was a "Private Teacher of the Mathematics" and an advertisement, at the end of the lengthy introduction, lists various topics that he taught. Another

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Figure 37:
Mr Peter Nicholson, the Practical Builder and mathematician.

advertisement indicates that he had invented an instrument called a Centrolinead *"very useful in Perspective and Dialling"*, price from £1 11s 6d (£3.57½p) to £3 3s 0d (£3 15p). My subsequent researches showed Nicholson to be a man still remembered as an architect and as the author of a number of influential books on architecture, carpentry, and building. As a mathematician, however, he has been largely forgotten, but all of his books have a strong mathematical bias.

Nicholson's Early Life

Peter Nicholson was born on 20 July 1765 in Prestonkirk, Haddingtonshire (later known as East Lothian). He was the third of nine children of George Nicholson, a stone mason, and Margaret (née Hastie). His formal education was confined to about three years at a local school. After leaving there in 1777, Nicholson initially assisted his father in his work but, in the following year, he began a four-year apprenticeship to Andrew Meikle (1719-1811), a millwright and inventor of the threshing machine. During this period, Nicholson learnt about civil engineering, millwrighting and carpentry and, for part of the time, a fellow apprentice was John Rennie (1761-1821) who was to become one of the outstanding civil engineers of the late 18th/early 19th Centuries. Nicholson also began studying mathematical works in his spare time[10].

After completing his apprenticeship, Nicholson moved, in 1782, to Edinburgh where he worked as a house carpenter. He also continued his study of mathematical books, including Emerson's *Fluxions* (the contemporary name for Differential Calculus).

About 1789 Nicholson moved to London where he had an uncle, named Hastie, who was a builder. The uncle discouraged Nicholson from his mathematical studies but, fortunately, he was not to be discouraged, so it was not long before Nicholson left his uncle and worked instead with Samuel Wyatt (1737-1807) in Berwick Street. Wyatt was a notable member of an architectural family and by this date had already done work in Portsmouth. Soon Nicholson set up an evening school to teach his fellow workmen.

Early Publications

In 1792 the first of Nicholson's books, *The New Carpenters' Guide*, was published by Nicholson himself, but he got into debt as a result and was sent to prison[8]. The book was also sold by the architectural publishers, I & J Taylor, who fortunately agreed to pay Nicholson's debts on condition that he wrote another book, *The Carpenter and Joiner's Assistant*. In 1793 Taylor published a 2nd edition of the original book, but under the grammatically more correct title of *The Carpenter's New Guide*. From an unfortunate start, this book was to become a standard work on the subject with many later editions. Many of Nicholson's books were published in instalments and, since the second edition of the *Carpenter's Guide* is longer than the first, it is possible that the financial difficulties prevented the first edition from being completed.

An advertisement in 2000 by Bookpress Ltd, Williamsburg, Virginia, for a copy of the second edition of the Carpenter's Guide included the following details: *"It is Nicholson's first and most successful book. It is the most important and influential handbook for carpenters ever published .... It is particularly noteworthy for Nicholson's original methods of constructing niches and groins of complex forms. There were several English editions up to 1856, and it was first published in America in 1818 with several printings up to 1867. Copies were advertised for sale in New York and Boston by the end of the eighteenth century. Thomas Jefferson*

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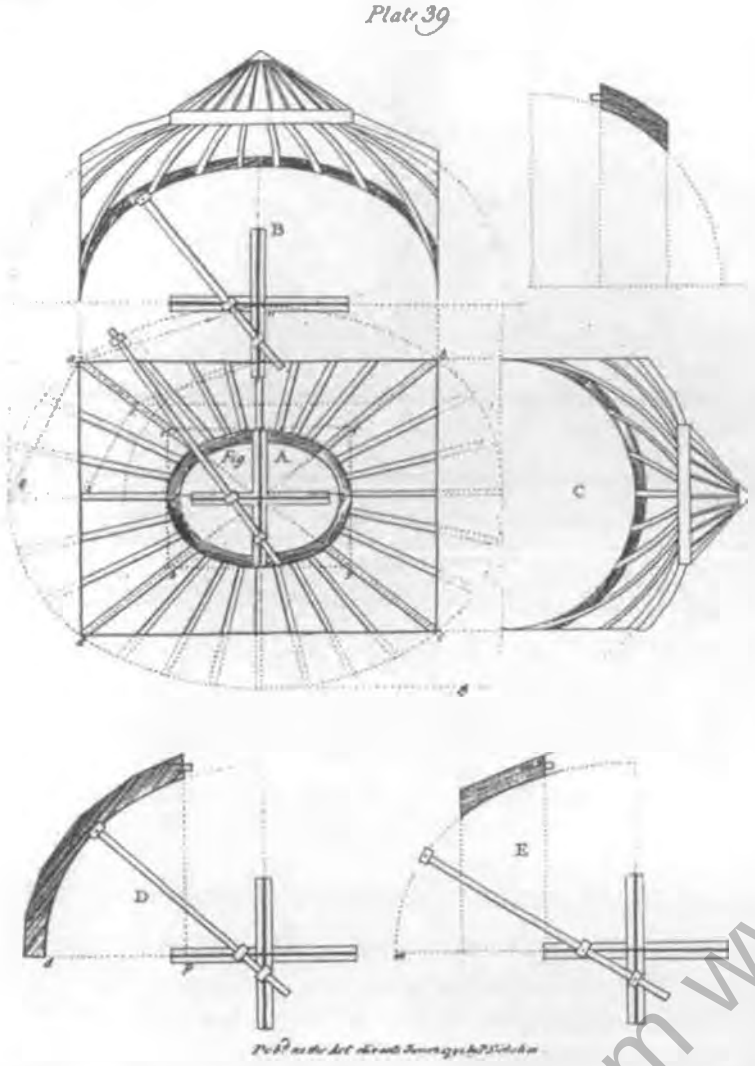


