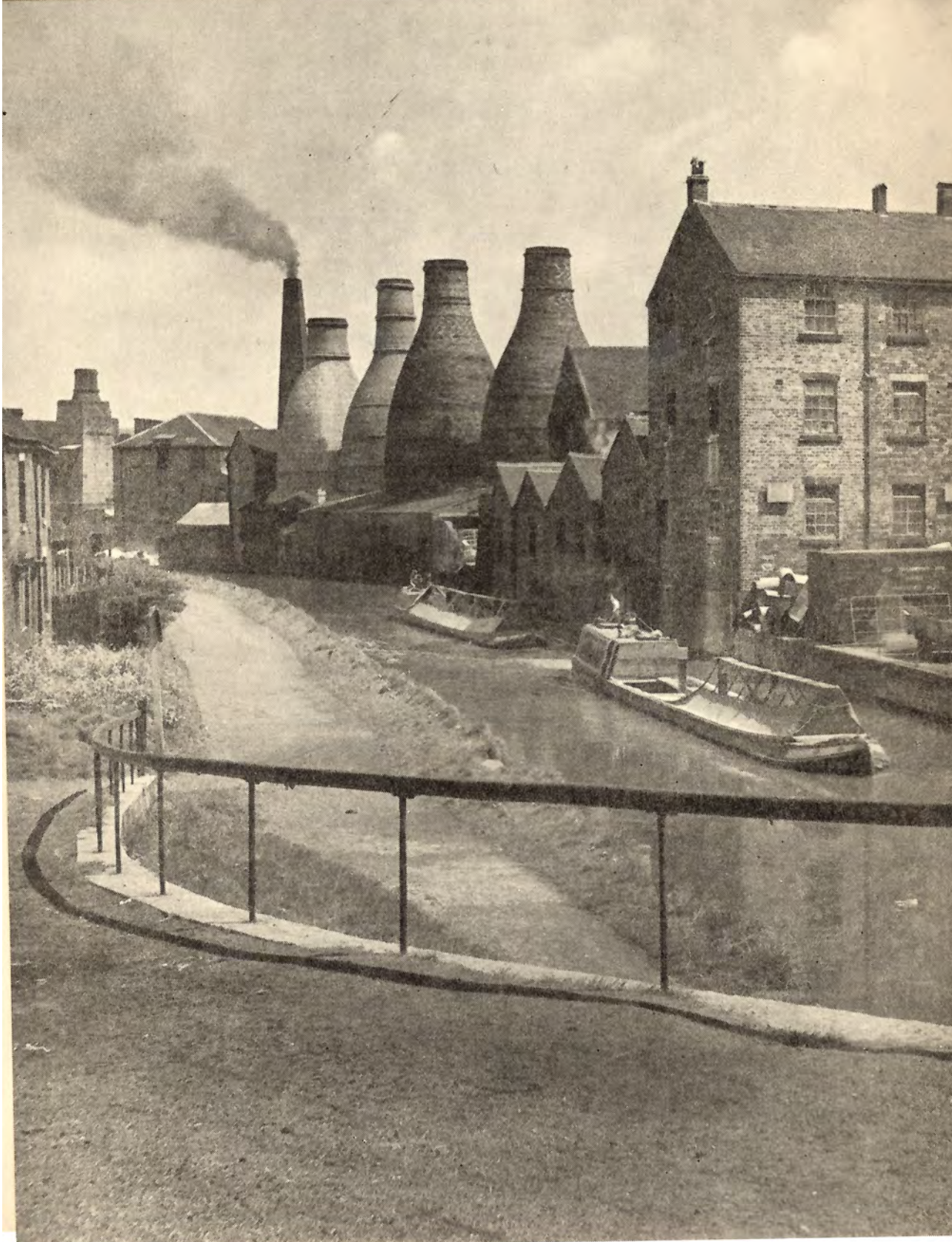
BRITISH TRANSPORT COMMISSION

INLAND WATERWAYS

NOTES ON THE FILM FOR THE USE OF THE LECTURER

LONDON
BRITISH TRANSPORT FILMS
1951



INLAND WATERWAYS

NOTES FOR
THE LECTURER ON A FILM
PRODUCED FOR THE
DOCKS AND INLAND WATERWAYS
EXECUTIVE

LONDON
BRITISH TRANSPORT FILMS
1951

◀ *Narrow Boats on the Trent and Mersey Canal at Longport in the Potteries*

First published in 1951

'*View of Pont-Cysylltau Aqueduct*
[*By Percival Skelton, after his original drawing*]'
Reproduced from Lives of the Engineers
by Samuel Smiles. London, 1861

Text by R. K. Neilson Baxter

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London and Hertford

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at present in Use for Commercial Traffic
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Introduction

The film INLAND WATERWAYS was made to be shown to members of the staff of the Docks and Inland Waterways Executive, but it is also available to schools, film societies and similar users. Its purpose is to show something of the ways in which boats move about the canals of the country and how the traffic is controlled. It is an introductory film, and as such avoids lengthy verbal explanation, but there are a great many practical aspects of canal work to be learned from it. Many of these—for instance, boat handling and lock operation—are shown in some detail, and the best practices are observed.

