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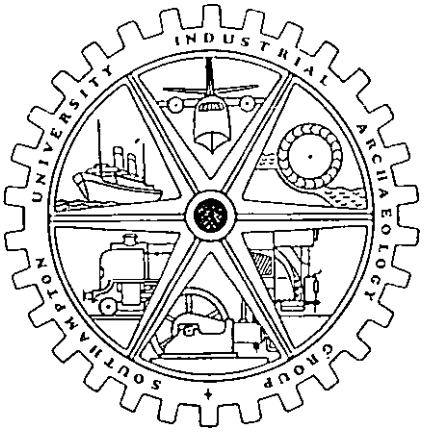
Southampton University Industrial Archaeology Group Journal



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The Contributors

Pam Moore
Pam Moore is a freelance writer and lecturer. She is secretary of SUIAG, Affiliated Societies' Officer and a Council member of the Association for Industrial Archaeology, a member of the Council for British Archaeology's Industrial Archaeology Committee and Convener of the CBA's South-eastern Region Industrial Archaeology Panel. She edited *A Guide to the Industrial Archaeology of Hampshire and the Isle of Wight* (SUIAG 1984) and is the author of *The Industrial Heritage of Hampshire and the Isle of Wight* (Phillimore 1988).

John Reynolds
John Reynolds began his working career as a deck officer in the Merchant Navy. Like many seamen he 'swallowed the anchor', became an architect, and, until his retirement, worked in the Architects Department of Hampshire County Council. He has been responsible for a number of restoration projects, including the barn at Brownwich, but perhaps his most celebrated work has been the restoration of Bursledon Windmill, which has recently won a national award. He is the author of a classic book on *Watermills and Windmills*.

Steve Fletcher and Dave Goodwin
Steve Fletcher and Dave Goodwin have embarked on an unusual study, namely the cultivation of watercress. Although based in Hertfordshire, they found that, as with hops, the growing of watercress was very localised and that some of the main concentrations were to be found in Hampshire. Their article is the product of two weeks fieldwork in the county.

Angela Smith
Angela Smith is, by, profession, a cartographer working for the Ordnance Survey in Southampton. However, in association with her husband Nigel, she has for many years been involved in industrial archaeology. In particular she has contributed to the preservation movement in three apparently unrelated fields — flying boats, the Mid-Hants Railway, and Southampton street tram-cars. Her article records the work of the Tram 57 Group on the restoration of Southampton Car No. 11. Angela has been the editor of *Focus*, the newsletter of SUIAG, since the first issue in 1973.

James Paffett
James Paffett began his working life in Portsmouth Dockyards. His career as a Naval Architect thereafter included various appointments in the Ministry of Defence and the DTI and a period as Professor of Naval Architecture at the Naval Academy in Greenwich. His contribution to the journal springs from the type of question he is frequently asked, and answers so ably, during the field visits of SUIAG.

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Editorial and Acknowledgements

The Southampton University Industrial Archaeology Group has been publishing monographs since 1969 and a *Newsletter* since 1973. For some years members have felt that an annual journal should be added to our publications, and this is the first issue. Our policy will be to consider for publication any article about industrial archaeology, the history of technology, or economic history in Hampshire or, alternatively, any pieces written by members of SUIAG. A length of about 5000 words is welcome but anything between 1000 and 7000 words is acceptable (shorter piece may be more suitable for the *Newsletter* and longer might better be published as monographs).

It is intended that the *Journal* should appear annually in the authumn. Comments on this 1992 edition would be most welcome, to help us to decide if there is to be a 1993 edition, and if so, suggestions for improvement. We are particularly grateful to Dr Julie Gardiner and Wessex Archaeology for producing our *Journal* and, of course, to our contributors.

For drawings and photographs we are grateful to the following (in a few cases the source is unknown): Deane Clark (Cover photo, Figs 1, 5, 6); Edwin Course (Figs 14–18); Ian Harden (Fig. 13); W.J. Haynes (Fig. 22); E.N. Lane (Figs 11, 12); Pam Moore (Figs 2, 6); James Paffett (Fig. 24); John Reynolds (Figs 7, 8); Nigel Smith (Figs 19–21).

Edwin Course
September 1992

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The Restoration Of The Golden Lion Brewhouse, Southwick

It is most unusual for industrial archaeologists to be able to undertake a project which culminates in the practise of experimental archaeology; the restoration of the Golden Lion Brewhouse at Southwick, near Fareham (SU 627085) was an exception. Not that any of those involved really imagined, on our first visit, that beer could ever be produced there again — at that point, even the restoration of the equipment to museum condition seemed an almost insurmountable task.

A century or so ago, brewhouses like that at Southwick were relatively common. Usually situated adjacent to the hostelry which they served (or in the case of the great estates, the big house), these establishments brewed beer on a relatively small scale. In the case of the *Golden Lion*, it provided sufficient for the public house, with a small excess for off-sales. Now, few of these brewhouses survive, and of those which do, hardly any contain their original equipment.

The history of the *Golden Lion* Public House can be traced back to at least the 17th century, and it is likely that a brewhouse existed at that time — remains of older brickwork at the rear of the present building supports this theory. The present brewhouse is, however, of 19th century date, a two storey red brick structure with a tiled roof. Closer inspection of the brickwork reveals that the bricks were almost certainly wood-fired, suggesting manufacture on the estate.

Southwick is a traditional estate village, a rare survival, five miles north of Portsmouth and three miles east of Wickham. Southwick Estate's considerable holdings include the *Golden Lion* and its brewhouse, although the public house is currently leased to Messrs Courages. The date of the present brewhouse is not known precisely; all efforts to locate documentary evidence have drawn a blank. Certainly, the brewhouse was well established by the mid 19th century, when the brewers were the Hunt family — trade directories of 1855 show James Hunt as the brewer. Forty years later, the incumbent was William James Hunt. Tthe family's links with the *Golden Lion* continued for many years — in an article in *Picture Post*, published in 1945, the public house is shown bearing a painted sign advertising 'Hunts Home Brewed Ales'. By this time, however, the actual brewing was being undertaken by one Dick Olding, and it was after his retirement in 1956, that the brewhouse ceased to function. Mr Olding is well remembered in Southwick, as we discovered when we undertook some oral research into the brewhouse's history. When Thomas Carter, who latterly assisted in the brewhouse, was interviewed, he recalled that Dick Olding was a 'real Governor's man'. He was also secretive — even when advancing age led him to accept help with the heavier work in the brewhouse, he would still allow no-one to enter whilst the actual brewing was taking place. Thus his secrets — the exact 'recipes' for his ales — died with him.

After Mr Olding's retirement, the brewhouse was simply closed up, complete with all its equipment. Not surprisingly, the fabric of the building deteriorated, and by 1970, when Michael Tighe produced his *Gazetteer of Hampshire Breweries*, he commented that Southwick was 'probably the most interesting old brewery in the county, but unfortunately its physical condition is such that it is dangerous to enter, and for this reason rightly neither the landlord nor the brewery owners allow inspection internally'. The timber of the first floor had rotted badly, and, as Michael Tighe observed, 'the machinery, like the building, had deteriorated considerably with age and damp'.

In the early 1970s, Paul Stephens, a member of a Cornish brewing family, instigated efforts to restore the *Golden Lion* brewhouse as a museum. Grants were promised and plans drawn up, but Mr Stephens moved to Cornwall before work could commence, and the scheme lapsed. In 1979, discussions began between Southwick Estates, and the Hampshire Buildings Preservation Trust, which resulted in the estate taking the decision to restore the building as a matter of urgency. Repairs were made to the roof, and the floor and timber louvres were replaced, together with some doors.

In June 1982, members of SUIAG were invited to visit the brewhouse to consider whether they could undertake the restoration of the interior and machinery. After some hesitation, we agreed to tackle what seemed an enormous task, and work began in January 1983.

Priority was given to cleaning thirty years of dirt, and the first few sessions were devoted to brushing and using a vacuum cleaner, and to the removal of loose paint flaking from the walls. Next, several coats of limewash were applied to ceiling and walls, before attention switched to the equipment.

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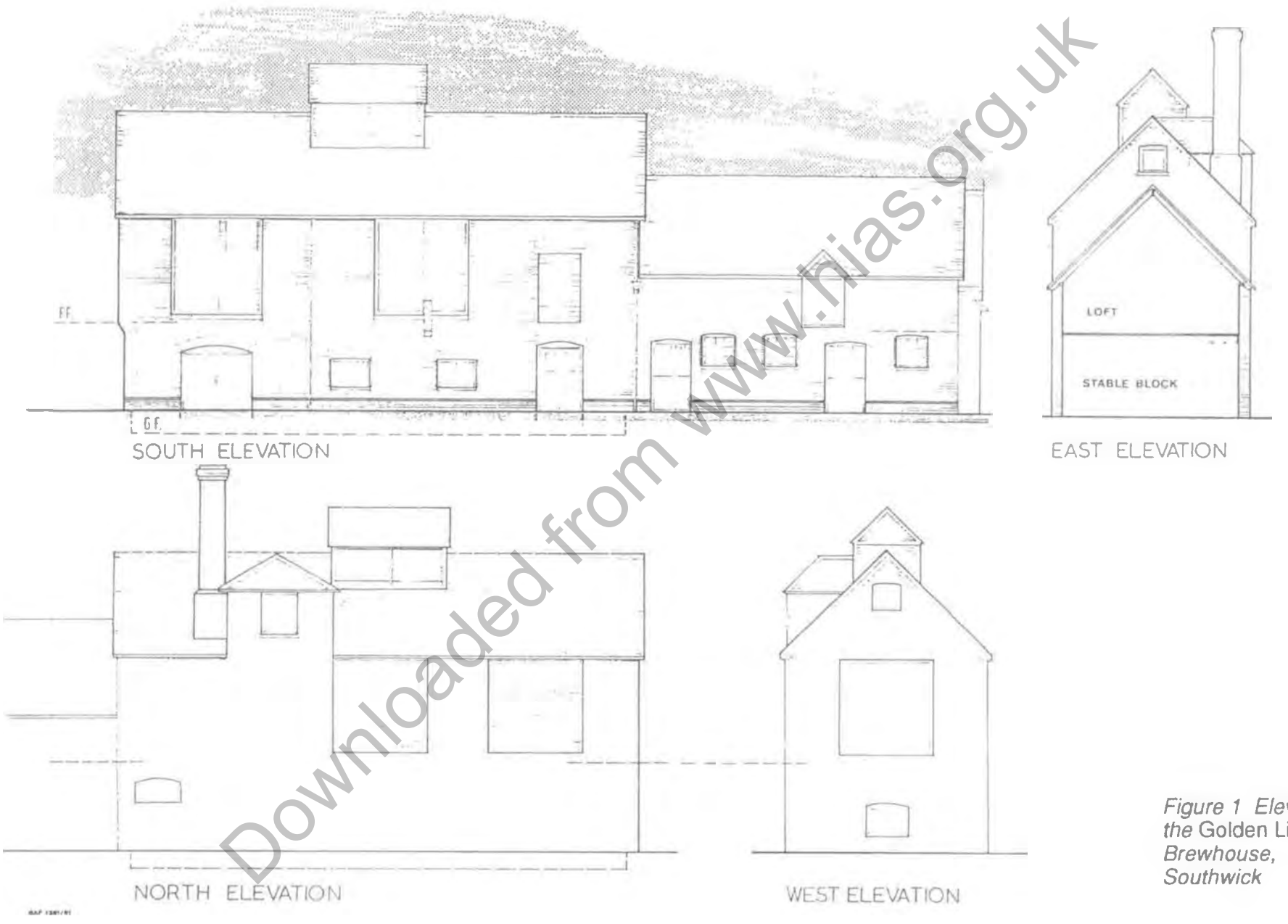


Figure 1 Elevation of the Golden Lion *Brewhouse, Southwick*

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Figure 2 Interior of Southwick Brewhouse, showing the top of fermenting vat (left) and hop back (right)

One of the brewhouse's most attractive features is its compactness, with almost all the brewing plant being housed in a single room on the first floor. The source of power, a single cylinder horizontal steam engine of *c.* 1875, is on the ground floor, and those volunteers with engineering expertise set to work to clean and restore it, and the Cradley boiler adjacent to it. We were gratified to find how well this phase of the work went, and before long, regular steam ups were a feature of the project.

The degree of renovation required for other items in the brewhouse varied considerably. The mash tun needed our attention, both to its machinery and to the vessel itself. The sparging arms were replaced, and welding was necessary to repair other parts. The vessel was rendered 'liquor-tight' by a combination of processes — when first tested it leaked very badly. The wood was thoroughly soaked, and newspaper placed in the vessel to maintain sufficient wetness. Next, reeds were inserted into the joints; these when soaked, expanded, sealing the leaks.

The copper presented few problems, with work confined to extensive cleaning, and some stitching of defective brickwork in the casing. The hop back needed attention in two respects — new gaskets were fitted, and the plates resting inside were redrilled — some by electric drill, others by hand, using screw-driver and hammer. Although work was undertaken on the dairy type cooler, it was, eventually found to be unfit for use — for every leak plugged, another appeared! The flat dish cooler, which had been used during the brewery's early years survives, but for reasons of hygiene, was not considered suitable for re-use.

The two fermenting vats posed a number of problems, since the timber was in poor condition, as were the hoops encircling the vessels. Although attempts were made to obtain the services of a cooper, this proved impossible (several came, but all shook their heads, politely said 'very interesting' — and left!). The volunteers mended the hoops as best they could, made the vats watertight using the same methods as with the mash tun, and undertook the welding necessary to the pipework used for controlling the temperature of the brew.

As work progressed, the temptation to attempt an experimental brew, to satisfy ourselves that the plant really was restored to working order, grew. After consultation with various bodies, including the estate, it was



Figure 3 The restoration team from the Hampshire Buildings Preservation Trust and SUIAG. Ted Argyle, Head Brewer, fourth from left, back row

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agreed that this should take place. Weeks of concentrated activity followed. The renovation work had to be completed, and the vessels had to be prepared for brewing. Supplies were obtained at a very favourable rate from Messrs. Gales, who also provided a day's training in brewing for the volunteers. The operation was to be supervised by Ted Argyle, former Head Brewer of Gales, and his help and advice were to prove invaluable.