Figure 38: A plate from the *Carpenter's Guide*, showing a plan of an elliptical domical skylight over a staircase. The instrument is a trammel which was used for drawing ellipses.

recommended the book for the library of the University of Virginia which purchased the London, 1823 edition". Hamlin[9] expresses the view that *"Nicholson, through the continual republication of his technical plates in American handbooks, almost deserves to be called the father of American carpentry and joinery"*. Some of Nicholson's publications also had influence in Australia[2].

Nicholson's output continued throughout the 1790s. *The Principles of Architecture* appeared in 1795-1798. Its three volumes are largely independent of one another and Vol 1 *Practical Geometry, Arithmetic and Mensuration*, is a purely mathematical work. Vol 2 *Methods for describing arches and mouldings, drawing spiral lines, ...* is a practical drawing treatise and Vol 3 *Five Orders of Architecture* looks at the decorative side of the subject. This was another title published in instalments and, with such works, Nicholson had a tendency to change his mind about the content and ordering of the material as the work proceeded. The result is that early editions of some of his books are sometimes perplexing and it can be difficult to decide whether a particular copy is complete. Vol. 1 of the *Architectural Dictionary* is reasonably coherent, but Vol. 2 contains 44 plates, three of which are unnumbered, and the others bear various numbers between 61 and 170. Furthermore, a page of directions to the bookbinder for placing the plates shows that the order of them is to be far from numerical. Nicholson had engraved the plates himself for his first work, but those for the *The Principles of Architecture* were engraved on copper by Wilson Lowry from Nicholson's drawings. At a later date, however, relations between Nicholson and Lowry became strained[10].

Nicholson is said[10] to have been the first person who noticed (in *The Principles of Architecture*) that *"Grecian mouldings are conic sections; and that the volutes of the Ionic capital ought to be composed of logarithmic spirals"*. The work must have sold well as Vol. 1 at least was later reprinted and, in 1809, a 2nd edition of the complete work appeared which had the plates renumbered so that they do appear in numerical order. Altogether, six editions were published, the last, in 1848, after Nicholson's death, and, in recent years, the 1841 edition has been reissued by Elibron Classics. The *Principles of Architecture* was published by J Barfield, but at the same time Nicholson was working on other books: *The Student's Instructor in drawing and working the Five Orders of Architecture* was published by Taylor in 1795 and the promised *Carpenter and Joiner's Assistant* appeared in 1797. There is some overlap between the *Carpenter's Guide* and the *Assistant*, but the latter includes new material on such topics as sash windows, flooring and roofs.

About 1798 Nicholson was initiated as a freemason in the Lodge Old Cumberland, describing himself on entry as a "drawing master".

A Practising Architect

In 1800 Nicholson returned to Scotland. He spent a few months in his native village and then moved to Glasgow where he practised as an architect. His work there included plans for laying out Carlton Place. The building work commenced in 1802, but was not finished until 1813, by which time Nicholson had left Glasgow. The centrepiece of Carlton Place is Laurieston House which is now a grade A listed building. The interior plasterwork is attributed to Francis Bernasconi, who also did work in such buildings as Windsor Castle,

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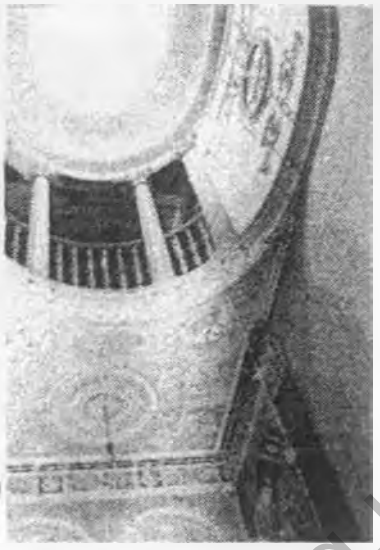


Figure 39 (above): Laurieston House (exterior)

Figure 40 (right): Laurieston House (interior plasterwork)

Westminster Abbey and Buckingham Palace. Laurieston House is currently owned by the Strathclyde Building Preservation Trust who had plans to restore it and sell it on to the National Trust for Scotland. The project was supported by Historic Scotland and Glasgow City Council, but a joint application to the Heritage Lottery Fund a few years ago was turned down, so the future of the building is now uncertain[16].