No film can be comprehensive on this subject. It is recommended that, at any showing, a short introductory statement about the film and the reasons for showing it to the present audience should be made, and that the audience be encouraged to ask questions afterwards. This handbook is intended to assist the speaker.

The main story of the film is centred round one of the canals used by narrow boats, the Grand Union. Working a pair of boats on a canal like this is the same in principle as working any boats on any canal. From time to time the narrative is interrupted to make comparisons with other waterways and other methods elsewhere in England.

On the Grand Union section, most of the northbound trade is in metal for Birmingham from Regent's Canal Dock and Brentford, grain for Northampton and Wellingborough, raw materials for the paper mills near King's Langley, cased goods for Birmingham and timber for such places as Wolverton, Northampton, Coventry and Leicester. The boats usually return *via* the Coventry coalfields, where they load fuel for the paper mills, power stations and other users. Elsewhere the canals serve the needs of, for instance, the Potteries, the salt industry in Cheshire, and the engineering works of the Midlands.

Many of Britain's industrial centres grew where they did because the localities were well provided with water communications. The great rivers were the earliest waterways on which navigation developed. In the seventeenth and eighteenth centuries many rivers were improved so that larger boats in greater numbers could use them. In 1769 the first artificial canal was built by James Brindley, to carry coal from the Duke of Bridgewater's mine at Worsley to Manchester.

This canal followed one contour and needed no locks. But in the sixty years that followed canals were built that crossed the Pennines and the Chiltern Hills, tunnelled beneath the Yorkshire moors and spanned the valleys of Wales on great aqueducts. Their builders were some of the first and some of the finest British civil engineers, the founders of the present-day Institution of Civil Engineers, men like Telford, Smeaton, Rennie and Jessop, whose bridges and harbours and roads are triumphs of construction.

Since the early part of the nineteenth century, when most of the canals were built, the location of industry has greatly changed and has become more concentrated. Many places originally served by canals have lost their importance and the canals have fallen into disuse. The coming of railways, and, more recently, of road transport, caused a reduction in waterborne trade, but, for many traffics, factors such as size of load (a pair of narrow boats can carry up to 55 tons), low maintenance costs and small manpower make transport by water the cheapest method. For non-perishable and certain bulk cargoes inland waterways offer an expeditious and convenient means of transport and the cargoes ride safe, smooth and cool. There are still nearly two thousand miles of waterways in the country available for a regular traffic.

The City Basin of the Regent's Canal, 1828
Engraving by F. J. Havell after a drawing by Thos. H. Shepherd