The financing of the work — both the restoration and the experimental brew — was another problem we had to solve; grant aid was obtained from a number of sources, and we also gratefully received donations. On 26th May 1985, the brew took place. The previous day, the raw materials had been brought from Gales, and the whole brewhouse thoroughly cleaned. An early start was made on 'brew day', the boiler being lit at 5.30 am, the engine soon turning over, and by breakfast time, the mixture of malt and liquor (the term used for water in a brewery) was in the mash tun being sprayed with additional liquor by the sparging arms. At 9.30 am the brew (at this stage called wort) was pumped into the copper and the hops were added. Throughout the morning samples were taken at regular intervals, and the specific gravity recorded.

By lunchtime, the wort had passed through the hop back, where the spent hops were drained off, rather like the action of a collander on vegetables, and was being cooled before being passed into the fermenting vat. As the cooler (borrowed from a farm because of the unserviceability of the original) was small, this part of the process took a considerable time.

Once the brew was in the fermenting vat, yeast was added and the specific gravity recorded once more — at this time it was 1037. The fermentation process began almost immediately, and, as the clearing up of the brewhouse commenced, the initial signs were that it would be a good brew.

During the week which followed, regular visits were made to check the progress of the fermentation, and to make any necessary adjustments of temperature. On Sunday 2nd June, racking took place. The beer, by now having a specific gravity of 1011, was fined and transferred to kegs in preparation for consumption.

Lord Asa Briggs, who had shown considerable interest in the project, had agreed to declare the brewhouse museum open, by sampling the first pint of beer, and on 9th June, guests gathered in the brewhouse for the ceremony. Little did many of them know of the tensions of the previous week, exacerbated by problems with the Customs and Excise; but with these behind us, little did anyone care.



Figure 4 The first pint of the experimental brew being sampled by Lord Asa Briggs. Ted Argyle, Head Brewer, on the left

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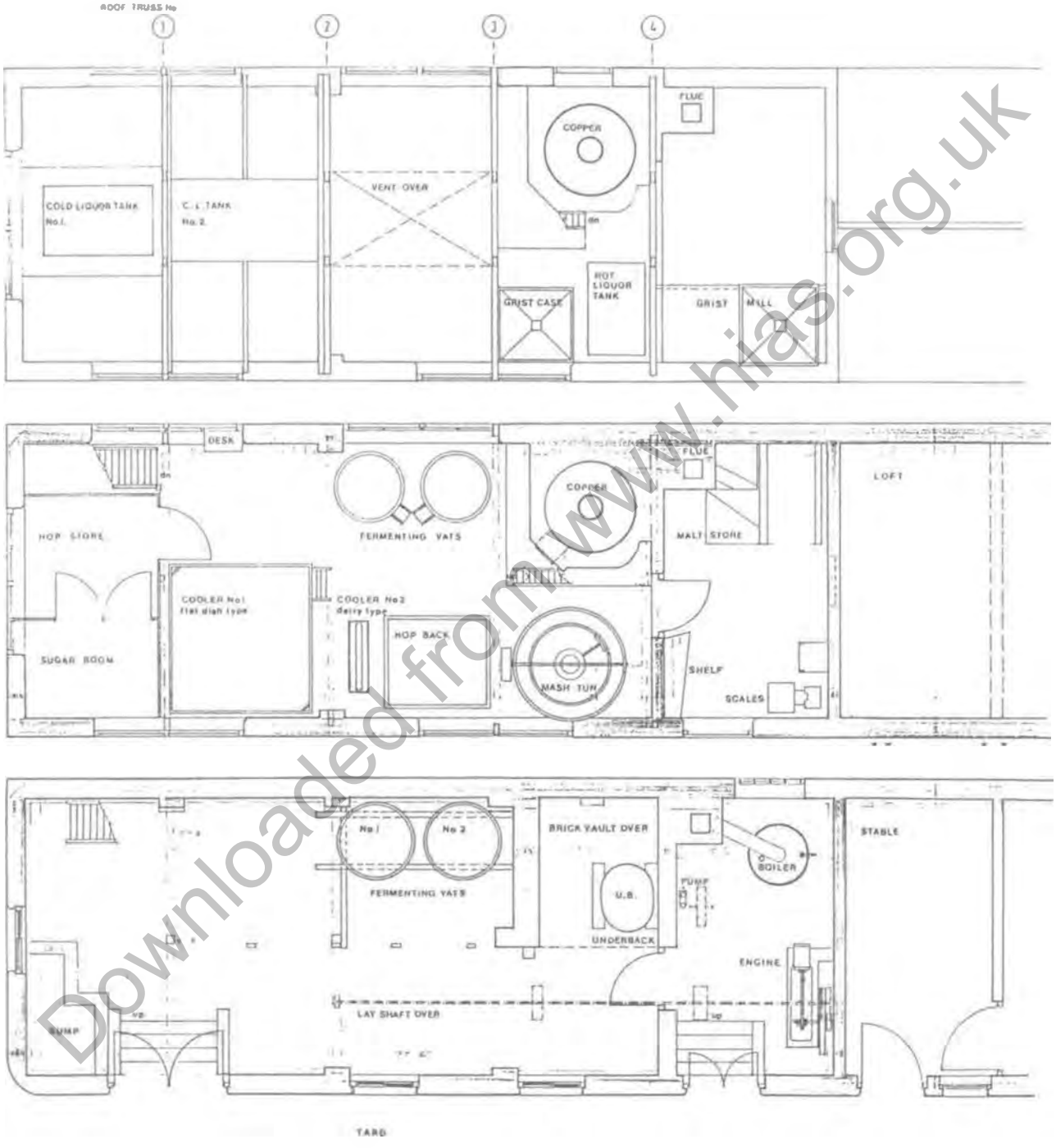
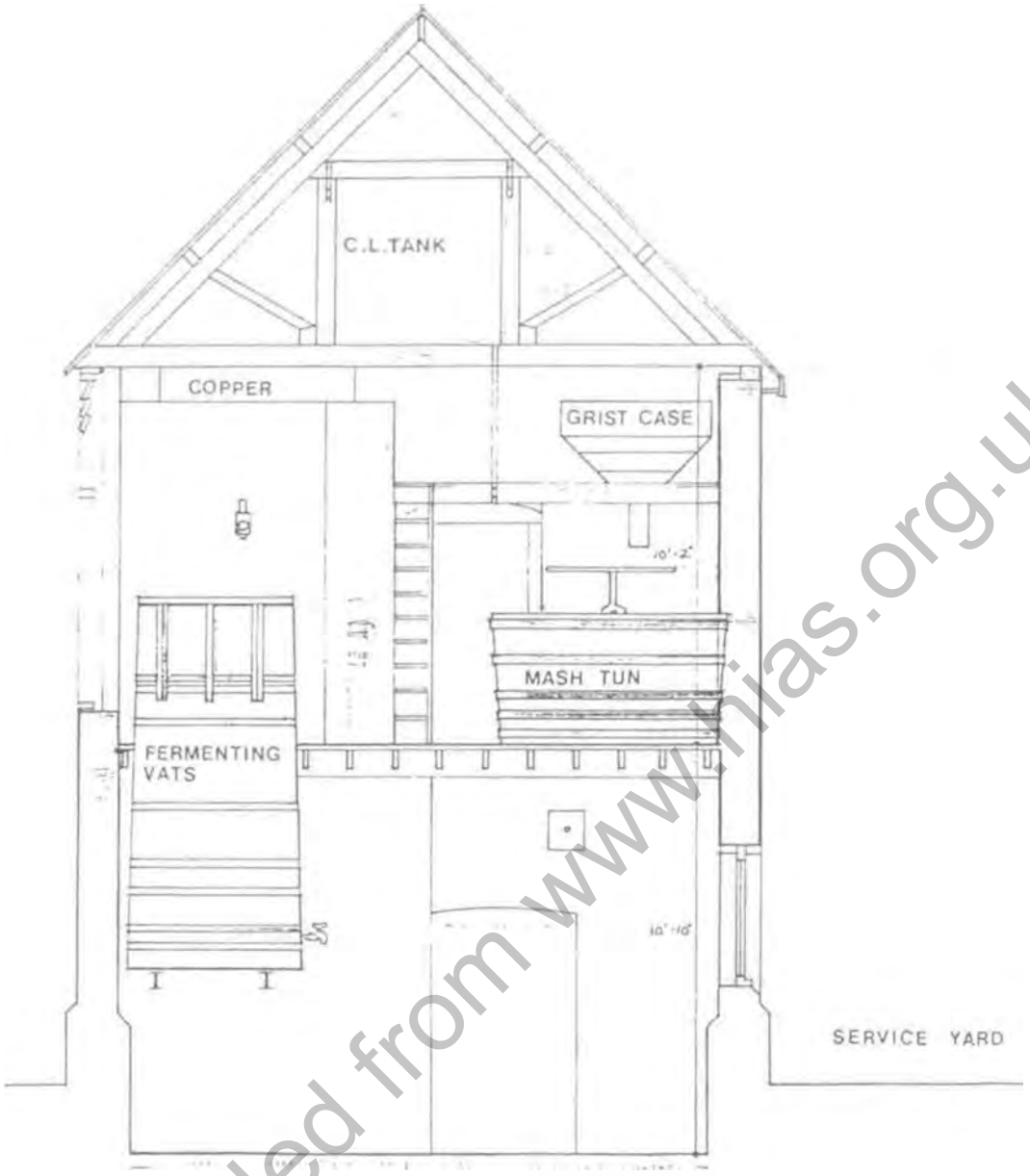


Figure 5 Plans of the Golden Lion Brewhouse, Southwick

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CROSS SECTION

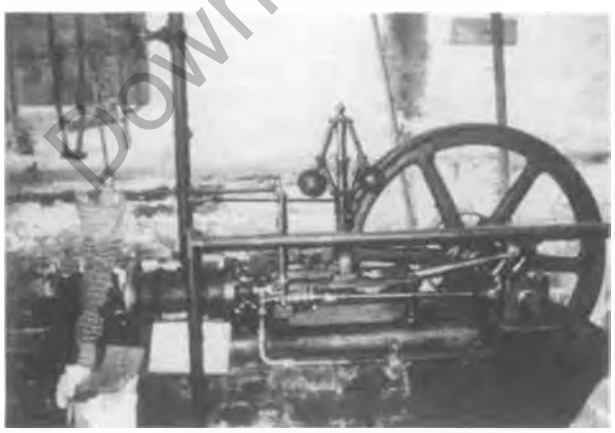




Figure 6 (Top) Cross-section of the Golden Lion Brewhouse, Southwick (left) steam engine at the Golden Lion (right) brewing day: steam pours from the brewhouse

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Amongst the organisations represented were Southwick Estate, the Hampshire Buildings Preservation Trust, Gales, Courages, Hampshire County Council, and, of course, SUIAG. Also present were two people whose interest in the brewhouse had been of many years duration — Michael Tighe and Paul Stephens.

One could almost feel Mr Olding's spirit too, as the brewhouse, filled with people, became hushed as Ted Argyle drew the first pint of Southwick Special Bitter. With the media recording the event, he passed the glass to Asa Briggs, who raised it and tasted the brew. We held our breath. Asa smiled broadly and proclaimed the beer to be good — what a relief! Then, other guests joined in the tasting, and a day of celebration followed. The remaining beer was bottled for us by Messrs. Gales, and gradually disposed of. However, a number of bottles remain, being kept for posterity — we were advised not to drink the brew after a year, although many who did declared it still to be good.

Now the brewhouse is quiet again, its peace only disturbed when occasional parties of visitors, wishing to see how beer was brewed in the past, are conducted around. SUIAG has comprehensive records of the project — written, photographic and video. The restoration of Southwick Brewhouse was an important project in a number of respects. As well as saving a remarkable relic of Hampshire's industrial past, it provided a chance to practise experimental archaeology. Most of all, however, it was a remarkable exercise in co-operation between various bodies. Asa Briggs, in his speech at the opening of the museum, commented on the teamwork, saying 'there is no other county in England where the County Council, University, volunteers and commerce could achieve such a project'. That is something of which we can be very proud.

Reference

1. M. Tighe, 'Gazetteer of Hampshire Breweries', *Proceedings of the Hampshire Field Club and Archaeological Society* 27, 92–104.

Acknowledgements

Without the efforts of the volunteers from SUIAG and the County Planning Dept this project would not have been possible; it is a testimony to the hard work undertaken by them, and to the team spirit which prevailed. It is sad to have to record that two of the 'prime movers' — Ted Argyle and Mike Inge — have since passed away; the restored Southwick Brewhouse is their memorial.