Other designs of Nicholson were also built in the Glasgow area, but most have disappeared in later redevelopments. Projects included additions to the University of Glasgow, a coffee house at Paisley and a wooden footbridge over the River Clyde. According to Dawson[5], the bridge *"was admired for the simplicity of its construction and its light appearance"*. Dawson also states that Nicholson was involved in founding the Glasgow Philosophical Society in 1802, that he taught many eminent engineers, including David Napier (the pioneer shipbuilder). The entry on Trevithick in the *DNB*[6] states that Nicholson helped Richard Trevithick draw up the patent specification for the latter's high-pressure steam engine dated 24 March 1802. Smiles[15] records that Joseph Clement (1779-1844) received drawing lessons from Nicholson. Clement went on to become an excellent draughtsman and toolmaker and, in 1823, was employed by Charles Babbage to construct part of the latter's Difference Engine.

Not all of Nicholson's work at this time was in Glasgow; he also laid out the town of Ardrossan, Ayrshire, for the 12th Earl of Eglinton. There Nicholson had contact with another eminent civil engineer: the construction of the harbour at Ardrossan was supervised by Thomas Telford (1757-1834). Nicholson's writings also continued and he wrote several articles for Brewster's *Edinburgh Encyclopaedia* and *Rees's Cyclopaedia*.

Some details of Nicholson's personal life are uncertain, but he is known to have been twice married. A Peter Nicholson married in St Marylebone in 1791 but it has not been established whether this was the Peter Nicholson of this article. In 1794 Nicholson had a son, Michael Angelo Nicholson, but no record has been traced of his first wife's death. Parish records confirm, however, that Nicholson married Jane (Jean) Jamieson in Glasgow on 27 August 1804.

Nicholson returned briefly to London in 1808, but he soon moved to Carlisle where he was appointed, on Telford's recommendation, resident architect for the new Court House, designed by Robert Smirke. Although his stay in Carlisle was fairly short, according to Taylor[17], *"His buildings, publications and partner William Reid had great influence on local architects"*. Taylor also asks *"Had Nicholson arrived [in London] by way of Portsmouth, where Telford was building Wyatt's Admiralty House in 1784-86?"*, but there seems to be no evidence to support this speculation. Nicholson was the architect for Castletown House, built 1809-1811 for Robert Mounsey, deputy registrar for the Carlisle diocese and secretary to the bishop. He also remodelled Corby Castle, the ancient seat of the Howards.

Return to London

The ten years from 1800 to 1810 which Nicholson spent as a successful practising architect were not to continue. After returning to London in 1810, he continued as a prolific author, as a teacher of mathematics and engineering and he also did some mathematical research. He did design other buildings but there was nothing on the same scale as the work in Glasgow, Ardrossan and Carlisle. One example of his later work is mentioned on the *Country Life* website for Spring Cottage, Cliveden, Bucks: a tea house designed in 1814, but it is now concealed within a later structure.

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PART I. PRICE SEVEN SHILLINGS,

To be continued Monthly, and completed in about Fifteen Parts.

AN

Architectural Dictionary

CONTAINING,

A CORRECT NOMENCLATURE AND DERIVATION

OF

THE TERMS OF ART;

WITH

A FULL DISPLAY OF THEIR TECHNICAL MEANING AND APPLICATION,

AS USED BY

ARCHITECTS, BUILDERS, AND WORKMEN.

EXHIBITING, IN A PERSPICUOUS POINT OF VIEW,

THE THEORY OF THE VARIOUS BRANCHES OF ARCHITECTURE, BUILDING, CARPENTRY, JOINERY, MASONRY, BRICKLAYING, &c. THEIR DEPENDENCE ON EACH OTHER, THE MOST APPROVED METHODS OF PRACTICE HITHERTO ADOPTED, AND

MANY PRACTICAL RULES NEVER BEFORE MADE PUBLIC:

THE WHOLE FORMING

A Complete Guide to the Science

OF

ARCHITECTURE AND THE ART OF BUILDING.

ILLUSTRATED WITH NUMEROUS COPPER PLATES,

ENGRAVED BY THE FIRST ARTISTS, FROM DRAWINGS MADE ON PURPOSE FOR THE WORK.

By PETER NICHOLSON, Architect,

AUTHOR OF THE PRINCIPLES OF ARCHITECTURE, THE CARPENTERS' NEW GUIDE, &c.

London:

PRINTED AND PUBLISHED BY J. BARFIELD, 91, WARDOUR-STREET, SOHO,

PRINTER TO HIS ROYAL HIGHNESS THE PRINCE REGENT;

And may be had of the Author, Mr. P. NICHOLSON, 401, Oxford-Street; J. TAYLOR, Holborn; T. GARDINER, Princes-Street, Cavendish-Square; LONGMAN, HURST, REES, ORME, & BROWN; SHERWOOD, NEELEY, & JONES; and GALE & CURTIS, Paternoster-Row; CROSBY & Co. Stationers-Court; CONSTABLE & Co. Edinburgh; BRASH & REID, Glasgow; and of all the principal Booksellers in the United Kingdom.