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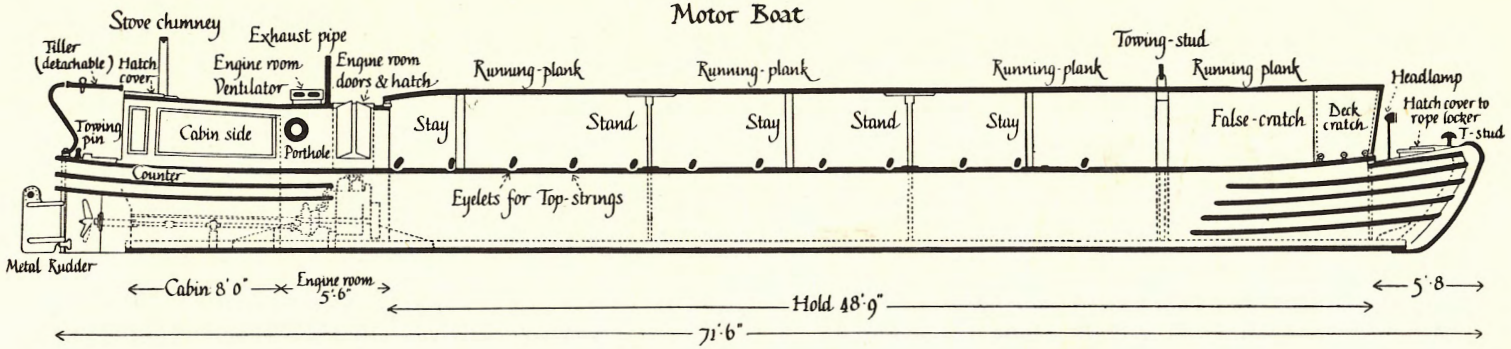
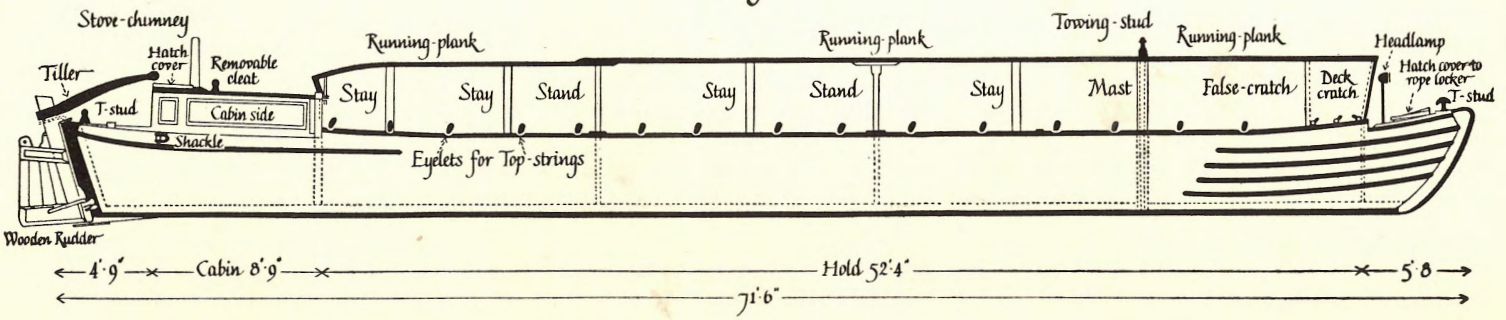
A PAIR OF NARROW BOATS

Motor Boat



Butty



Synopsis of the Film

(Running time: 39 minutes)

Numbers in brackets refer to the sections of the technical notes on pages 5 to 13

Bull's Bridge Depot, Southall, Middlesex. In the lay-by is the usual crowd of narrow boats, the families that live on them chatting in the sunshine, doing their washing, polishing up their brasses.

In the green shed which serves as traffic office, the telephone rings. The City Office is on the line: fourteen pairs of boats to go to Brentford, eight to pick up a cargo of aluminium for Birmingham, six to load grain for Northampton (I).

Over the loud-hailer at the end of the lay-by, the boatmen are called to the office for orders. The first of the boatmen comes in. His trip card and loading order are made out, emergency ration cards are provided and a cash advance handed over (I). He goes back to the lay-by and starts up his motor (II).

By now other boats are getting ready. The boatmen are drawing their stores, filling up with fuel oil, drawing wheat-cloths to line the boats carrying grain.

Bill Beresford is the last to leave the office. He walks back to the lay-by where his brother Joe, who works as his mate, has already got the motor going. The two of them cast off (III), and soon they are moving along the canal with the others towards Brentford (IV).

Next morning, down at Brent Meadow Wharf, the boats have been run in alongside the big Thames lighters under the gantry cranes, and the wharfmen are busy loading. The commentator compares the methods of loading at Brentford with those used elsewhere (V).

When loading is finished the boats are sheeted up (VI). After this they are taken to the tollhouse to be gauged (VII). Then they set off along the canal, probably to reach Cowley, near Uxbridge, by nightfall.

In the City Office there is a Craft Control Board. The commentator explains how this works (VIII).

At four o'clock in the afternoon Bill Beresford's boats, reported as having left Cowley early that morning, are at Lock 62, Slaughter's Lock, near Boxmoor. We see them go through this lock and next through Winkwell bottom lock. Here, because it is the first lock of a flight, the boats are 'breasted up'. They move out together, handled by Bill alone. Joe goes ahead to open the swing bridge and prepare the next lock (IX).

The commentator compares these locks with those on other canals (IX).

Later, Bill and Joe are coming up the canal with the butty once more towed astern. They have come through the Boxmoor locks and are getting close to Marsworth, where they will tie up for the night (X).

Next day, according to the Control Board, Bill and Joe are somewhere up beyond Fenny Stratford.

At the Gayton depot, the maintenance engineer takes a telephone call from Bill, who is ringing from a telephone box in Linford village. His boat, No. 161, has broken down at Target Turn (the boatmen's name for a bend in the canal near Bridge No. 75).