Pam Moore

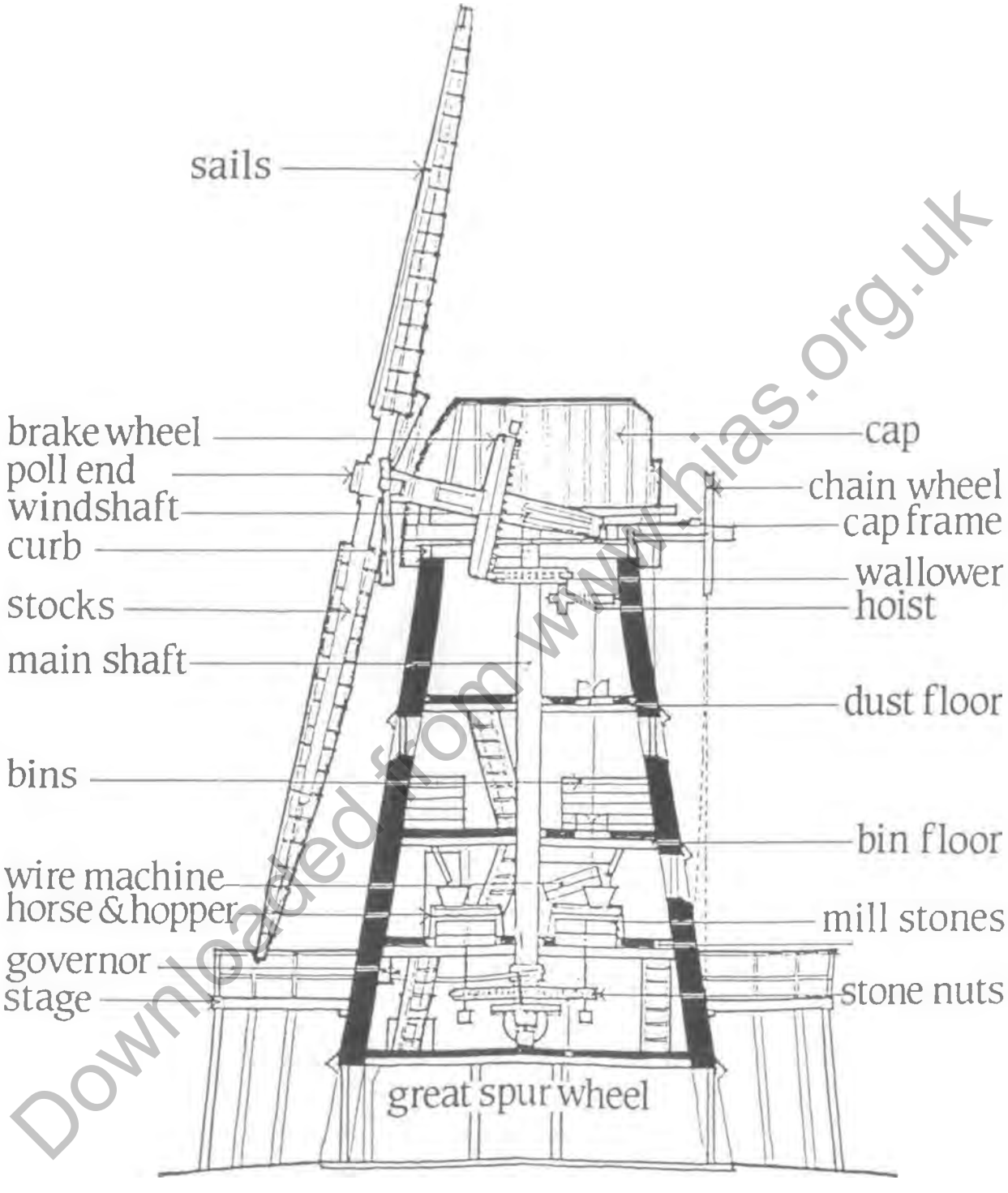
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The Restoration Of Bursledon Windmill

Bursledon Windmill is a brick tower mill dating from the early 19th century. It is referred to as 'lately erected' in an application for a grant of copyhold land made to the Bishop of Winchester (as Lord of the Manor) in 1814. It replaced an earlier mill on the same site for which permission to build was granted in 1767. It is possible that the first mill stood on the lawn behind the mill house, and that the brick vaulted tunnel, which projects on the north side of the house, once gave covered access to the mill. The absence of any other visible remains suggests that the first building may have been a postmill, but these are questions which could only now be resolved by excavation.

It is most fortunate that a single early photograph showing the windmill in working order has been preserved in the Mill House. As well as providing vital information on features long since lost, it shows the way in which the site itself has changed, mature trees now clothing what was once a bare ridge of heathland overlooking Southampton water.

The present mill was apparently commissioned by a Mrs Phoebe Langtry, wife of William Langtry who had owned the earlier building; certainly the application for the adjoining land was made in her name, 'independent of any husband'. The new mill was completed at an unpropitious time. The end of the Napoleonic Wars saw a decline in the local demand for flour, and the business does not appear to have prospered. The mill was mortgaged in 1814, and was sold some years later, although William Langtry (Phoebe's son) continued in service as miller. It subsequently changed hands several times, and seems to have gone out of use in the 1870s after a short working life of some sixty years. The then owner, Mr George Gosling, continued to operate from the site as an



Section through Mill

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Figure 7 Section through Bursledon Mill

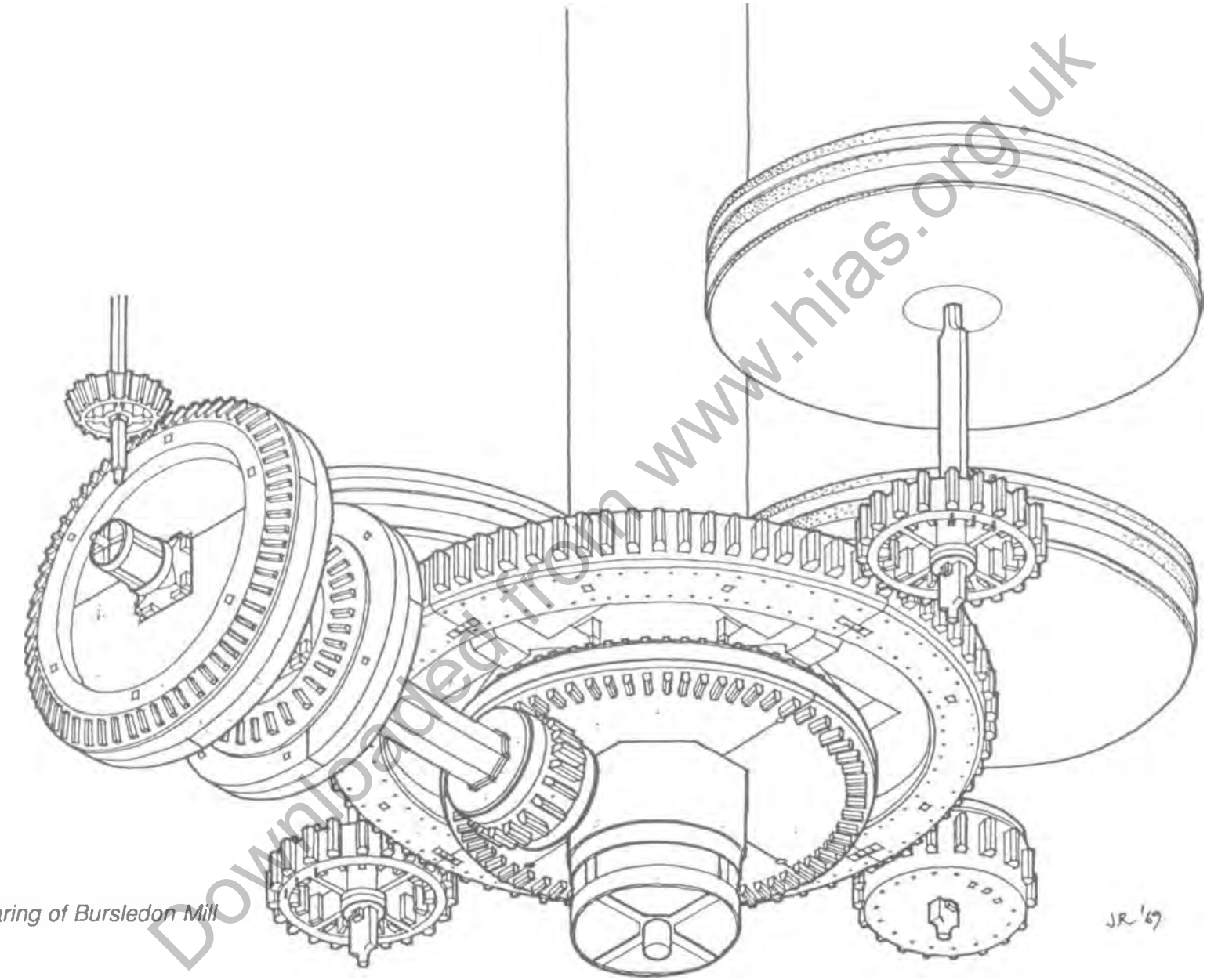


Figure 8 Gearing of Bursledon Mill

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Figure 9 Bursledon Windmill, disused, c. 1880

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Agricultural Contractor. His traction engines and threshing gear were housed in a large shed of corrugated iron and timber erected near the mill, the pond providing a water supply.

According to family tradition, Mr Gosling sometimes worked the mill for the benefit of neighbours after commercial milling had ended. On one such occasion he suffered a fall while setting the cloths, and his wife insisted that the time had come for final closure. Thereafter the building seems to have deteriorated fairly quickly. A water-colour painted in 1890 shows one pair of sails fallen, and the reefing stage heavily overgrown with ivy. Wedding photographs dating from the turn of the century show the stage completely removed, and it was probably at about this time that the cap was dismantled and a viewing platform constructed, from which 'you could watch the racing at Cowes'.

This platform, which consisted of a stout timber deck laid on top of the cap frame and water-proofed with asphalt, was in fact instrumental in preserving the internal machinery. The timber left exposed to the weather fared less well, and later photographs record the gradual disintegration of the brake wheel, winding gear and windshaft. Trees grew up around the tower, and for many years the mill stood more or less forgotten except by the occupants of the mill house, who used the ground floor as a garden store, and by local children who risked life and limb climbing in the machinery above.

Memories of the mill lived on, however. In that exemplary volume of reminiscences entitled *It happened in Hampshire*, compiled in 1936, a local resident recalls that farmers would celebrate the harvest by carting the first wheat threshed up to the mill, their horses decked out with red rosettes and harness bells.

Even when the working windmill had passed out of living memory, Mr Gosling himself was remembered in the district as a Methodist Minister and as a kindly man. Certainly his accident at the mill, which precipitated its closure, seems to have resulted from an act of kindness, and there are those who still recall the excitement of Sunday

School outings made to Lee on the Solent in a wagon drawn by one of Mr Gosling's traction engines.

In the 1960s concern for the future of the mill was expressed by Dr Edwin Course and by Roger Brown (then County Planning Officer) who recognised its importance as an industrial monument of a kind rare in Hampshire, and a survey was undertaken by members of the Winchester Model and Engineering Society with the encouragement of Rex Wailes. It was not until 1978, however, and through the generosity of the owners, Mr & Mrs Jenkins, that the opportunity arose for the mill to be acquired by the newly formed Hampshire Buildings Preservation Trust and for a programme of repair and restoration to be put in hand.

Bursledon windmill is important for various reasons. Although the County once had its fair share of windmills, only five now survive, and of these Bursledon alone retains its machinery. Its interest is not only local, however. Already old fashioned when it was built, it represents the early tradition of timber millwright's work, and displays few of those Victorian improvements which are to be seen in the majority of surviving windmills. The windshaft, for example, is of timber throughout, the stocks for the sails being housed in mortises cut through the projecting poll end, and the neck being reinforced against wear by strips of metal let into the face of the timber and secured by iron straps. The new windshaft, cut from a baulk of English oak eighteen feet in length and two feet square, is as far as possible an exact reproduction of the original, most of which survived *in situ*, and incorporates the original iron gudgeon and hoops at the tail end. No trace of the poll end remained, however, and the method of strapping adopted follows continental practice.

The sails are of the 'common' type, with cloths spread on timber frames. The original sails had completely disappeared, but it has been possible, with the aid of the early photograph, to produce reasonably accurate replicas. Most English mills were equipped (or re-equipped) in the 19th century with spring sails or patent sails, with shutters which opened and closed automatically to compensate for changes in wind speed, and a corn mill with four common sails is a rare survival today.

The cap at Bursledon is turned head to wind manually, by means of an endless chain passing over a large transverse wheel mounted at the rear of the cap. This in turn drives, through gearing, a pinion engaging with a circular iron rack on top of the curb. Much of the rack survived, and is back in use. Of the gearing, only one broken pinion and a short stub of shafting were recovered. Even the cast iron centre from the chain wheel, which had been lying in the brambles at the foot of the tower when the early survey was made, had disappeared and was given up for lost. By an incredible stroke of luck it was found and identified by an enthusiast in a Sussex garden, and is now performing its original function once more. Traces of filled mortises found in the surviving fragments of the original oak curb suggest that the cap may once have been turned by a timber worm gear, engaging with projecting cogs, an arrangement which can still be seen at Bembridge. If so, the substitution of rack and pinion was one of the few mechanical modifications made to the mill during its working life, and it was thought best to reinstate the later arrangement of which some parts at least survived. Chain operated luffing gear of this type represents an intermediate stage in mill design. Early caps were turned by tail poles, later ones by fantails which relieved the miller of much work and worry. The fantail was invented in the mid 18th century and was thus available to the millwright at Bursledon, but as in other matters he elected to follow the older practice.

The turning of the cap is eased by two iron rollers under the breast beam. Elsewhere the curb is 'dead', the cap frame sliding on cast iron slipper blocks. The original cap frame had six short strips of iron nailed to the underside to serve this purpose, probably pieces of old wagon tyre.

The cap is centred by wooden truckle wheels, of which three survived *in situ*. The placing of the missing wheel (or wheels) at the rear of the cap could not be determined, but it is quite likely that the arrangement adopted in the restoration follows the original layout. A keep flange of oak projects from the inner face of the curb, above the centring wheels, as a precaution against the displacement of the cap.

An interesting detail of construction came to light with the removal of the remains of the curb, which exposed a series of pockets in the brickwork, filled with decayed timber. These extended downwards to a depth of some five feet, and had contained upright posts resting on short horizontal plates, which had clearly been built into the brickwork of the tower during construction of the mill. Tenons on their upper ends had been mortised into the underside of the curb, and secured with

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Figure 10 Bursledon Windmill before restoration, 1969

tree-nails. No metal holding down bolts or straps had been used. After consideration it was judged to be neither feasible nor desirable to attempt to reproduce this original fixing system. The cavities were accordingly cleaned out and packed with concrete, with adjustable steel holding down bolts incorporated in plastic sleeves.