1811.

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Figure 41: The cover of Part I of *The Architectural Dictionary* 1811

The next Nicholson part work to appear commenced publication in 1811. Entitled *An Architectural Dictionary*, it was jointly owned by Nicholson and the publisher, J. Barfield, "Printer to His Royal Highness The Prince Regent". At that time when a part work was completed, the parts were usually bound and the original paper wrappers of the parts discarded. I was, therefore, pleased to find a few years ago, the first three parts in their original wrappers. Each contains 48 pages of text and six plates. A prediction on the back cover of Part I states that *"A Part, Price Seven Shillings, to be published if possible, on the first Day of every Month, ... The Work is expected to be completed in Fifteen Parts"*. In the event, the work was completed in 35 parts (with 281 plates) and the suggested monthly publication rate proved very optimistic as it was not completed until 1819. Meanwhile, other books appeared: *Mechanical Exercises* in 1812 (but most later editions are entitled *Mechanic's Companion*) and *A Treatise on Practical Perspective* in 1815. Like other Nicholson books, *The Architectural Dictionary* has a mathematical bias and, in an Appendix, includes a 43-page article on Algebra!

Awards from the Society of Arts

In April 1814, Nicholson received recognition from the Society of Arts which awarded him its Gold Isis Medal for his work on handrailing for staircases[20]. Previously, cutting out wood for handrailing had been done largely by trial and error, but Nicholson's principles enabled it to be done more efficiently with consequent saving of both time and materials. Richard Sorsky, in an introduction to a modern edition of Mowat & Mowat[11], writes *"The late Nineteenth Century is considered by many to be the golden period in the art of stair building. Peter Nicholson had developed his mathematical system and at last staircasing and handrailing could be reduced to an art available to the master and journeyman carpenter and joiner ... there evolved numerous books on stairbuilding and handrailing, all based to some degree, either by elaboration or refinement, on Nicholson's original system"*.

A further award from the Society of Arts came in May 1814, when Nicholson received twenty guineas for his "centrolinead", an instrument used in producing perspective drawings[20]. Later in the year, he was elected a member of the Society and in 1815 he was awarded a silver medal for an improved version of the centrolinead[20]. For some reason, however, he declined to pay his subscription to the Society in 1816. Nicholson claimed to have invented the centrolinead in the 1790s and he states that it was *"made by Mr. Dollond, St Paul's Church-yard, London, who has been long celebrated for his accuracy in the manufacture of optical and mathematical instruments"*[12].

A Priority Dispute

The next several years were Nicholson's most mathematical period and he was a member of Spitalfields Mathematical Society for at least part of this time. From 1816 to 1823, as well as writing about eight mathematical books, he also wrote at least ten articles which were published in such journals as *The Gentleman's Mathematical Companion* and *The Philosophical Magazine*. Not surprisingly, in view of his awards from the Society of Arts, he also published *A Treatise on the Construction of Staircases and Handrails* (1821) and *Rudiments of Practical Perspective* (1822). This is not the place to discuss his mathematical contributions in detail, but some of them were on improved algorithms for solving equations. Here Nicholson became involved in a priority dispute with Theophilus Holdred, a watch maker by trade who also wrote on mathematics. The method is usually known in Britain as Horner's method or the Ruffini-Horner method, but none of Holdred, Horner, Nicholson or Ruffini was the first to discover it since it was known in China at least 800 years earlier. The method was used, for example, by Jia Xian in the Song Dynasty, but this knowledge was subsequently lost and the 19th Century rediscoveries were made independently.

The Holdred-Nicholson dispute was conducted partly in their books and in *The Philosophical Magazine*; accounts of the dispute also appeared elsewhere. A recent assessment of the claims is given by Fuller[7], who concludes that Nicholson's *"work on these algorithms does not show much originality"* and that *"his claim to have anticipated Holdred has little justification"*.

From the January 1821 issue of *The Philosophical Magazine*, we learn that Nicholson had decided that he was spending too much time on mathematics to the detriment of his professional duties. From what he says, it is clear that his finances were again in a poor state and this probably explains why, in March 1821, he sold his interest in *The Architectural Dictionary* to Barfield. He also entered into a covenant not to publish any other work detrimental to the sales of the Dictionary, but soon he was to do just that.