A mechanic is sent out with the maintenance van. In order to get close to Bill's boats, the van cuts across farmland and passes grazing cattle. It arrives on the crown of Bridge No. 75 and Bill gives the mechanic a wave.

It is not only the boats that have to be looked after. The waterways must be constantly dredged, locks have to be repaired, and gates replaced (XI).

Back at the canal-side, 161's motor is running again. The mechanic enters up the delay on Bill's trip record card, and Bill and Joe start on their way once more.

Next morning, the boats leave early from Stoke Bruerne. In a few minutes they go into Blisworth tunnel with Bill on the motor and Joe on the butty (XII).

The next sequence of the film covers two days and gives an impression of the journey from Gayton to Tyseley Wharf, where they spend Sunday night. On Monday morning, they do the short piece from there to Sampson Road Depot.

Having arrived at Birmingham, Bill hands over his papers to the yard foreman. A mobile crane runs up into position as Bill and Joe start to get the cloths off the boats ready for discharging (XIII).

Next, a map shows that, although the narrow canals converge on Birmingham, there are a lot more besides, and not only narrow canals.

The commentary outlines the way in which the system is divided under nationalization, and picks out some of the more important waterways by name, describing their characteristics, those of the boats they carry (XIV), and the industries they serve.

Many of the inland waterways are magnificent examples of engineering skill (XV). Their bridges, tunnels and aqueducts were masterpieces of their age and many of them are still in use today, well over a hundred years later.

Men like Bill and Joe Beresford are doing a job that counts. Unless there are men like them to handle the boats with skill and understanding, the canals are only idle strips of water.

As the commentary finishes, Bill and Joe go slowly chugging away through the rain with their empty boats to pick up a new load.

(*c*) Open decompression cock, turn fly-wheel till it nears bottom dead centre and close decompression cock

(*d*) Kick-start the engine against compression.

(*c*) Hold decompression lever down and get the engine turning by means of the starting handle

(*d*) Release decompression lever and engine will fire.

Two-strokes drive the propeller-shaft direct at 500 r.p.m. Four-strokes work at 1,000 r.p.m. and drive the propeller through a two-to-one reduction gear. The boats' speed through the water is $3\frac{1}{2}$—4 m.p.h. Fuel consumption in both types is about nine pints per hour, and fuel-tank capacity is 100–130 gallons.

Most other canal boats and motor barges are nowadays powered by diesel engines, though some are still steam-driven. A few boats and barges are horse-drawn.

III. ROPES

The set of ropes issued to each pair of boats consists of one 35-yard 3-inch tow-rope, one 27-yard 'snubber', one 30-yard cotton line, two 'uphill straps' and two 'downhill straps'. The uses of these will be found in Sections IV and IX. Short straps (*see* Section IV) and mooring ropes are made up from old straps and line.

Boats must be provided with mooring ropes at both the fore end and the stern end. When a pair of boats, side by side, is lying stern to shore, as in the lay-by at Bull's Bridge, both stern ropes are taken ashore and secured, and a breast-rope is put on across the fore ends. When boats are lying alongside, ropes are taken ashore and secured at both ends, fore and stern, and the outside boat is also secured at both ends to the inside boat.

When not in use, mooring-ropes should always be coiled down neatly; tow-ropes should be stowed in the rope locker. A tangle of ropes on deck is dangerous. A loop may accidentally pull taut round a man's ankle and throw him overboard. If this happens in a lock, he may easily be crushed and killed.

IV. TOWING

There are several methods of towing, in all of which the tow-rope is made fast to one of the two towing studs on the counter of the motor boat:

(*a*) with the butty a boat's length or more behind the motor boat on the 3-inch tow-rope. This method is used in long pounds when travelling loaded. It keeps the butty clear of the wash from the propeller and gives the butty-steerer complete freedom to steer his own course;

(*b*) with the butty anything from a few feet to a boat's length behind the motor boat on the 'snubber'. This is a very thick strong rope used when the boats are doing a lot of stopping and starting. It is designed to withstand the 'snatch' of the butty's loaded weight as the motor boat hauls it away from a stop;

(*c*) with the tow-rope rove through a pulley attached to the mast and through wooden running-blocks lashed to the running-planks of the butty, and brought down to a removable cleat on the cabin top within reach of the butty-steerer. This method is used

when boats are passing through a flight of locks. The advantage is that, when the butty has to be cast off from the motor on entering a lock (*see* Section IX (*b*)), the boat-steerer does not have to coil up the slack of the rope and throw it on to the butty's fore-end—no light job with the snubber. He simply casts off and the butty-steerer, without leaving the tiller, hauls in the line until the forward end hangs ready for the motor-boat steerer to grasp later, as he leaves the lock. When the boats leave the lock, the butty-steerer pays out the line until it has been made fast to the motor's counter, then allows it to take the strain gently, and the butty moves off without snatching. On boats not equipped with running-blocks, a makeshift can be achieved with a line made fast to the mast;