The tower itself is of local red brick with a thickness of 1ft 10½ inches up to Stones Floor level, except between the main floor beams where the thickness is reduced to 1ft 6 inches. This complication was perhaps introduced to facilitate the insertion of the floor beams, while at the same time providing a seating for the secondary joists of the Stones Floor. Above the Stones Floor a thickness of 1ft 6 inches is maintained throughout. The tower takes the usual form of a truncated cone. While this produced a structure of great intrinsic strength, the resulting inclination of the brick courses encouraged water penetration, which has clearly occurred at Bursledon throughout the life of the mill. The brickwork was thickly coated with tar, and a profusion of nail heads, especially on the weather side suggested that the exterior was at some time sheathed, probably with sheet iron. During restoration the brickwork was thoroughly cleaned down, repointed, and painted with a black microporous material designed to resist the effects of driven rain.

When originally built the mill was equipped with two pairs of stones. A third pair was added at some later date, a main floor beam being very nearly cut through to accommodate the spindle. The stones are driven from below, and taken out of gear by the removal of slip cogs. Tentering was effected by a single iron centrifugal governor, mounted on the wall at Hurst Floor level and driven by a belt from the main upright shaft. When the work began the governor had fallen to the floor below, and although the lighter bars or levers controlling the bridge trees remained in place, only one pulley survived to show how these components had been linked. The solution adopted in the restoration, employing adjustable control lines attached to a pivoting lever, is based on the method employed at Bembridge, a mill which has much in common with Bursledon.

The sack hoist is operated by a friction drive from the underside of the Wallower. Although the original barrel and driving wheel had disappeared, sufficient remains of the supporting frame and levers were found to allow reasonably accurate reinstatement. Because the main beams on upper and lower floors do not cross at right angles, there is only one position at which sack hoist traps can be vertically superimposed through the full height of the mill. No physical evidence for the placing of the traps was thought to survive, but marks of wear on one of the Hurst Floor beams, caused by the rubbing of the hoist chain, now confirm that the position chosen is correct.

There are two items of auxiliary machinery in the mill. The wire machine on the Stones Floor is driven by gearing from a timber layshaft located below the Great Spur Wheel. The original casing was riddled by beetle and has been renewed, but the iron components have been re-used. In order to meet the anticipated demand, the cylinder has been covered in nylon mesh of a single coarse gauge, but the meal chute discharging to the Ground Floor below is capable of separating three grades of flour or meal if required. An iron Kibbler, a late addition to the equipment of the mill, is mounted at Hurst Floor level, and driven by a belt from the layshaft which serves the wire machine.

The Hampshire Buildings Preservation Trust acquired the mill in 1980 and an attempt

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was made to establish at once the basic principles to be followed during restoration. It was decided that the mill should be restored to full working order, and not simply conserved as a static exhibit. It was recognised that financial and other constraints would not allow the work to be undertaken as a single contract, and a programme of phased repair was accordingly drawn up. Although modified and extended during the course of the work, this basic programme was followed through to completion. The support of local enthusiasts was sought, and the Friends of Bursledon Windmill contributed a great deal in raising funds and arranging for help from local firms, especially during the early days. As with other Trust projects, professional input was provided by the County Council, the Architects, Planning, Museums and Estates Departments being involved as and when other commitments allowed. The possibility of appointing a skilled craftsman as a direct employee of the Trust was examined, and by good fortune it was possible to secure the services of Jim Lewis, a retired Shipwright, whose work at Eling Tide Mill was then nearing completion. It would be impossible to overstate the importance of his personal contribution, and his name is recorded on a main beam inside the mill. His work included the new cap and windshaft, the construction and cogging of the new gear wheels, and the shaping of the new stocks. Millwrights and contractors were employed for various other aspects of the work, while horses and hoppers, bins and chutes installed during the later stages of the project were expertly made by Nicholas Kerson, a volunteer.

The actual sequence of operations, which was at first dictated by sheer necessity, in fact began before the Trust took possession. The most urgent need was to prop floors and machinery from the Ground Floor upwards to forestall a general collapse. This was accomplished in the nick of time; as the work progressed it was found that almost every piece of timber in contact with the external walls had rotted away. A crane was then used to lift down the remains of the windshaft, cap frame and curb, and to raise a temporary roof into place on the top of the tower. Screens were fitted to door and window openings and the mill was at last made safe and weather tight so that the work of repair could begin.

On examination it was found that many of the floor joists and almost all the boarding to the upper floors had been roughly renewed in softwood at some date. These replacements, which had in turn become rotten, were



Figure 11 Bursledon Windmill after restoration, 1990

removed. It was the Trust's aim to retain original materials where possible, and in the case of the main floor beams this was achieved by cutting away decayed ends and incorporating concealed steel brackets built into the brickwork. Beams were jacked up to their original level and concrete padstones faced with oak board were inserted in place of decayed wooden plates. This work enabled the crude oak props driven under the ends of floor beams during earlier makeshift repairs to be removed. Of the four handsomely chamfered oak posts supporting the Hurst frame at Ground Floor level, two were found to be past repair. The remaining pair, together with the two replacements, were carefully cut in half longitudinally and hollowed out to enclose tubular steel stanchions. The two oak beams supporting the Bin Floor were obtained from Hyde Barn in Winchester. They had been removed during conversion, and were donated by Winchester City Museums.

The main upright shaft and the gear wheels mounted on it all remained in place, but were in various stages of decay. The shaft itself was found to be remarkably sound, and is still in use. Its condition is probably due to the fact

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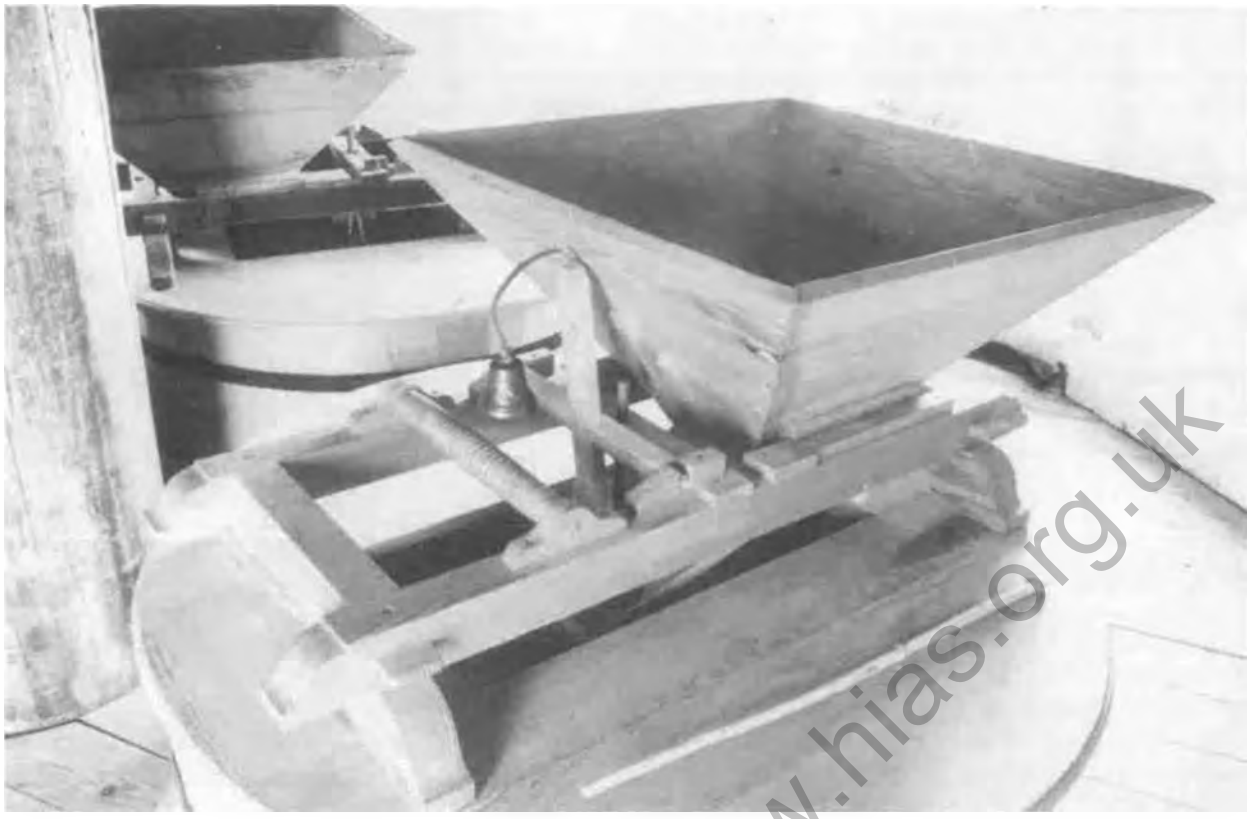


Figure 12 Bursledon Windmill, grinding machinery restored 1990

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that the end grain was effectively sealed against moisture by a thick coating of grease dripping from the head bearing. The Wallower, the Great Spur Wheel and the Face Wheel below it were all more or less complete but were ravaged by the combined effects of wet rot and beetle infestation. They were removed from the shaft and re-assembled to serve as models for the new gear wheels, and their remains will be conserved and displayed on the site. Of the Brake Wheel nothing remained but parts of two clasp arms, and the design of the new Brake Wheel is based on these fragments and on comparable wheels from other mills of the period.

In the meantime, the old sheds which had once housed Mr Gosling's traction engines were cleared of rubbish, and roughly repaired for use as a workshop and store. It was here that the new cap, windshaft and brakewheel gradually took shape until the great day when the roof could be removed and the whole assembly lifted by crane into place on top of the tower. The remains of the sheds were then cleared away, and their place was taken by two old farm buildings more appropriate to the site, a barn from Chineham and a granary from Chandlers Ford, both rescued from impending demolition.

The barn in turn was to prove invaluable when suitable timber for the new stocks was at last located. For these spars (which support the sails) two forty foot lengths of pitch pine were required, and the need was eventually met by the purchase of two massive floor beams, salvaged from the demolition of a Rochdale textile mill. The new stocks were delivered to site roughly shaped and were accommodated diagonally in the barn, with inches to spare, by removing a section of weatherboarding from one of the end walls.

The barn also provided storage space for the new sails, constructed from the same timber by E. Hole and Son, the Sussex Millwrights, at their yard in Burgess Hill. English oak and elm, used elsewhere in the restoration were supplied by East Brothers of West Dean, who also provided the hornbeam used for new cogs. Oak for the external reefing stage was drawn from the County Council's own store of timber brought down by the gales and stockpiled for use in the repair of the County's historic buildings.

The erection of the reefing stage in 1990 marked the practical completion of the project, and the first batch of corn was ground successfully soon after. With the work completed the Trust was concerned to see arrangements made as quickly as possible for the future care and maintenance of the site. This objective has now been happily achieved by the setting up of a Joint Management

Committee, representing the Trust, the County, and Eastleigh Borough Council. While the mill remains the property of the Trust, the County Museums Service has assumed responsibility for the administration and staffing of the site, and is busy with further improvements. These will include better facilities for visitors, including school parties, and the installation of displays in the barn.

The Trust is grateful for assistance given during the progress of the work by countless individuals, Companies and Organisations. It is not possible here to attempt a list of acknowledgements, but mention should be made of Cyril Hathaway, who was involved from the very beginning; to Derek Moore who has researched the early history of the mill; and to the members of SUIAG and the Hampshire Mills Group who have maintained their support throughout the duration of the project.

John Reynolds

Watercress Growing in Hampshire
A forgotten industry?

This article is written in response to the encouragement given in the introduction to Pam Moore's *The Industrial Heritage of Hampshire and the Isle of Wight* to study further one of the topics covered only briefly in that publication, and is the result of a cursory look at Hampshire's watercress growing industry during a two week holiday in the summer of 1989.

Watercress growing is something of a forgotten industry but the crop's past importance in our national diet cannot be overstressed. Before we became accustomed to more exotic salad vegetables on our supermarket shelves, it was highly rated, not least for its year-round availability. During the Second World War it was promoted along with carrots and apples as one of the most wholesome vitamin-rich foods which we could grow for ourselves.

The management of watercress beds is a complicated business, the secrets of successful growing often being passed on through members of particular families. Watercress cannot nowadays be cultivated using river water, however apparently pure — beds are supplied by boreholes welling up from groundwater flowing directly from chalk strata. Hence growing is concentrated in Hertfordshire, Wiltshire and Dorset following a wide band of chalk running roughly north-east to south-west across the country, with a secondary belt of chalk reaching out from Salisbury Plain towards Kent. This supplies the headwaters of Hampshire's river system, feeding the wide shallow valleys of classic chalk rivers such as the Itchen and the Test.

The writers' interest in watercress started in 1988 when we began a study of the industry in Hertfordshire. Our background in industrial archaeology and especially canal and water engineering, made the subject an appropriate choice in a county which, like Hampshire, is not noted for its heavy industry but where the emphasis is on industries based on agriculture and its products.