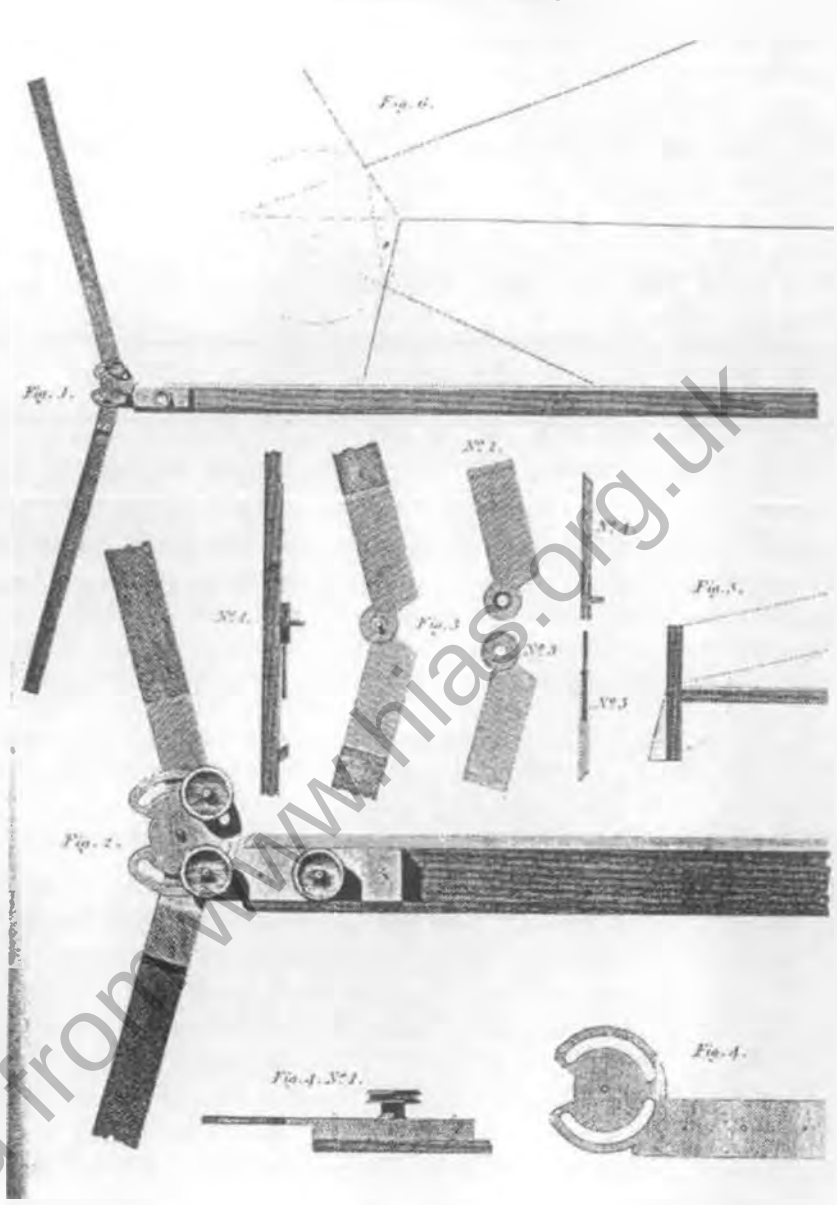
Litigation in Chancery

A publisher called Thomas Kelly wished to publish a work entitled *The New Practical Builder and Workman's Companion*. He also wanted Nicholson's name on the title page, although it was to contain work written by other people, including Michael Angelo Nicholson. Peter Nicholson signed an agreement with Kelly

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Figure 42:

The Centrolinead



in October 1821, and the work itself commenced publication, in weekly instalments, on 23 July 1823 with Nicholson's name on the title page and some of the plates. *The Builder* was much cheaper than *The Architectural Dictionary*. On 10 November, Barfield filed a bill seeking an injunction to stop publication of Kelly's work. Initially the case of Barfield v. Nicholson and Kelly was heard before the Vice-Chancellor's Court, Lincoln's Inn, but the Lord Chancellor presided over some of the later hearings. The case dragged on until at least 1827. [Readers familiar with Charles Dickens' *Bleak House* will recall the case of Jarndyce and Jarndyce which was litigated in the Chancery Court over many years.]

Barfield claimed that his copyright had been infringed and that Nicholson had breached his covenant; Kelly claimed that he was unaware of the covenant when Nicholson agreed to write for the Builder. The case was regarded as an important one and was extensively reported in *The Times* as well as in contemporary Law Reports. In addition, a detailed account of the hearing in February 1824 was printed by Kelly and presented to purchasers of *The New Practical Builder*. Barfield lost the copyright claim on the grounds that most of the material in *The Architectural Dictionary* had already appeared in earlier works. It was ruled in July 1824, however, that Nicholson had breached his covenant and Kelly was ordered to stop using his name on the work, but Nicholson's name reappears on some later editions.

Barfield soon cited the injunction in his publicity for *The Architectural Dictionary*: for example, an advertisement appeared in the *Carlisle Journal*, 23 October 1824, which refers to the injunction and then goes on to say that "Persons wishing to possess A GENUINE WORK, will find the *Architectural Dictionary* the completest on Architecture and practical Building ever published". A close examination of my own copy of *The New Practical Builder* seems to indicate that an attempt has been made to erase the words "Drawn by P. Nicholson" from several plates. One has visions, therefore, of some poor soul at the printers, in order to comply with the letter of the law, laboriously scraping away on all unsold plates bearing Nicholson's name.