(*d*) with the butty hauled up close behind the motor boat and cross-strapped. This means securing a rope from each side of the motor's counter to the opposite side of the butty's bows. It is only used when a pair of boats are travelling light. It assists in steering the butty: in fact the butty virtually steers itself. It is also used on wide canals when a train of three boats is being worked by only two men. In this case the first dumb boat is cross-strapped, and the mate steers the third boat on a longer tow-rope.

V. LOADING

Narrow-boat holds are nominally divided into compartments, motor boats into three, butties into four. These are called 'rooms'. There are no actual partitions: the divisions are established by the standard position of the bracing chains with which all boats are provided. The boat is normally loaded stern room first, then fore room, fore middle, and lastly stern middle (stern, fore, middle in the case of a motor).

Coal is normally loaded from some form of tip, and unloaded by grab. Other bulk cargoes are both loaded and unloaded by grab. Grain is frequently handled by grain elevators at larger warehouses. Most other commodities are handled by some form of crane, frequently the modern motorized mobile crane. Some recently-built transit sheds are equipped with gantry cranes like those at Brentford.

VI. PROTECTION OF CARGOES

Every narrow boat is provided with canvas side-cloths, permanently attached to the gunwales. A number of lashings, called side-strings, are fixed at intervals along the upper edges of these. When loading is completed, running-planks are erected to form a catwalk from the cratch (the triangular structure at the fore end) to the cabin top, supported by the mast and by upright stands corresponding with the positions of the bracing chains. A number of pairs of notched wooden stays are placed aslant between the gunwales and the running-planks to prevent the latter from slipping sideways. The side-strings are slung across the running-planks, pulled tight and secured. When a boat is carrying a non-perishable cargo, such as coal, felspar, sand or china clay, the side-cloths alone will give sufficient protection against water slopping in over the side, or ejected by the pumps of passing boats.

Full protection is provided by tarpaulin top-cloths. Every boat has its own set of these. They are draped over the running planks and hang down to the gunwales on either side, supported by the taut side-cloths and side-strings. A narrow tarpaulin

runner, called a 'tippet', is laid out over them along the running planks. Another set of lashings, permanently made fast to the left-hand gunwales, are slung across, to be rove through small eyelets, fixed to correspond, along the right-hand gunwales. These are the top-strings.

This process is known as either 'clothing-up' or 'sheeting-up'.

Wide boats have normal wooden hatch covers with tarpaulins or canvas covers to go over them.

VII. GAUGING

Gauging is a 'means of ascertaining by the draught of a vessel the weight of cargo on board for the purposes of taking tolls' (Bradshaw).

When a boat is first built, its loading characteristics are determined by putting a number of equal-sized weights, one after the other, into the boat and noting the amount by which the 'dry side', or freeboard, diminishes at four points, one each side near the fore end and one each side near the stern. The measurements thus obtained, of dry side relative to load, may be shown on graduated scales attached to the sides of the boat, but in the case of narrow boats they are published as a printed table issued to toll-offices.

With this system, to find the weight of cargo in a loaded boat, the amount of dry side is measured with a gauge. This is a hollow metal tube fitted with a bracket on the outside and a float inside. The bracket is placed on the gunwales of the boat at the four standard places. The amount by which the float is displaced is made to represent the amount of dry side. By comparing this with the published table, the tonnage of the given load is obtained.

Users of British Waterways pay tolls to the Docks and Inland Waterways Executive. Whether the user has his cargoes carried by Executive-owned boats, or by private carriers, or in his own bottoms, the calculation of the toll to be paid is based on the load carried on any given trip.

The tallyman at the dock or wharf where the boat is loaded will estimate the tonnage and this figure will be entered at the dock office on the boatman's consignment note. The boats are then gauged. (This used to be done not only as a means of cross-checking the tallyman's estimate, but also to guard against unexplained 'losses' of part of the cargo during transit, since a boat would pass several toll offices on a journey and be gauged at each. Now it is only done at the beginnings of journeys and on some canals not at all.) For bagged and cased goods, and similar cargoes, the tallyman's record is accurate, but for bulk cargoes the gauge-weight is still used as the basis for calculating tolls—and the boatmen's wages—wherever it is available.