Hertfordshire

Commercial watercress growing started in Hertfordshire in the early nineteenth century, increasing after mid-century, with growers being most numerous in the first decade of the twentieth century. A Hertfordshire grower gained a national reputation as a pioneer of improved standards of cultivation, and his work formed the basis of the MAFF code of practice first published in 1947. This was a mixed blessing — many growers faced with the requirement to improve their standards of hygiene and water quality opted instead to cease growing altogether. Of growers who had sunk boreholes to acquire pure water, those in the upper reaches of some of the rivers found their water supplies failing because of increased extraction downstream for town use. Improved wages for workers and difficulties with the reliable transport needed have caused many sites to be abandoned since the Second World War, or turned over to the more lucrative, and less labour intensive, raising of trout. Of the 70-plus onetime sites in Hertfordshire, seven are still in production, using the traditional hand methods of cultivation, harvesting and packing. Whilst some families could be regarded as dynastic watercress growers, working beds in many locations over several generations, none could or can be seen as

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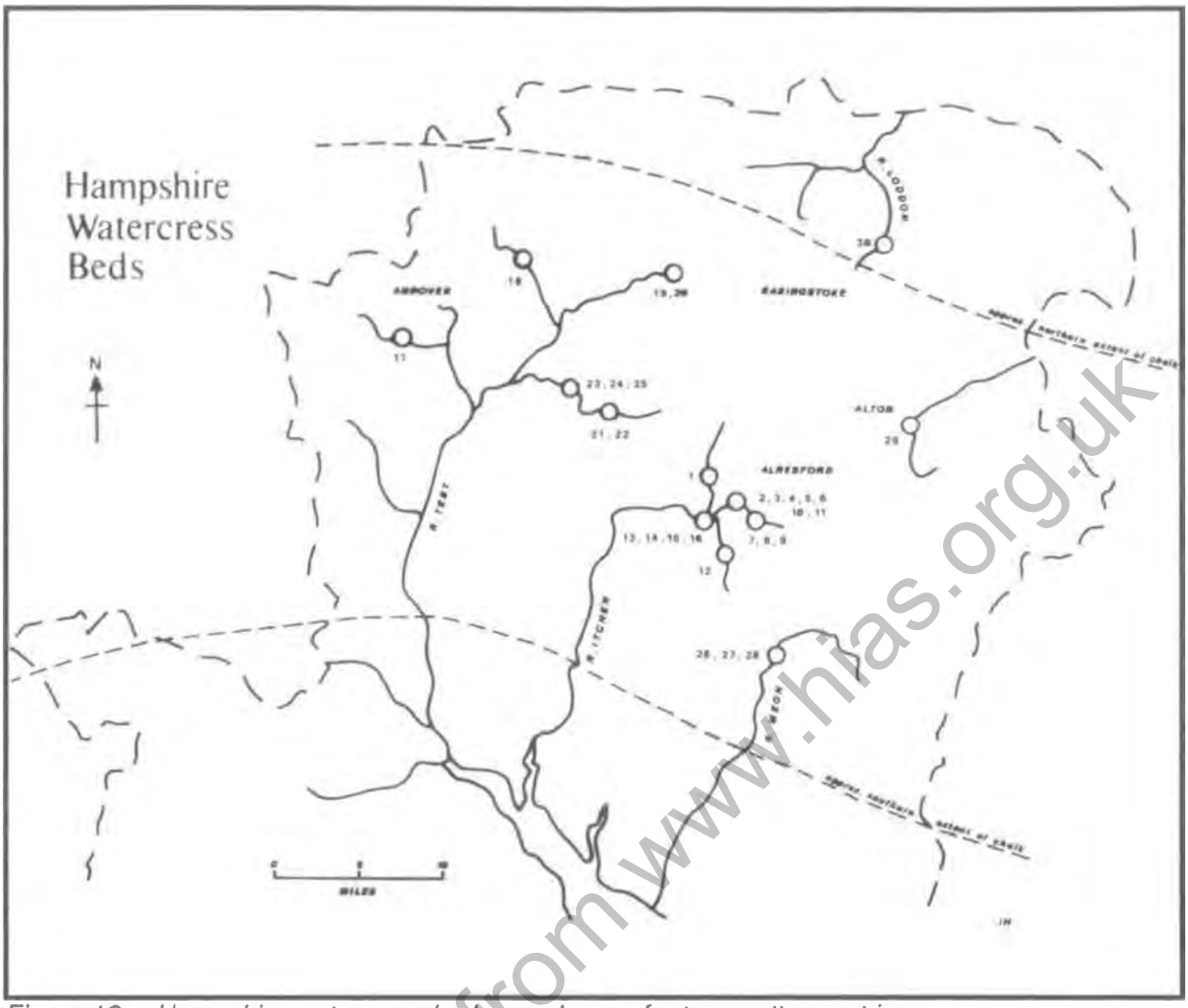


Figure 13 Hampshire watercress beds. numbers refer to gazetteer entries

major entrepreneurs. It is a steady industry, demanding hard work and commitment, and one views with apprehension what will happen when the present generations undertaking this specialised work are no longer involved.

Hampshire

By comparison with Hertfordshire, Hampshire was a later starter in watercress growing. *The Victoria County History of Hampshire and the Isle of Wight* noted in 1912 that growing 'is on the increase in the county?' — in fact it had begun as far back as the 1860s, reaching a peak of expansion in the 1920s. Much of Hampshire growing a century after its establishment is in the forefront of technology, processes, transport and organisation, with high input of capital being justified by the income thus generated. Some sites are still run by small concerns using traditional methods, but it is the large operations which form the most striking contrast with the still traditionally managed industry in Hertfordshire.

In the course of a fortnight's work it was possible only to scratch the surface of the subject. The *Victoria County History* furnished the names of sites where watercress growing had originated; current 1:50,000 and 1:25,000 O.S. maps showed a number of likely bodies of water, some labelled as watercress beds; general books on the county where scanned for passing references.

We toured the river valleys, annoying other motorists by driving slowly along peering through hedges and occasionally coming to an abrupt halt when a gateway afforded a better view; in likely villages we accosted passing locals and gleaned what information we could; when we located sites we cornered workers and conducted impromptu interviews. We discovered that the exceptionally hot dry summer of 1989 was not beneficial to growers of watercress, and may have affected what we saw at some sites. We

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learnt a great deal about processes, both traditional and modern, have begun to appreciate much more of what we had already seen and have had our observation sharpened as a result.

It is to be hoped that the gazetteer, albeit incomplete, will encourage local industrial archaeologists to undertake further work, in the field to locate and record small, abandoned and changing sites using all editions of large scale O.S. maps and other documents, and by talking to people involved with the work, to establish more fully the history of the industry in Hampshire.

Layout and equipment of sites

Existing sites, whether derelict or in use, fall into two categories as regards their physical layout, namely whether they have been constructed for hand working or for machine. All have shared characteristics, but important differences of detail.

All existing beds are constructed with concrete divisions between them, about a foot high and 9 inches wide, with an impermeable lower surface dressed with gravel and sand. On hand operated sites, where rake, scythe, cutting knife and wheelbarrow are the normal tools, the beds may be made in any more or less rectangular shape to fit the nature of the site. At the southern site at Upper Bullington the beds fit snugly into the plot, with a series of tiny beds at the top and one large multisided one below. Ladycroft in Alresford has beds alongside the road, with several extensions into the slope to take advantage of useful water sources, showing clearly their piecemeal development.

Sites set up for the use of mechanical equipment need to be on a much larger scale to justify the expenditure on that equipment and to enable it to be worked efficiently. Beds need to be the right width to accommodate and manoeuvre machinery, be it Allen scythe technology (Bighton Road, Alresford) or tractors, trailers, dumpers (Drayton Farm) and specially designed combine-like harvester (Hampshire Watercress sites); and as long as can successfully utilise one flow of water, to avoid moving machinery between beds more often than necessary. At Alresford Watercress and Drayton Farm, beds were being constructed and refurbished rather narrower than formerly, presumably to make use of the latest thinking on bed design.

All sites require a constant supply of water from boreholes, which will maintain a year-round temperature of 50°–51°F, 11°C; the amount needed ranges from ½ — 1 million



Figure 14 Disused beds at Upper Bullington, 30 June 1992 (Gazetteer No. 25)

gallons per acre per day. On smaller sites artesian boreholes sometimes rise directly into the carrier (Cranbourne), but are more usually pumped, the pumps being protected by buildings. At Bighton Road, Alresford, new pumps with weatherproof electric switchgear were being installed. Carriers which conduct water from the boreholes to the beds are usually left uncovered, but at some of the largest sites (e.g. Drayton Farm) they are covered by paving slabs. Many beds add zinc to the water, from the huge cylindrical tanks at Pinglestone set in a protective sump, to a 10-gallon rigid plastic drum at Hunton.

Small sites tend to be sufficiently sheltered by the valley sides, but the larger ones need to have shelter provided in the form of a long row of straight-growing conifers, so as not to overhang and foul the beds, or reduce light. Tall fences of 'paraweb' may extend laterally between blocks of beds (Alresford Watercress).

The raising of new seedlings for planting beds can be done in the home greenhouse for a small site (Ladycroft), in a polytunnel on site (Western Court) or at a central site to serve the whole organisation (Hampshire Watercress at Abbots Ann). Once the plants are growing, access must be available to the beds for maintenance and harvesting. On the sites using traditional methods a narrow bridge (The Shrubbery) or duckboard (Ladycroft) crossing the carrier will be sufficient access for a man with a barrow; on a long narrow site a railway might be utilised (Upper Bullington). Large equipment needs wide roadways around the site — the most common layout is blocks of four long narrow beds with their associated water channels surrounded by roadways perhaps 15 feet wide (Drayton Farm), multiplied up to fill the land available.

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Figure 15 Cold store, packing shed and on-site sales, disused, Upper Bullington, 30 June 1992 (Gazetteer No. 25)

Wide ramps are used from the roadways down into the beds.

On many sites it is now common practice to cover some beds with woven plastic sheet during the winter. This may be supported by a makeshift framework of short lengths of scaffold pole (Ladycroft) and held down along the concrete by wire and bricks (The Shrubbery) or special gripper bars (Warnford). At the other end of the cycle plants have to be dried for seed — again, the small man can use his greenhouse, a specially constructed wooden and wire mesh horse (Hunton), or construct a long framework of hoops and wire mesh over plastic sheeting (Bishops Sutton).

When plants are no longer required, beds are cleared and the waste dumped in odd corners about the site or in a specially designated area. This is no place to linger — the liquor issuing from the watercress waste has a particularly nasty smell.

All sites have buildings for various purposes. Shelters for equipment, if secure, need not be beautiful, but the housing and maintenance of a fleet of refrigerated vehicles requires more sophisticated provision (St Mary Bourne). Packing sheds need be little more than wooden shacks with washable benches and a cold store (Ladycroft): or could be a modern purpose-built range of buildings served by fork-lift truck and with good access for lorries (Drayton Farm). Hampshire Watercress do all their packing in huge modern buildings at St. Mary Bourne, so their other sites do not have their own packing sheds or cold stores (e.g. Warnford). This also means that they cannot sell at the gates, as do the sites who cut by hand — Alresford Watercress utilise a redundant freezer, Borough Farm an old cabin trunk containing a ceramic sink, and The Shrubbery a wooden bunker with trays of bunched watercress on ice to retain freshness.

The growing year

Time spent looking over the fence of sites in use will be rewarded as most exhibit beds in the various stages of the growing cycle. First, a firm, gently sloping base will be prepared using gravel and sand. What the independent one-man operation will do with wheelbarrow and rake, the large producer will accomplish using tractor and trailer, although finishing will still be done by hand.

Seedlings grown in peat can be dropped deftly on to the prepared bed, like dealing a pack of cards, spread evenly to start the growing cycle. Mechanical planting has been tried with a device imported from the rice paddy fields. This needs no fewer than six people to operate it, and the traditionalist might be forgiven for being less than impressed by its efficacy. Slips of plant material can also be used, as watercress roots easily. Under ideal conditions, three weeks' growth will give an even, billiard-table appearance to the bed.

A further three weeks' careful nurturing, with the application of zinc sprays to feed the plants and protect them from potential pests and diseases, and the bed will appear as an even mat, fast reaching readiness for cutting. All the time the depth and flow of mineral-rich borehole water has been carefully increased as the plants develop — in effect, hydroponic cultivation.

There is wide variation in cutting methods. The lone grower will bend over the bed wielding his cutting knife, gathering bunched watercress between his open fingers until he has a 'hand' looking like a miniature sheaf of corn. Alternatively, a mechanical harvester can be driven through the bed cutting off the tops and gathering them into large plastic skips. Such a device is used by Hampshire Watercress, and is taken from site to site to cut as crops are ready. It also cuts parsley from the owner's extensive gardens.

Hand-cut cress is bunched neatly and held by an elastic band, ready for packing into chip baskets for display and sale. Mechanically picked cresses appear on the supermarket shelves in plastic 'jumble packs'.

Crops are usually cut to order, so if the preferred cycle is interrupted the crop can be cut back to water level then allowed to crow on again. The cutting may be done by scythe or by rather ominous-looking devices based

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on rotovators or Allen scythes for greater speed.

In winter, rather than cutting, the crop is 'pulled over' by hand, leaving gaps into which cushions of new growth will regenerate, with designated beds being protected in turn from frosts by woven plastic sheeting. Another method of protection is carefully to press the crop down to water level using a special pressing tool or wooden roller. This takes full advantage of the naturally raised borehole water temperature. A cold 'wind chill' can damage the watercress leaves. Hampshire Watercress have solved the problem of British winters by growing in Portugal to ensure supplies over the winter months.

At the end of the cycle, beds can be cleared using sickle, rake and barrow, or torn up wholesale using a tractor fitted with front forks and carted away on a trailer or dumper truck. This is a dramatic process to watch as load upon load is pressed down into the dumper to reduce the number of journeys to the waste heap.

A proportion of the mature crop may be permitted to run to seed to provide next year's new plants. Hampshire Watercress use their Portuguese sites during the summer to produce seeds for the English beds. Other growers save their own seed, drying the plants, collecting the tiny seed pods and sieving the seed to remove unwanted material.

Transport

Today transport of watercress from site to market is exclusively by road — in the back of an estate car for the small site, to fleets of refrigerated lorries for the big companies. In earlier times, the industry could serve only its local area by horse and cart. The coming of the railway in 1865 stimulated the setting up of beds, and growers made use of the fast connection for the London markets and for distribution further afield. The volunteer-run Watercress Line taking excursionists by steep gradients and deep cuttings 'over the Alps' between Alton and Alresford gives a flavour of the bustle of former days. Horses and carts delivered watercress from the growers to special railway vans waiting in a spur beside the station at Alresford, where as much as 14 tons was moved each day.

Further Reading

Little has been published on the history or archaeology of watercress growing either nationally or locally. On the historical side for Hampshire, the most useful starting point is *The Victoria County History of Hampshire and the Isle of Wight* (Constable 1912), volume 5, page 455, which gives an outline of the early development and distribution of watercress growing in the county.