Improved Editions

From the 1820s, some of Nicholson's books contain a memoir of him[10], thought to have been written by John Bowen of Bridgwater who was once Nicholson's pupil and for some years his assistant. When Nicholson was awarded the gold Isis medal, Bowen was employed to demonstrate his principles on handrailing to the Society of Arts. Later, in 1839, Bowen married Nicholson's daughter Jessie, a half-sister to Michael Angelo. The memoir is very much a hagiography and includes statements such as *"During his apprenticeship ... He studied algebra assiduously from Maclaurin ..."*.

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Bowen also produced *An Improved and Enlarged Edition of Nicholson's New Carpenter's Guide* which, apart from the position of the apostrophe, reverted to the original title. This first appeared in 1825 and, later in the Century, was further revised by John Hay. Thus for some years, different publishers were simultaneously issuing the *New Carpenter's Guide* and the *Carpenter's New Guide*. Bowen claims to have improved the arrangement of the material in the Carpenter's Guide and he also added some new material. The work contains an interesting section on examples of roofs which had actually been built, but some of this information had already appeared in *The Carpenter and Joiner's Assistant*. The Pantheon theatre, Oxford Street, is mentioned: by 1812 its roof was in a dangerous condition and Nicholson was one of the people who examined and reported on it.

Another person who improved the arrangement of some of Nicholson's work was his son, Michael Angelo Nicholson, in his book entitled *The Carpenter & Joiner's Companion* (1826). It combines the material in two of his father's works: *The Carpenter's New Guide* and *The Carpenter and Joiner's Assistant*. Some of Nicholson's other works would also have benefited from being rewritten. The original plan for the *Essays on the Combinatorial Analysis* was for two essays, but this grew to four and the pagination indicates that parts were added to it whilst it was in press: page 30 of Essay I is followed by pages 30A, 30B, ..., 30Z, 30*A, 30*B, ..., 30*L. Furthermore, a note on the back of the title page reads: "The Reader is desired to peruse pages 49, 50, and 51, of the Fourth Essay, which explains the Notation employed in the Introduction and in the Essays themselves, before he begins to read any part of the Work". But notwithstanding its eccentricities, the *Combinatorial Analysis* is important historically since it appears to be the first book on the subject in English, although there were earlier books in Latin and German.

A New and Improved Edition

By 1825, Kelly had finished issuing the *Practical Builder* and, even if the later parts were bereft of Nicholson's name, early subscribers already had it on the title page. Kelly soon took the sections in the work on carpentry and on masonry, had them revised and issued them as separate works entitled *Practical Carpentry, Joinery, and Cabinet-Making* (1826) and *Practical Masonry, Bricklaying and Plastering* (1829). Neither work bears an author's name. Later, *The New and Improved Practical Builder and Workman's Companion* appeared. This was organised into three separate volumes, two of which were just the *Practical Carpentry* and *Practical Masonry* with the third volume on *The Five Orders*. Contemporary Kelly catalogues indicate that the complete work was available in 35 parts at 3/- (15p) each or in numbers at 1/- (5p) each. In addition, each of the three volumes could be bought separately in parts, numbers or as a bound volume. *The Practical Carpentry* in particular seems to have sold well and it was reissued frequently from about 1835 to 1852.

Most of these later editions bear Nicholson's name on the title page as well as the words *"revised by Thomas Tredgold"*. Tredgold (1788-1829) may have been one of the unacknowledged people who wrote for the original *Practical Builder*, but since he had died in 1829, the acknowledgement of his work was rather belated. I do not know why the 1824 injunction no longer applied. Perhaps Barfield was now dead since, by 1835, the *Architectural Dictionary* was in the hands of a different publisher.

Nicholson's books were evidently used in Hampshire. A new edition of the *Practical Carpentry* appeared in 1835, and a copy being advertised a couple of years ago by Joslin Hall Rare Books, Concord, Massachusetts had an "Ownership signature of Mark Barnes, Southampton, Hants, July 7th, 1843". At about the same time, Nicholas Pounder Bookseller, Sydney, was advertising a copy of the original *Architectural Dictionary* "With ownership signature of George Banks dated Lymington, Hants, 1825."

However much or little of *The New Practical Builder* was actually written by Nicholson, it proved to be another influential work. A large portion of the original text and plates is reproduced in Bowyer[1] together with commentaries. The dustjacket on Bowyer states that *"The original book is probably the best-known textbook dealing with the construction of Georgian and Regency buildings"*. The new work gives *"authoritative information on the methods which should be used today in the restoration and conservation of the original buildings"*. But none of the contributors to Bowyer seems to be aware that the work was litigated in Chancery and that not all of it was written by Nicholson.