VIII. CRAFT CONTROL

The 'Craft Control' system on the Grand Union section is based on the control board (which is a diagram of the canal) in the City Office, in the P.L.A. Building on

Tower Hill. The movement of boats is recorded by means of coloured and numbered tabs. The numbers correspond with the boat numbers and each boat has several tabs, one colour for use when it is loaded, another for when it is travelling light, and so on. The tabs are hung on wire pins, indicating by their position the last reported location of the boats.

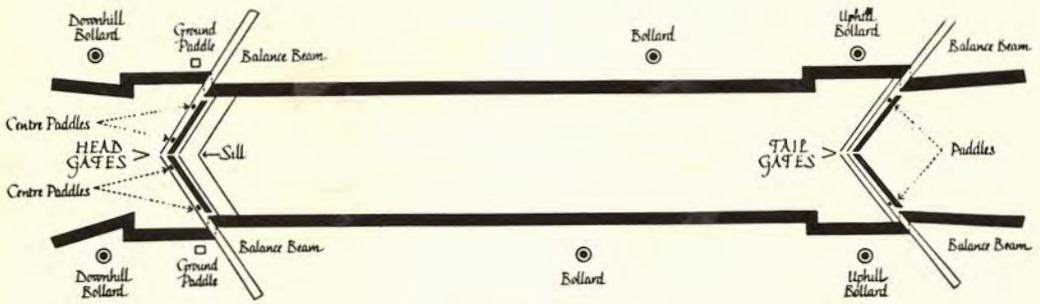
Information about boat movements is collected at a number of points—toll-offices, certain manned locks, a number of depots—which every boat must pass sooner or later. The information collected in this way is telephoned to the City Office each morning, and the tabs on the control board moved to fresh positions accordingly.

Each time a pair of boats goes away on a trip, the steerer is given a trip record card. This is marked at each of the reporting points with the date and time at which the boats go through, so that there is a permanent written record of the trip. Details of breakdowns are entered as well as of any other causes of delay.

IX. WORKING THROUGH LOCKS

(*a*) Approaching a lock with the butty towed astern, the motor is slowed down when the motor boat is about half a boat's length from the lock entrance. The tow-line will slacken, and the steerer must immediately cast off, keeping the line clear of the propeller. The butty is then on its own, and the mate steers it into the lock alongside the motor boat. The steerer tosses the tow-rope on to the butty's fore end as it passes him. He takes the way off the motor by putting it into reverse. To stop the butty, the mate goes ashore as the stern end reaches the lock entrance with a rope, attached, if the boat is going uphill, to a shackle at the after end of the cabin side. This rope is known as the 'uphill strap'. On the lockside are a number of bollards. One of these just above the tailgates is the uphill bollard. The mate takes a couple of turns of the uphill strap round this bollard and allows it to tighten up, thus stopping the boat. It should be stopped just as it touches the sill of the headgates.

The mate uses the same strap to secure the butty to the next bollard while the tailgates are closed and the paddles dropped. The motor has been left ticking over in forward gear in order to keep it up to the sill for the same time.



A Lock

The paddles at the head of the lock are now opened, ground paddles first. The centre paddles, on the gates, should not be opened until the boats have risen enough for their fore decks to remain dry when the water gushes in through the centre paddle holes.

As the water rises, the motor boat can be allowed to drop back, for the stern end is protected by two sausage-shaped rope fenders called 'tipcats' attached to the counter by chains. Sticking out beyond these is the small round (back) fender which protects the rudder below. The butty cannot be so protected because the construction of its stern end and its rudder makes it impossible; so the mate keeps the butty up to the sill, and off the tailgates, by continually hauling in the slack of his uphill strap. Both tillers should be prevented from swinging while the boats are in a lock by tag-strings secured at either side of the cabin hatches.

When entering a lock downhill, the butty is stopped in a similar way. A 'downhill strap' is attached to the T-stud at the butty's stern end and the downhill bollard is just above (outside) the headgates of the lock. There is, however, no need to hold either of the boats during the emptying of the lock, as the tendency will be for them to run forward with the flow of water. The bow fenders must be kept properly in position to protect both the boats and the tailgates from damage.

When leaving a lock the gates must be opened by hand. Pushing the headgates open with the nose of the motor boat causes extra wear on the gates: pulling the tailgates open, by taking a line round a paddle post or hand rail and going astern, strains the lock machinery. When working downhill, the stern of the butty will tend to swing as the motor boat starts to move out. If this is not prevented the butty may jam across the lock, or at least damage itself. A tag-string attached to the T-stud at the stern should be looped over the small pin provided beside the top of the hollow coign of each headgate. Just before the tow-line tautens this can be flipped off. Once again, to avoid damage and excessive wear, the tag-string should not be attached to any part of the lock machinery.