Figure 16 Beds in use, Old Alresford, 30 June 1992 (Gazetteer No. 2)

During the 1960s, *Hampshire: the County Magazine* published four articles which gave information on methods prevailing at that time, and which largely hold true for the surviving traditionally managed sites. The articles appeared in: vol. 2, part 7, May 1962 (pp 23–4); vol.3, part 7, May 1963 (pp 22–4); vol.7, part 1, November 1966 (p. 33); vol. 9, part 7, May 1969 (pp 25–6). More recently, a brief history of watercress growing in the Alresford area was published in *Alresford Displayed* (1977), paper no. 8 by Edward Roberts, entitled 'Our watercress industry'.

For technical information on the growing of watercress and the changing standards required, one must go to the several editions of the MAFF booklet, originally written in 1947 by C.H. Sansom, himself a watercress grower in Hertfordshire. The latest edition is *Watercress: production of the cultivated crop* (Grower Books, 1983) (ADAS/MAFF reference book 136).

For a brief history of rail transport serving the Alresford area's watercress growers, see *Branch Lines to Alton* by Vic Mitchell and Keith Smith (Middleton Press, 1984).

Gazetteer

In addition to the sites listed, the *VCH* refers to watercress growing at Andover, the Wallop Streams, Steep, Ashford, Micheldever, Basingstoke and Basing. Other sources indicate beds at Hurstborne Priors, Whitchurch and Tichborne. None of these were we able to identify on maps or on the ground. There are potentially many more sites

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to be discovered and recorded, a task which we now leave to local industrial archaeologists.

The gazetteer lists those sites which we have located. It is organised by river basin, with tributaries dealt with clockwise and sites listed downriver. Grid references will be found adequate on 1:50,000 or 1: 25,000 maps. Each entry gives a brief description of the site today; historical notes are given where available.

Ordnance survey 1:50,000, Sheet 185:

RIVER ITCHEN BASIN

1. ABBOTSTONE. FOBDOWN FARM
CANDOVER STREAM. SU 571 339
Extensive beds are north and south of grid reference, below road. In use by Hampshire Watercress organisation — *Vitacress* Head Office address. Set up originally by 'Baron' Hunt in 1896.

2. ALRESFORD. ALRESFORD WATERCRESS
R. ARLE SU586 339
Extensive beds (entrance at The Green) can be viewed from a footpath to the west of the site. New beds under construction at lower end in 1989. In use, with sales at the gate. Dorey family set up the beds at Manor Farm in 1890.

3. ALRESFORD. PINGLESTONE FARM
R. ARLE SU 583 332
A small site above the road, with extensive beds (in conjunction with a market garden operation) below. View also from top of nearby hill at watercress dump! In use, part of Hampshire Watercress. First set up by the Dorey family in 1890.

4 BIGHTON. DRAYTON FARM and THE NYTHE
R. ARLE SU 595 334
Extensive beds run east, view from road and glimpse through protective hedge of conifers from adjacent footpath. In use, currently being refurbished (summer '89). Drayton Farm was set up by John Mills in 1896; The Nythe was laid out by John Mills in 1880 with the aid of steam ploughing engines. Both are now run by Peter Mills.

5. ALRESFORD. BIGHTON ROAD
R. ARLE SU 591 334
Medium sized beds running eastwards, beside the Bighton road. In use.

6. ALRESFORD. THE SHRUBBERY
R. ARLE SU 588 333
Restricted terraced site below the Great Weir —view from the Little Weir (footpath to Old Alresford). Beds in use, site incorporates an outbuilding of Old Arle Mill, with sales from a bunker outside. Set up by Thomas Smith in 1867.

7. BISHOPS SUTTON UPPER
R. ARLE SU 610 319
Small derelict site below North Road. Water supply of this area is now pumped via a Water Authority borehole to augment the flow of the River Itchen. Outfall above site 8.



Figure 17 Disused beds at Stoke Charity on the River Dever, 30 June 1992 (Gazetteer No. 21

8. BISHOPS SUTTON LOWER
R. ARLE SU 607 321
Small site above road. In use by Peter Mills — plants being dried for seed on a tubular metal frame for the Western Court operation (site 9).

9. WESTERN COURT
R. ARLE SU 606 323
Difficult to see full extent of this property, but can be glimpsed from the *Watercress Line* and local roads. Recent large investment in buildings. Run by Peter Mills.

10. ALRESFORD. LADYWELL LANE
R. ARLE SU 585 331
Small derelict site, represented on sketch map of Alresford by A.E. Wade, 1959, displayed around the town.

11. ALRESFORD. THE DEAN
R. ARLE SU 584 329
Now excavated as pools for fishing. Small site shown on map O.S. 1:25,000, 1988. Set up by John Dorey in 1865.

12. CHERITON
Close to source of R. ITCHEN SU 585 282
Tiny long abandoned overgrown site alongside road south of village. Set up by Mr Giles 'The Watercress King' in 1894.

13. ALRESFORD. LADYCROFT
R. ITCHEN SU 577 316
Beds either side of road leading to deep ford, arranged to take advantage of all sources of spring water. In use as West Lea Watercress by the Curtis family. Set up by Curtis in 1890.

14. ALRESFORD. ITCHEN VALLEY TROUT FARM
R. ITCHEN SU 574 320
Former beds shown on map O.S. 1:25,000, 1988.

15. ALRESFORD. BOROUGH FARM
R. ITCHEN SU 569 323
A small derelict site alongside the B3047 road. Currently in use for sales only by *West Lea* (site 13), including their own brand of Watercress Soup! In 1989 the site was up for sale and future uncertain. Set up by Baker in 1925.

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16. ITCHEN STOKE
R. ITCHEN SU 554 324
A tiny site adjacent to West House, Itchen Stoke, on B3047. In use for growing, some plastic sheeting still in place in July! Set up by Frank Roland in 1925.

RIVER TEST BASIN

17. ABBOTS ANN
PILLHILL BROOK SU 327 438
Extensive protected linear site alongside road NW of village. Twenty borehole/pumphouses. Quarter of the area under 16 polytunnels used to raise the seedlings for all Hampshire Watercress beds (from seed grown and gathered in Portugal).

18. ST MARY BOURNE
BOURNE RIVULET SU 430 492
The major centre of the Hampshire Watercress packing operation with large modern buildings. View from B3048. Harvesting, packing and distribution from here. Stringent hygiene requirements needed by prestigious food-chains reflected by cleanliness in packing sheds, their own lorry-wash for the road fleet, even an automatic device for keeping watercourse downstream clear of floating debris.

19. OVERTON. POLHAMPTON FARM
Source of R. TEST SU 524 535
View from road to farm. Watercress beds were converted for fishing around World War II, but this in turn is now derelict. Locals can remember packing sheds on the site.

20. OVERTON. THE LYNCH
R. TEST SU 507 496
View over derelict and heavily overgrown sites can be had from the river bridge on Southington Lane.

21. STOKE CHARITY
R. DEVER SU 488 393
A compact site, beds at river crossing to north of village, close to the church. In use in 1989, matching green caravan/shed/loo suggests an independent operator!

22. HUNTON
R. DEVER SU 486 393
A modest site beside road between Hunton and Stoke Charity. Apparently disused at time of survey, but fully equipped for traditional hand-cultivation.

23. CRANBOURNE
R. DEVER SU 469 408
A small linear site running west from road between upper Bullington and Wonston. In use by hand cultivation but currently in a poor state. Boreholes can be seen welling up in carrier. Set up by Mr Fitzwilliam in 1930s as *Green Leaves*, operated by Major Fitzwilliam in 1960s.

24. UPPER BULLINGTON
R. DEVER SU 465 411
A tiny terraced site viewed from the road by the river crossing. Currently disused. Traditional large flat barrow with wooden slats on site.

25. UPPER BULLINGTON
R. DEVER SU 464 412
Road passes end of long narrow site which curves away to the north. Serviced by 2ft gauge railway, with flat-bed wagon. In use in 1989.



Figure 18 Disused beds at Hunton, 30 June 1992 (Gazetteer No. 22)

MEON VALLEY

26.WARNFORD
R. MEON SU 625 233

27.WARNFORD
R. MEON SU 624 232

28.WARNFORD
R. MEON SU 621 231
Well tended small sites, part of Hampshire Watercress, easily viewed from village roads and the A32. Warnford was the first venture of Mr Isaacs — owner of Hampshire Watercress who lives nearby.

O.S. 1:50,000, Sheet 186:

WEY VALLEY

29.ALTON
Source of R. WEY SU 713 395
Reed-grown marshy area is now designated Flood Meadows Nature Trail (leaflet available locally). Access from Tanhouse Lane or Basingstoke Road. Beds are derelict — unused for 40 years. Cultivated by George Mills and later Mr A.E. Tabor who used the name *Wey Spring Watercress*. Site gradually starved of water from 1934 onwards, later artesian well boreholes near the New Odiham Road were unsuccessful.

LODDEN VALLEY

30.MAPLEDURWELL
R. LYDE SU 689 521
Viewed from footpath to south of site. Former beds now appear as ponded sections of a stream. *White Ensign Watercress* sign seen on house previously called Yew Villa, which was occupied by a Miss Mary Ann Dudney, a well-known watercress grower.

Steve Fletcher and Dave Goodwin

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Restoring A Southampton Tram

It was in March 1977 that we first heard about Southampton tram No.11, from SUIAG member Brian Stallwood. Tram 57 Project had been formed two months earlier to work on the restoration of No. 57, a knifeboard car donated to the City Museums in 1975. We held an Open Day to allow members of the public to see the tram before we began to dismantle it and it was on this occasion that information about the existence of No. 11 was revealed. 57 was thought to be the only Southampton tram body still in good enough condition to restore and we were a little sceptical about what we would find when we visited No. 11.

Mr Stallwood lived at Cheriton, near Alresford, and a neighbour of his, Mr John Corbett, owns a large estate. It was here in 1950 that No. 11 was taken after Mr Corbett purchased it for his sons to use as a playhouse. Over the years a wood grew up around it and eventually the tram was abandoned, the haunt of peacocks and surrounded by daffodils in the spring.

No. 11 was one of the dome-roofed trams specially constructed to enable a covered double-decker to pass under Southampton's Bargate arch which, until bypassed in the 1930s, was the only direct route between Above Bar and High Street. It was built locally at Portswood in 1923 as a double-deck open-top tram with reversible 'garden' seats on the upper deck. Four other trams of this design were built between 1920 and 1923 and they were given the number sequence 1 to 5, the original cars carrying these numbers having either been scrapped or renumbered.

No. 11 was No. 3 in this series. In the lower saloon it had longitudinal wooden slatted seating under the windows as the restricted width between the rocker panels — a leftover from the days of horse buses — was insufficient for cross-seating as on the slightly wider upper deck. These seats carried 13 passengers each and 10 were allowed to stand. On the upper deck were seats for 43, the 'odd' seat having the trolley mast beside it offset from the central gangway. There were eight double reversible seats on one side and seven double plus one single on the other with curved seats carrying six passengers at each end. Railings around the upper deck were covered by a yellow mesh grill. The platforms were partially enclosed by glazed vestibules. These had only been adopted by Southampton Corporation Tramways in 1920: all earlier trams, except the demi-cars 50 and 51, had their platforms open to the elements on three sides. The tram ran on a standard Brill 21E 4-wheeled chassis with 33 inch diameter wheels, powered by two Dick, Kerr DK20 40hp motors and operated by Dick, Kerr DB1 Form K3 controllers. No. 3 entered service on April 13th 1923.

Nos 1 to 5 were low enough to pass under the Bargate, unlike the Milnes cars 30 to 37 of 1901 which were of a similar design but with higher saloons. Six of these were lowered in the early 1920s and had vestibules added to their platforms so that they looked almost like



Figure 19 Car No. 6 about to pass through the Bargate; Car No. 11 passing round, in the 1930s

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Figure 20 Martin Petch working on newly arrived 'truck' for car No. 11, 1989

Nos. 1 to 5 and could pass under the Bargate. The only obvious difference was that the Milnes cars had three side windows and the SCT-built trams had four.

The problem of designing a double-decked roofed tram to negotiate the Bargate was solved later in 1923 by Percy Baker, who was soon to become General Manager of Southampton Corporation Tramways. The basic design was the same as Nos. 1 to 5, but with less headroom in the lower deck, a curved roof with steel dome ends and a specially modified Brill 21E truck with 27 inch diameter wheels and British Thomson-Houston high speed motors. The prototype car was numbered 12 and was successfully tested under the Bargate in September 1923. Future new buildings adopted this design until the 'Pullmans' were introduced in 1929.

As Nos. 1 to 5 were so similar, they were converted to domecars — or 'top covered Bargate' cars (TCBs), as they were officially known. This required the upper deck floor being lowered by 1 1/2 inch and the trucks being modified, as well as removing the upper deck railings and adding sides and roof. The upper deck seating was increased to 44 when the trolley mast was removed. No. 3 was taken out of service in November 1924 for its conversion and renumbered No. 11 upon return on January 22nd 1925. Its sisters were renumbered 7 to 10, so that the series of TCBs began at 7 and were due to continue in sequence, but they only got to 20 before reverting to the original numbering system at 92. However, Southampton's tram numbering and renumbering is another story!

Little alteration was carried out on No. 11 during its life. Route number boxes were introduced in the late 1920s and on the TCBs this was in place of the front upper deck window, which was a large fixed pane with a small opening window above it. The original front destination boxes from its open-top days were retained for a time on the TCB, protruding more than the boxes on the purpose-built ones, later moved further inside to match the others. The driver's front window underwent a slight alteration. Outside, a pole was later added part way down the upper deck side windows, as the windows themselves could be made to drop a considerable distance. This was presumably to prevent children from accidentally falling out rather than people jumping out! The means of dropping these windows also changed at various times, from holes at eye level to chrome strips on the top edge.

In the lower saloon, the false ceiling was originally made of beaver-board (a kind of fibre board). This was replaced at a 1929

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Figure 21 Restoration of Car No. 11 upper deck seats, 1989

overhaul by plywood panels. At the same time a water channel was fitted round the roof and the brass stair handrails and platform poles were covered by a sort of early black plastic tape called Doverite — possibly to prevent electrical shocks. As the main power cable from the trolley pole was fed down one of the upright poles at the head of the stairs at one end, it was not unknown for passengers to get 'a mild tingling sensation' on wet days. No. 11 is being restored to its 1925 condition, but for safety and other reasons, some of the later modifications are being incorporated.