More Books

Whilst the court case was dragging on, Nicholson was writing other books. *The Builder and Workman's New Director*, the contents of which seems to have a large overlap with *The New Practical Builder*, appeared in 1824 and *The Practical Cabinet Maker, Upholsterer, and Complete Director* in 1826. The latter was written jointly with his son, Michael Angelo Nicholson, and it is a curious work. Pages 11 to 152 of the text and some plates deal with geometry, but there is very little other text. A large number of additional plates, however, depict

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furniture and furnishings, including *"The chair in which the late Duke of York died"*. Many plates are coloured and today the complete work commands a high price on the antiquarian book market. A modern (1973) reprint can be found at a more reasonable price but, alas, it omits the pages and plates on geometry.

Other works published during this period were *The Carpenter and Builder's Complete Measurer: a Practical Treatise on Mensuration* (1826-1827), which is a sequel to the *Carpenter's Guide*, and *A Popular and Practical Treatise on Masonry and Stone-Cutting* (1827).

The court case was, of course, ruinous to Nicholson's finances and he suffered further with another publication. *The School of Architecture and Engineering* began to appear in instalments in 1827, but the publisher got into financial difficulties and only a few of the twelve issues planned actually appeared.

Professor Nicholson?

At about this time, Nicholson was one of over thirty applicants for the post of Professor of Mathematics at what is now University College, London. In 1828 the job was given to a much younger man, Augustus De Morgan (1806-1871), another interesting character.

To the North of England

In February 1829, Nicholson's brother-in-law, Thomas Jamieson, purchased at an auction, premises in Morpeth from Northumberland County. Included was the Old County Gaol which he converted into a dwelling house. Nicholson was involved in the work and, later in the year, took up residence in the building. Nicholson's second wife died of cholera in Morpeth in 1832 and he soon moved to Newcastle upon Tyne. During his stay in Morpeth, Nicholson worked on a book on the theory of sundials, entitled *A Treatise on Dialling*, the first edition of which he published himself in Newcastle in 1833. Some of the calculations in it are for Morpeth's latitude. One source[8] states that this publication led to a dispute between Nicholson and Dr Lardner. This was, presumably, Dionysius Lardner (1793-1859), but I have found no other reference to the dispute.

During his nine years in Newcastle, Nicholson was recognised as an eminent person. In 1833-1834 he was given honorary membership of the Literary and Philosophical Society of Newcastle and, in 1835, he was president of the Newcastle Society for the Promotion of Fine Arts. He continued his teaching; an advertisement in the *Newcastle Courant* for 30 November 1833 reads: "TO ENGINEERS, CARPENTERS, &c. MR. PETER NICHOLSON HAS REMOVED his OFFICE to the Royal Arcade, (adjoining the Post Office,) where he continues to give Instruction, either privately or in Classes, in Mathematics, Architecture, Masonry, Carpentry, and Mechanical Drawing."

Nicholson's parlous finances continued, however, and, in January 1834, a public meeting was held for the purpose of promoting a general subscription in order to buy an annuity for him. A report[14] of the meeting records numerous speeches made on that occasion, including one by Mr John Dobson, architect. He said of Nicholson *"that in his profession he was a Hercules, whilst in mere worldly matters he was a child"*. He then expressed the belief that some of the publishers of Nicholson's books had distributed *"the honours which attended their publication"* to Nicholson, *"but the profits were carried into their own private treasures"*. Although £320 was raised, this *"only sufficed for present emergencies"*[19] and an application was made to procure a sum for him from the Royal Privy Purse, but that was unsuccessful.

Nicholson produced two more books: *A Treatise on Projection* (1837) and *The Guide to Railway Masonry comprising a Complete Treatise on the Oblique Arch* (1839). Nicholson was born before the railway age began, but in the late 1830s it was starting to develop rapidly and its beginnings some years earlier had, of course, been in the north of England. In his earlier treatise *Masonry and Stone-cutting*, Nicholson had already written on oblique arches and, in the *Railway Masonry*, he reproduces three testimonials about arches already constructed on his principles. These relate to: an arch executed on the Hartlepool Railway, near Castle Eden, in 1834, nine bridges on the Newcastle and North Shields Railway, and to five oblique arches on the Brandling Junction Railway.

More Disputes

Not everyone was happy with the *Railway Masonry*, however, for in an historical section, Nicholson takes a critical look at the literature on oblique arches. He takes Charles Fox to task for not acknowledging his (Nicholson's) priority either through *"ignorance of the subject on which he treats, or with want of that candour which induces men of science to allow their predecessors the honour and credit of what they have written on the same subject"*. Fox was one of the engineers on the London & Birmingham Railway and his paper on skew arches appeared in the *Philosophical Magazine* in April 1836. He was later engaged on numerous railway projects in various parts of the world and he was knighted.

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After several pages lambasting Fox, Nicholson then turns his attention to two other authors: John M. Hart and George W. Buck. Hart had published *A Practical Treatise on the Construction of Oblique Arches* in 1836, but Nicholson concludes that a bridge built on Hart's principles would be very expensive because of the labour which it would require. Buck's *Essay on the Theory and Practice of Oblique Arches* was published, in July 1839, at much the same time as Nicholson's *Railway Masonry*. Both works are based on similar principles, but Nicholson's was published in three parts, two of which appeared before Buck's Essay.