(*b*) When a flight of locks is to be negotiated, one member of the crew goes ahead, usually on a bicycle, to prepare the locks and give warning of oncoming boats. He is called the lock-wheeler. If the boats are manned by three hands or more, a pair of loaded boats will be taken through on a long line (*see* Section IV (*c*)), two hands managing the boats and the third lock-wheeling. A two-handed pair, however, must be breasted up, so that it can be managed by one man alone while the other lock-wheels. Deeply loaded boats become less manageable when breasted up: this is why the use of the long line is preferable when enough hands are available, but even well-handed boats will often breast up when travelling light, so that the hand who would otherwise be looking after the butty may get on with other work.

(*c*) On narrow canals where locks are only large enough to take one boat at a time (that is, on most of them other than the London-Birmingham section of the Grand Union), the butty must be cast off on approaching the lock, and the mate must lay it alongside the bank until the motor has gone through the lock. A tow-line is fixed to the butty's mast, and the crew haul on this to bring the butty into the lock by hand.

When a flight of such locks is being negotiated, the motor boat is frequently taken through the whole flight to wait at the bottom (or top) lock, and the butty is bow-hauled all the way through the flight. All flights of locks are manned and at some of them trace-horses are permanently kept to avoid the labour of bow-hauling by hand. Elsewhere very long lines are provided so that the motor can tow the butty through, one or two locks behind, but this practice is only possible for well-handed boats.

(*d*) Most large locks on river navigations are manned and worked by lock-keepers. The locks are big enough for all types and combinations of craft likely to use them (*e.g.* all locks on the Aire & Calder Navigation will take a full train of nineteen 'Tom Pudding' compart-

ment boats and its tug; locks on the Trent Navigation will take a motor barge and three dumb-boats at one filling, etc.). There are, therefore, few problems for the boatmen.

X. TYING UP

Boatmen tie up for the night at their own discretion. They have no fixed working hours, and the boats carry headlamps for use after dark. The places at which they will normally stop are chosen for their proximity to villages or towns where supplies can be obtained, or to main roads where bus services are available. The specific places where boats can be moored without obstructing the canal and where there is sufficient depth of water are well known to the boatmen. Tying-up points have therefore become traditional.

XI. REPAIRS AND MAINTENANCE

Boatmen are discouraged from repairing their own motors. Experience shows that expert treatment results in least delay in the long run.

In the event of a breakdown, the steerer should get in touch immediately with the appropriate maintenance depot serving the section of the canal on which the breakdown has occurred. He may do this by public telephone, or by reporting to the nearest manned lock. Manned locks are normally equipped with telephones. Alternatively, if the breakdown occurs in a very isolated part of the canal, a passing boat may be given a message for the maintenance depot.

The maintenance depot will send a van to the scene of the breakdown, for a repair to be carried out on the spot if this is possible. If not, arrangements will be made with a passing boat to tow the casualty into the depot.

Maintenance is carried out on the boats at principal repair depots (*e.g.* Bull's Bridge on the Grand Union) according to a regular programme. For instance, the engine and hull are serviced every time a boat returns to Bull's Bridge (roughly once every three weeks); annually the engine receives a 'top' overhaul, and once every two years it is taken out and reconditioned. The boat is examined in dry dock at frequent intervals and is withdrawn from service for complete overhaul every three to four years.

Maintenance of the waterways is also carried out from the local depots. Each of these will be responsible for the dredging and bank protection of about fifty miles of waterway, for keeping the bridges and locks in a good state of repair, the towpaths mown and the hedges trimmed. To this end every depot has a small fleet of maintenance craft including icebreakers, and dredging equipment, pile-drivers and pumps are available.

XII. TUNNELS

Navigation of tunnels is largely a matter of common sense. In a tunnel like Blisworth, there is room for the boats to be handled quite freely. There is adequate room to pass

and plenty of headroom: there are air shafts at intervals to draw off exhaust fumes from the boats' motors.

In other narrower tunnels a system must be provided to avoid boats meeting in the middle; in other words boats may only enter the tunnel at either end at certain times of day. The timetable is so arranged that any reasonable number of boats, starting before a given time, will have passed through the tunnel by the time other boats are allowed to enter from the opposite end.

Most tunnels were built without tow-paths. In the old days boats were 'legged' through them by two men lying on their backs at the fore end and working the boat through with their feet against the sides of the tunnel. But later, tugs were provided which could tow a number of boats through at a time. Legging has not been practised for twenty years or more. Nowadays, tugs still work at places where sufficient horse-drawn traffic survives, but in most places boats go through under their own power and the occasional horse-drawn boat gets a tow from a friendly motor.