Southampton tramways closed on December 31st 1949. Car 11 was in service until October, when it was sold for £20 to Dukes Road scrap dealer Arthur Harris, who bought and scrapped a large number of Southampton trams. No. 11 was one of the only two known to have 'escaped' from Dukes Road, other trams which survived having either been sold direct to private individuals or — as in the case of No. 57 and others — through the small firm of Southern Engineering at Four Post Hill in Shirley, the site still being in use as a car salesroom.

We made a brief visit to see No. 11 in April 1977 and were surprised at the condition after nearly thirty years in the open. One of the steel domes had fallen off and the whole of the upper deck side panelling and pillars around that end had also ended up in a rotten heap on the ground. The other dome had separated from the roof, but otherwise that end was still intact, although in a fairly dangerous state. Much of the side panelling under the windows on the upper deck had completely rotted away. However, that part of the upper deck which was still slightly protected from the weather was in quite good condition and was safe to walk on with care — apart from the ends. Some of the stairs treads were missing, but those that were intact were sound. There were eight of the reversible seats still in place on the upper deck, leaning at various strange angles. Parts of others were found in the lower deck and in the surrounding undergrowth. The curved end seats were in place, but beginning to rot.

The lower deck presented a quite different picture. Having been totally protected from the elements — all windows were still intact — the interior woodwork was in remarkably good condition. The seats, light fittings and ceiling grab rails were still there, and much of the wooden trim looked re-usable. The ceiling panels had warped from water that had come in from the upper deck and there was a hole in one place, but clearly restoration was feasible.

Some platform fittings were found at one end — brake gear, lifeguard reset pedal, sanding pedal and some of the connecting rodding leading to the sand boxes. Neither end had its headlight, but the complete

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resistance box was in place. Obviously the controllers had been scrapped, as also was the original truck.

A further visit was made towards the end of May 1977 when we met Mr Corbett. By this time we had decided that No. 11 should be acquired for restoration and Adrian Rance, then Senior Keeper of Southampton Museums, was eager to accept it. Mr Corbett agreed to donate it, but two provisos were that we should not reveal the location of the tram and that as little disturbance as possible should be made to his property. A set of black and white photographs were taken on this occasion and have proved to be invaluable in our restoration work. We failed to realise at the time that it would be eighteen months before we could move No. 1, that more deterioration would take place, and that dismantling was to be so hurried, leaving many important items unrecorded either on film or drawings. A lesson learnt here is that you can never record too much!

Taking on the restoration of another tram was one thing, finding premises to accommodate it, money to fund it and people to do the work was quite another! It was the intention that the Tram 57 Project volunteers would continue working on No. 57 and take only an advisory role on No. 11.

An initial approach was made to the Community Industry scheme, who would be responsible for finding a building. Adrian contacted the Science Museum with a view to obtaining a grant and John Horne wrote the historical notes on No. 11's eligibility. Science Museum funding is paid in arrears, and only covers up to 50% of the cost, so careful budgeting was required. In December 1977, Nigel Smith and I, along with Martin Petch, spent a day clearing rubbish and leaf mould from the tram so that an investigation could be carried out. By this time the other dome end had collapsed further. To keep out as much weather as possible from the upper deck we bought a large polythene sheet to cover it and also both platforms. One intrepid person had to go on the roof to pull it over and this is when the trolley base was found. An inspection of the old advertisement panels from the upper deck sides, which had long ago fallen to the ground, revealed that one was Poultons and Noels Soups and the other (as seen in post-war photographs of No. 11) Co-operative Society CWS. The lettering was very faded but we still have parts of it in store.

In January 1978 we enlisted the aid of experts from the London County Council Tramways Trust, who were restoring LCC 106 in London, and also of Dave Plunkett who was at that time employed by a Southampton firm specialising in wood preservation. Jeff Peppiatt and Jeff Mackenzie from London spent the day going over the tram with a fine tooth-comb and Dave probed and prodded the woodwork looking for all kinds of rot and other nasties — fortunately not finding very much. We discussed possible methods of moving the tram and decided the best way would be to detach the roof section where the upper deck pillars meet the floor — they were only attached by brackets — crane it off and move the roof and lower deck in two sections.

It was not long before a very detailed report arrived from London, telling us that at 1978 prices we would need about £8,000. That would mean, with a 50% Science Museum grant, we would have to find £4,000. The report also listed which parts were re-usable, which ones needed replacing and the wood most suitable, plus various items we would have to obtain.

One of the latter was the tram chassis. It was felt we needed to make a move to acquire one as soon as possible and not wait for the tram to be nearly completed. Through tram restoration circles we had heard that Oporto, in Portugal, was reducing its fleet of rather ancient tramcars which fortunately used Brill 21E trucks. A discussion with a shipping agent revealed that a service ran from Leixoes, Oporto's port, to Shoreham, and that an item such as a tram chassis could be carried as deck cargo. Adrian said some money was available in the Museum's funds to purchase and transport tramway equipment from Portugal.

So, in August 1978, Adrian, John and Shirley Horne, Nigel and I set off to Portugal. A visit to STCP, Oporto's tramway authority, gave us the promising news that two trucks without motors could be available 'right away'. Motors would have cost an extra £600 a pair, but we did not have enough money for these. In Lisbon the purchase of two controllers was agreed, but later we were told there were none for sale. A shipping agent in Oporto was appointed to organise the transport as far as Shoreham.

Things were starting to look promising, but we still had no accommodation for No. 11, no-one to take on the restoration and no funds to start purchasing materials. At this time Southampton Council was running a City Lottery and a Tram 57 Project member Bill White proposed an application for a grant from this. With the help of Councillor Fred Goater, a £3,000 grant was agreed upon at the end of 1978. At about the same time the

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Figure 22 Car No. 11 at Floating Bridge Terminus towards the end of the Southampton tramway era

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Science Museum grant was approved for up to £4,000.

Meanwhile, John Horne had been busy trying to sort out our other problems. Through his work at Southern Gas he had found a recently disused storehouse on the Millbrook Holder Station site which was large enough to take at least two trams. Southern Gas also very generously purchased a large amount of wood which we could repay over four years, plus a helpful donation to start this off until we received the lottery grant. A contact with Southampton Technical College also resulted in the involvement of the Vehicle Body Apprentices' course, under lecturer Sid Bristow, taking on the task of No. 11's restoration at Millbrook and at the college. Volunteers from the Tram 57 Project, who had by this time stopped work on No. 57, were to help on No. 11 with painting and restoration work.

So everything was ready, except for the tram! In the early months of 1979 we had several working parties at Cheriton to take out all the fittings from the upper deck - windows, lazy tongs, seats, rails — after diagrams had been made. The end which had once been in quite good condition had by now collapsed and the dome, number box, stair rails and front end were lowered to the ground for safety and we shored up the canopy. We hired a van and took all the loose parts, plus some items from the lower deck and the trolley base to Millbrook. As the daffodils would not be finished until May, Mr Corbett asked us to carry out the move from the summer onwards.

The move was undertaken on October 9th by a team from the Royal Corps of Transport, based at Marchwood, with members of Tram 57 Project and the Technical College assisting. The brackets holding the upper deck pillars to the floor had already been removed and the RCT's crane liftedoff the roof section. The lower deck was then lifted and slowly moved to their lorry on the gravel track some 300 yards away through a wood and across a lawn. It was necessary to use corrugated metal road plates over the latter as recent rain had made the ground soft. Once the lower deck was safely on the lorry we set off in convoy to

deliver it to Millbrook, arriving about dusk. It then took the next two days to move it into the warehouse, during which time it was dropped once, causing slight damage to one end of the saloon. On the fourth day the roof was also moved from Cheriton.

The college students immediately began to dismantle the lower deck, working Friday mornings each week. Project members occasionally helped at these sessions, recording items before they were removed and carrying out some dismantling. The underframe was the last thing to go to the college. The students would now make a replica of the main construction of the lower deck, using existing woodwork where possible. It was impossible to find large sections of oak to build a new underframe, so a laminate construction was used. Project members had the task of cleaning all the layers of varnish from seats, bulkheads and doors and to eventually revarnish them.

In February 1980 the two tram trucks from Oporto arrived at Shoreham and delivery to Millbrook was carried out on the 21st of the month, with a large crane from Sparrows (conveniently having their depot a few hundred yards away) coming to the rescue when the lorry's own hyab failed to lift 4 ½ tons. A visit to our friends in London had also resulted in the purchase of two DB1 controllers previously in use in a cement works at Greenhithe, Kent, two ex-Brussels gongs and canopy light switches. SUIAG had made us a grant of £200 to purchase and refurbish one of the controllers.

March came and so did the new underframe, which was then given some good coats of chassis black paint by Project members, in between sessions of scraping varnish off seats (a task which was going to appear never-ending). In May the new dashes were delivered.

Nigel and I made a further visit to Portugal in June 1980 and purchased two more DB1 controllers and two circuit breakers from Lisbon. I should, perhaps, point out that we had acquired a third tram at the same time as No. 11 was delivered, so we needed additional equipment.

In January 1981 we broke up the original roof after a detailed drawing had been made of it by a draughtsman from Southern Gas. Certain parts of it were kept either for re-use or as patterns, but most of the woodwork was burnt on a ceremonial bonfire at Millbrook. Although we had thoroughly checked that the ashes were quite safe before we left the site that evening, some over-diligent train driver (the site is alongside the main railway line) must have spotted a glowing ember, reported it, and the fire brigade were called out.

From February the new side frames were being delivered from the college and assembled, which meant a lot more painting for the volunteers. There were slight problems in fitting the platforms and it was only on the third attempt that everyone felt happy about their positions. Gradually the lower deck was built up and the floor laid. By July 1982 it was in a presentable form for the public's eye and Southern Gas sponsored its move to the Southampton Show. Although still in its primer grey paint, it created considerable interest.

The students ceased working on the tram at Millbrook whilst construction work took place at the college on the upper deck components. During this time the volunteers continued work on No. 11, but were also carrying out restoration on the other tram housed at Millbrook, No. 38.

From the autumn term of 1984 the upper deck components were assembled and by the end of the college year in May 1985, all the wooden parts were completed. This was the last work that the college students were able to do as the source of apprentices ceased, making the course unnecessary. Without a doubt, the work that had been undertaken by the college would have been an impossible task for volunteers. What they had, in effect, done was to build a completely new tram body. As the ultimate aim was for No. 11 to be a working tram, the structure had to be sound enough to take the wear and tear of possible everyday running. The original body was not capable of this so a replica had been built, although some parts had been re-used. The tram made a second appearance at the Southampton Show in 1985, again sponsored by Southern Gas, only this time we had given it some life by painting it in red and cream. The bodywork certainly stood up well to the pounding given to it by hundreds of children who treated it as a playhouse!

The time had now come to consider the reconstruction work to be undertaken on one of the tram trucks. The standard Brill 21E was incorrect for No. 11 and, although it will never be asked to pass under the Bargate, at least we should make its truck look right. We had acquired, from Beamish Museum, a Glasgow tube railway bogie which had MV101 high speed motors and 27 inch diameter wheels. BRML at Eastleigh agreed to take on the task of rebuilding the truck. This meant lengthening the existing chassis by one foot,

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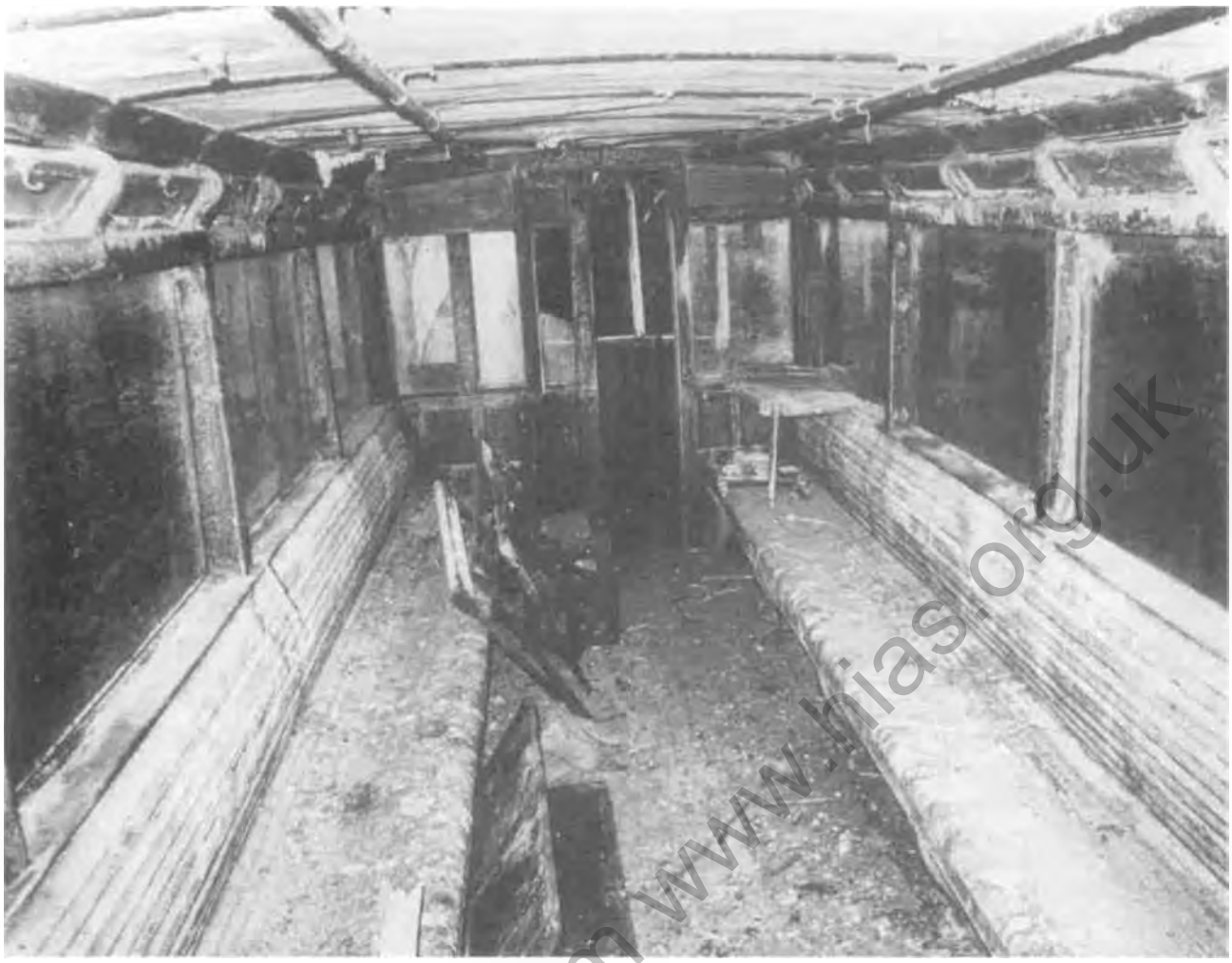


Figure 23 Interior of lower saloon of Car No. 11 as found at Cheriton, 1977

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using second-hand BR wagon axles to re-gauge the Glasgow wheels (the tube railway gauge is 4 ft), fitting the motors and making new gearwheels and refurbishing the axle boxes. They also made for us two sets of bearer bars, as neither No. 11 nor No. 38 had them fitted. As this work was being done in 'slack time', the completed truck was eventually delivered in August 1988, after having been electrically tested at Eastleigh.