Whether Fox or Hart responded to Nicholson's remarks about them, I do not know, but the comments about Buck, although comparatively mild, produced a reaction in the form of a letter to the *Railway Magazine*[3]. Then Buck's *"highly scientific friend and assistant, Mr W. H. Barlow, son of Professor Barlow of Woolwich"* joined in and the dispute was conducted, in somewhat intemperate terms, by Barlow, Buck and Nicholson in the columns of *The Civil Engineer and Architect's Journal* [4].

The Final Years

In 1841 Nicholson moved back to Carlisle where he was to spend the remaining few years of his life, supported financially by Thomas Jamieson[8]. His son, Michael Angelo, died in 1841 and Peter Nicholson himself died of old age on 18 June 1844. He was buried in Christ Church cemetery but, twelve years later, a monument, designed by R W Billings, was erected to him in the Richardson Street Cemetery. The monument, some 30 feet high, is, not surprisingly, the largest in the Cemetery and is now a listed building. A diagram of it, which appears on an information leaflet produced by the Cemetery, draws attention to the following features in the design: inverted torches signifying the end of life, carved thistles indicating Nicholson's birth in Scotland, and a plumb board indicating his architectural profession. The whole design is said to illustrate "perspective". An inscription on the monument reads: PETER NICHOLSON / ARCHITECT AUTHOR / OF THE ARCHITECTURAL / DICTIONARY AND OTHER / WORKS OF MERIT / BORN AT PRESTON KIRK / JULY 20 1765 / DIED AT CARLISLE / JUNE 18 1844.



Figure 43: The Monument to Peter Nicholson in Carlisle Cemetery.

Posthumous Publications

Most of Nicholson's books went through more than one edition and new editions of a few continued to be produced for some years after his death. As already mentioned, the original *Carpenter's Guide* was probably his most influential work, not only in Britain but also on the other side of the Atlantic. At least ten editions were published in London and almost as many in Philadelphia. Most later editions of *The Architectural Dictionary* were titled *Encyclopaedia of Architecture* and editions edited by Edward Lomax & Thomas Gunyon appeared in the 1850s and 1860s both in London and New York. These have a reduced mathematical content and, in particular, the lengthy article on algebra is omitted. Some later editions of the *Railway Masonry* were edited by R. Cowen and, not surprisingly, they do not contain the historical invective.

Conclusions

Peter Nicholson was a remarkable man who had contact with a number of notable contemporaries, including Clement, Meikle, Napier, Rennie, Telford and Wyatt. He spent several years as a successful practising architect, but his main contribution was nearly thirty books on architecture, building, carpentry and mathematics. Some of his techniques, especially in carpentry, were highly influential in various parts of the world. It has to be said, however, that there is considerable overlap in the content of several of the books.

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An interesting feature of some of Nicholson's writings is his tendency to include historical material and his opinions of others' contributions. This is often directed at establishing his own priority, but it provides useful material for the present day historian.

Nicholson was involved in a number of disputes and appears to have been rather naive in some respects. His disregard for the covenant which he entered into with the publisher Barfield is an example, and this cost him dearly.

All Nicholson's books have a strong mathematical bias and a few are entirely mathematical, ranging from school books to research level. One can but speculate how different the end of his life would have been had he been successful in his application for a chair in mathematics.

Rather ironically, Nicholson spent the later years of his life in poor circumstances financially but, a few years after his death, a large sum was raised to erect a substantial memorial to him.

E. Keith Lloyd

Acknowledgements

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Sources of and a Plea for Information

In view of Nicholson's eminence and breadth of interests, information on him is scattered over a very broad range of sources, far too many to detail in full here. Besides the many books by Nicholson himself, a selection of the sources used is listed below. I shall be grateful to any reader who can produce additional information on Nicholson or who knows the whereabouts of any of his books.

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Publications

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£4.00 (to non-members)

Published by Hampshire Industrial Archaeology Society

Martin Gregory (ed.) *Hampshire Industrial Archaeology Society Journal*
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Other publications, including *Shipbuilding in Victorian Southampton* and *Water and Wind Mills in Hampshire and the Isle of Wight* are out of print.

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Hampshire Industrial Archaeology Society

Hampshire Industrial Archaeology Society was founded as the Southampton University Industrial Archaeology Group in the 1960s from members of University Extra-Mural classes who wished to continue and develop the practice of industrial archaeology. Recording has included surveys of mills, breweries, brickworks and farm buildings. Restoration work is undertaken directly or by associated groups, such as Tram 57 Project, the Hampshire Mills Group or the Twyford Waterworks Trust. In addition to the Journal, the Society publishes a newsletter and lecture meetings are held every month. Current membership fees are £11.00 (single member); £16.50 (joint); £18.00 (Corporate); £8.50 (out of county).

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