XIII. DISCHARGING

A steerer's responsibility for his cargo begins immediately it is loaded into his boats, and ends immediately it is unloaded.

On arrival at his destination, he surrenders his consignment note and trip card to the yard foreman (or other individual in charge), but his responsibility does not end until the cargo is out of his boats. He retains a copy of the consignment note as it is needed for the computation of his wages. His trip card is marked up and handed back to him with orders for picking up a new load. Where the cargo is for delivery to a wharf or warehouse not owned by the Executive his orders are obtained from the nearest Docks and Inland Waterways office. In the case of day-boats, or boats carrying out short trips, orders for picking up return loads (if any) will probably have been given before departure.

XIV. TYPES OF CRAFT

Some canal craft are always called boats, but most of them are barges. A barge may be broadly defined as any craft, with or without motor, with a beam of 14 ft. or more; boats are of narrower beam. There are two notable exceptions, namely Liverpool short boats, whose beam is 14 ft. 4 in., and Lower Trent boats, with a beam of 14 ft. 6 in.

The craft that use the inland waterways vary greatly in size, shape and style. Many of the old regional types are now obsolete or nearly so. There are no more than one or two Severn trows or Fen lighters, mostly converted from sail to motor or dumb craft.

The dimensions of craft that still exist in sufficient numbers to constitute definite categories are shown in the table on the next page.

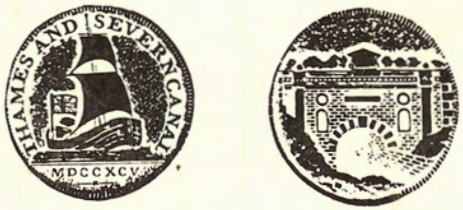
Type	*Length*	*Width*	*Draught (loaded)*	*Capacity (tons)*	*Waterway*
Liverpool short boats	61′ 0″	14′ 4″	4′ 0″	50	Leeds & Liverpool Canal
Yorkshire keels (the Executive's new type)	72′ 0″	15′ 6″	powered 6′ 0″ dumb 5′ 6″	90 106	Aire & Calder Navigation
Tom Pudding compartment boats (towed in trains of up to nineteen)	19′ 10″	15′ 4½″	7′ 6″	with coal 36 with pitch 25	do.
Lower Trent boats	powered 82′ 8″ dumb 82′ 6″	14′ 6″	powered 6′ 0″ dumb 6′ 3″	111 145	River Trent from Nottingham to the Humber
Tank barges (1)	82′ 6″	15′ 6″	5′ 6″	85	do.
(2)	120′ 0″	17′ 6″	7′ 9″	240	Aire & Calder Nv.
(3)	135′ 0″	21′ 3″	9′ 0″	with petrol 365 with gas oil 400	River Severn & Gloster-Berkeley Canal
Weaver flats	powered 90′ 9″ dumb 81′ 3″	20′ 7½″ 20′ 0″	9′ 6″	180 190	River Weaver
Narrow (monkey) boats (sizes given are average)	71′ 6″	6′ 10″	motor 3′ 8″ butty 3′ 6″	25 35	All narrow canals

XV. WATER SUPPLY

One of the principal problems of canal engineering is to keep the canals full of water. Every time a boat on any canal passes from one of the lowest levels to a summit or *vice versa*, a lock-full of water is transferred from the top to the bottom. On the Grand Union section this means 56,000 gallons. On canals with single-width locks it is about 25,000 gallons. This consumption of water has continually to be made good throughout the year—not an easy matter in time of drought.

Water is fed to the summit levels and to intermediate pounds from suitable streams. Reservoirs are built in the hills to provide a supply in summer when the streams run dry. Pumping stations are installed at lower levels to pump the water back to the higher levels as boats bring it down lock by lock from the summits.

Conversely, in wet weather, excess water in the lower levels has to be disposed of; so most long pounds are provided with weirs and sluices in their banks at a number of points, through which flood water can be let off into convenient streams or rivers.



Thames and Severn canal token showing a Severn trow and an entrance to Sapperton Tunnel

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The photographs are all by British Transport Films.

JAMES BRINDLEY, 1716–1772

JOHN SMEATON, F.R.S., 1724–1792

These four men are outstanding amongst the early engineers who built the canals of Britain, with their aqueducts, tunnels, locks and bridges, in the eighteenth and early nineteenth centuries.

THOMAS TELFORD, F.R.S., 1757–1834

JOHN RENNIE, F.R.S., 1761–1821