From summer 1985, the volunteers had been on their own. Various minor faults were found in the bodywork construction and we dealt with these before continuing with our own programme. Another major item we had been been evading was the two dome ends. Fortunately the college had made a 'former' of the shape and, after many enquiries, we found a vehicle body firm in Dorset who would make the domes in aluminium for us. A visit to Blackpool had resulted in us purchasing two refurbished trolley bases and, from the firm of Brecknell Willis in Somerset, a brand new trolley pole.

An eight-month break in the work in 1987/88 was necessary when new regulations on the amount of asbestos allowed in the air meant our asbestos-clad 'tramshed' was out-of-bounds. British Gas carried out a fine refurbishment job, painting the inside and installing the high chipboard inner cladding so that we were isolated from the asbestos. This has made a perfect base for us to display photographs and posters and also some of the glass advert panels which many trams carried in their windows. No. 11 would not have had these, but No. 38 and No. 57 did, so we acquired sets for both trams when these panels were discovered at Portswood depot many years ago.

There are many tasks still to be carried out before No. 11 is restored. We have set out a list of jobs for every part of the tram which, from a brief glance, might appear to be long enough to take even the youngest of the volunteers into retirement! Recently the lower deck seats were installed and work on fitting out the upper deck side panelling and seating is

underway. SUIAG member John Asteraki, who only joined us a year ago, has greatly speeded up our progress by his expertise in many fields, helped by a few newcomers. Another fairly long-standing member is Jeffrey Earle, who was once Southampton's City Architect, and who is a skilled woodworker.

What the ultimate destiny of No. 11 will be is anyone's guess. As already stated, it is our intention to restore it to working condition. Our hope is that sufficient funds and a suitable location will mean that it, and Tram No. 38 when that is restored, will be able to run in Southampton, providing a working transport system for citizens and tourists to enjoy. As far as a time scale on No. 11's restoration is concerned, it will be 70 years in April 1993 since No. 3 made its debut — or 70 years in January 1995 since it became No. 11. For those of us who have been working on it from the beginning, it cannot come soon enough!

Angela Smith

The Parallel-Motion Mechanism

Steam engines of the 18th and 19th centuries often displayed elaborate linkages attached to the piston rods. These were the 'parallel-motion mechanisms'. What did they do, and why do we not see them in more recent engines?

The parallel-motion story illustrates how the development of mechanical engineering design is sometimes governed by the availability of machine tools. In the 18th century, the only machine tool of any significance was the lathe, which made possible the manufacture of accurate pistons and cylinders. Given a well-fitting piston and cylinder, one has the beginnings of a steam engine. The motion of a piston-rod, however, is back and forth along a straight line. To be of any practical use, this needs to be converted into a rotation — either continuous, as in a winding engine, or oscillatory as in a beam engine. The mechanism for achieving this is the familiar crank AB (Fig. 24.1). In the beam engine, AB is one half of the beam.

However, it will be seen from this diagram that during most of the working cycle the connecting rod is at an angle to the piston rod, and so tends to push the end of the piston rod sideways. If unrestrained, this action would lead to friction and heavy wear on the gland where the piston rod leaves the cylinder, indeed it might even bend the rod. We need to support the piston rod end against sideways movement by some sort of guide.

In later engines the rod-end junction or crosshead is guided by a block which slides along a set of smooth straight rails, the crosshead guides — these are clearly visible in most steam locomotives. However, in the early days there was no easy means of machining such guides accurately; the lathe was good at making 'round' things, but it could not manage straight flat surfaces. Some other means of guiding the crosshead was needed, using only parts which could be knocked up by the blacksmith and/or turned on the lathe. Hence the parallel-motion linkages, which met this requirement.

The basic Watt mechanism was the three-bar linkage ABCD (Fig. 24.2). The pins at A and D were fixed. If we envisage the bar AB swinging up through a small angle to the dotted position, we see that B moves up and a little to the left of its original position; because of the link BC the bar CD moves up similarly and C moves to the right. At X, the centre of the bar BC, the leftwards and rightwards movements cancel out, and so we find that X moves up and down in a straight line. (Strictly speaking, the motion of X is not *exactly* linear, but the approximation is very close indeed. One can easily demonstrate this to one's own satisfaction by making a model mechanism out of cardboard and pins). The colliery winding engine at Beamish offers an excellent example of the basic Watt parallel-motion mechanism. (Fig. 24.3).

Applied to a large engine of the beam type, however, the basic mechanism can be inconveniently large, demanding links extending well out beyond the main engine frame. Watt, therefore, used the pantograph principle to devise a more compact mechanism. This was an invention of which Watt was reportedly, and justifiably, proud. The pantograph is a linkage of four bars ABCDEF, pin A being fixed (Fig. 24.4). It can be shown that if point C is caused to describe any given figure in space, then the point F will describe a precisely similar figure to a larger scale; hence the use of this device in

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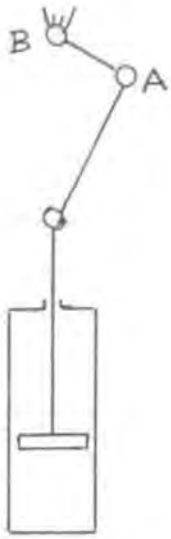


FIG. 1.

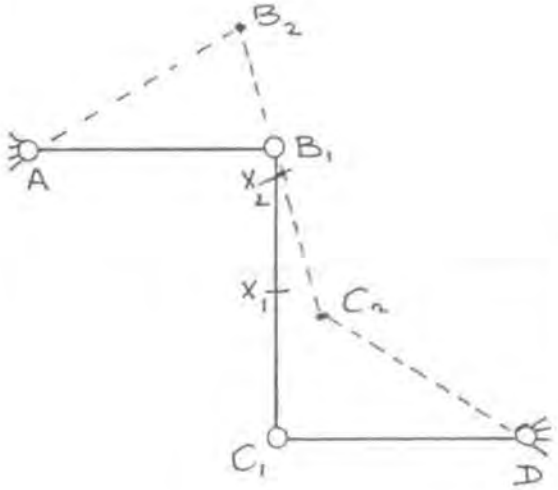


FIG. 2.

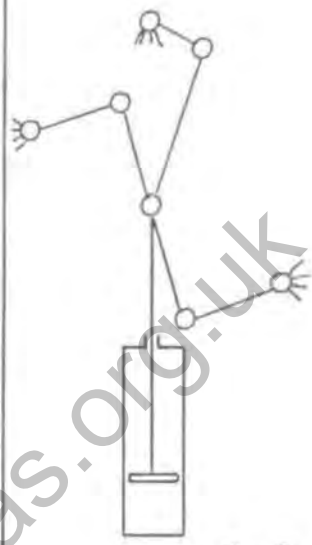


FIG. 3

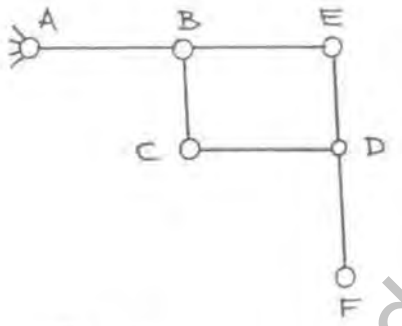


FIG. 4.

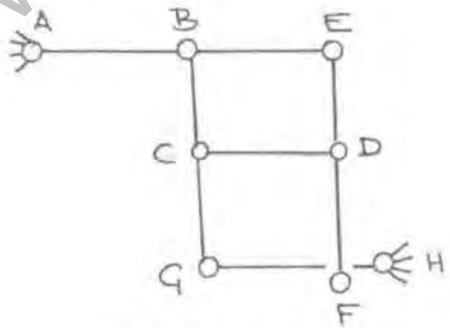


FIG. 5.

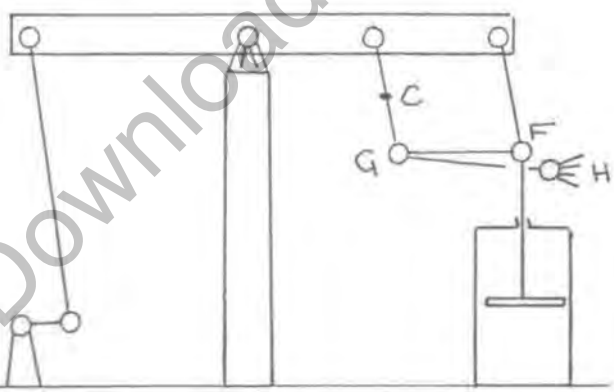


FIG. 6.

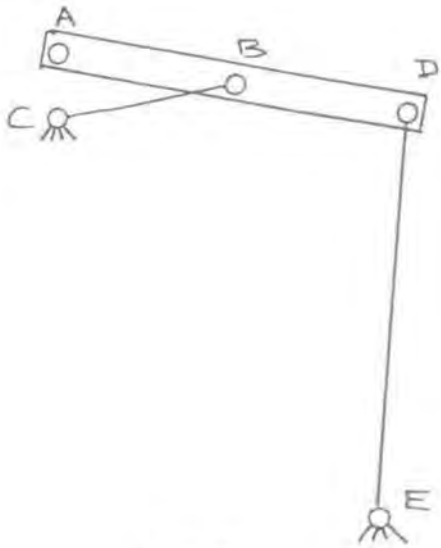


FIG. 7.

Figure 20 Development of the parallel-motion mechanism

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transcribing drawings. In particular, if we make C move up and down in a straight line, then so will F.

Watt achieved this by extending the bar BC to G, and linking G to a fixed point H by the new link GH (Fig. 24.5). He thus created his basic mechanism, with pin C corresponding with X in Figure 24.2. Since the Watt action now constrained C to move in a straight line, the pantograph action constrained F to move similarly.

In practice, the link CD was replaced by the equal and parallel link GF, giving a neater and stronger layout; the operation of the linkage was unchanged. In the usual beam engine arrangement, ABE constituted one half of the rocking beam, the other half being to the left of A. The top of the main piston rod connected with F, and C — also moving in a straight line — was sometimes used to operate the air pump. The whole linkage lay conveniently within the main engine frame. (Fig. 24.6).

The Watt linkage was not the only parallel-motion mechanism. Another was the so-called 'grasshopper' arrangement. In the linkage ABCDE (Fig. 24.7) the pins C and E are fixed. We can show from geometry that if D moves left-and-right in a straight line, then A will move up-and-down also in a (true) straight line. In practice the pin D moves in an arc of a circle; the link DE is made as long as possible so that this arc is very flat. Pin A, to which the piston rod is attached, then moves up-and-down in a very close approximation to a straight line. The grasshopper gear can be seen in the railway engine *Locomotion* at Darlington.

These mechanisms provide ample evidence of the sheer ingenuity of the early engineers in building very effective engines with the severely limited manufacturing equipment available to them. Once power-driven planing machines appeared the builders could machine flat surfaces accurately; sliding crosshead guides became possible and so the linkages were no longer necessary. They lingered on, however, in beam engines into Edwardian days.

Another feature which might be noticed in the early engines was the paucity of nuts, bolts and screws. Wherever possible parts were joined together by wedges and cotter pins, which could be made by smiths and fitted by hand filing. The early lathes were not 'screw-cutting', and such screw threads as were used had to be cut laboriously by hand using dies and taps; they were limited in size and uncertain in quality. Later on, development of the lathe enabled it to be used for cutting internal and external threads up to any size. Whitworth laid down standards for pitch and thread shape, so that nuts and bolts became to some extent interchangeable between manufacturers. Screwed fastenings became more common, but in some applications, e.g. in securing connecting rod bearing brasses, wedges continued in use almost into our own times.

James Paffett

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SUIAG Monographs

Monica Ellis *Ice and Icehouses Through the Ages* (with Hampshire gazetteer)1982 **£2.25**

Southern Railway *A Souvenir of Southampton Docks* 1982 (replica of publication *c.* 1930) £1.50

Edwin Course *The Itchen Navigation* 1983 **£1.95**

Pam Moore (ed.) *A Guide to the Industrial Archaeology of Hampshire and the Isle of Wight* 1984 **£1.80**

Edwin Course and Pam Moore *The Changing Railway Scene in Hampshire* 1991 **£4.50**

All the above are obtainable from Capt Ivan Downer, Publications Officer, SUIAG, 4 Hartley Close, Bishopstoke, Eastleigh SO5 6SE (postage and packing extra). Other publications, including *Sea Planes and Flying Boats* and *Water and Windmills* are temporarily out of print.

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The Parallel-Motion Mechanism

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Cover photo: Bursledon Windmill after restoration in 1990