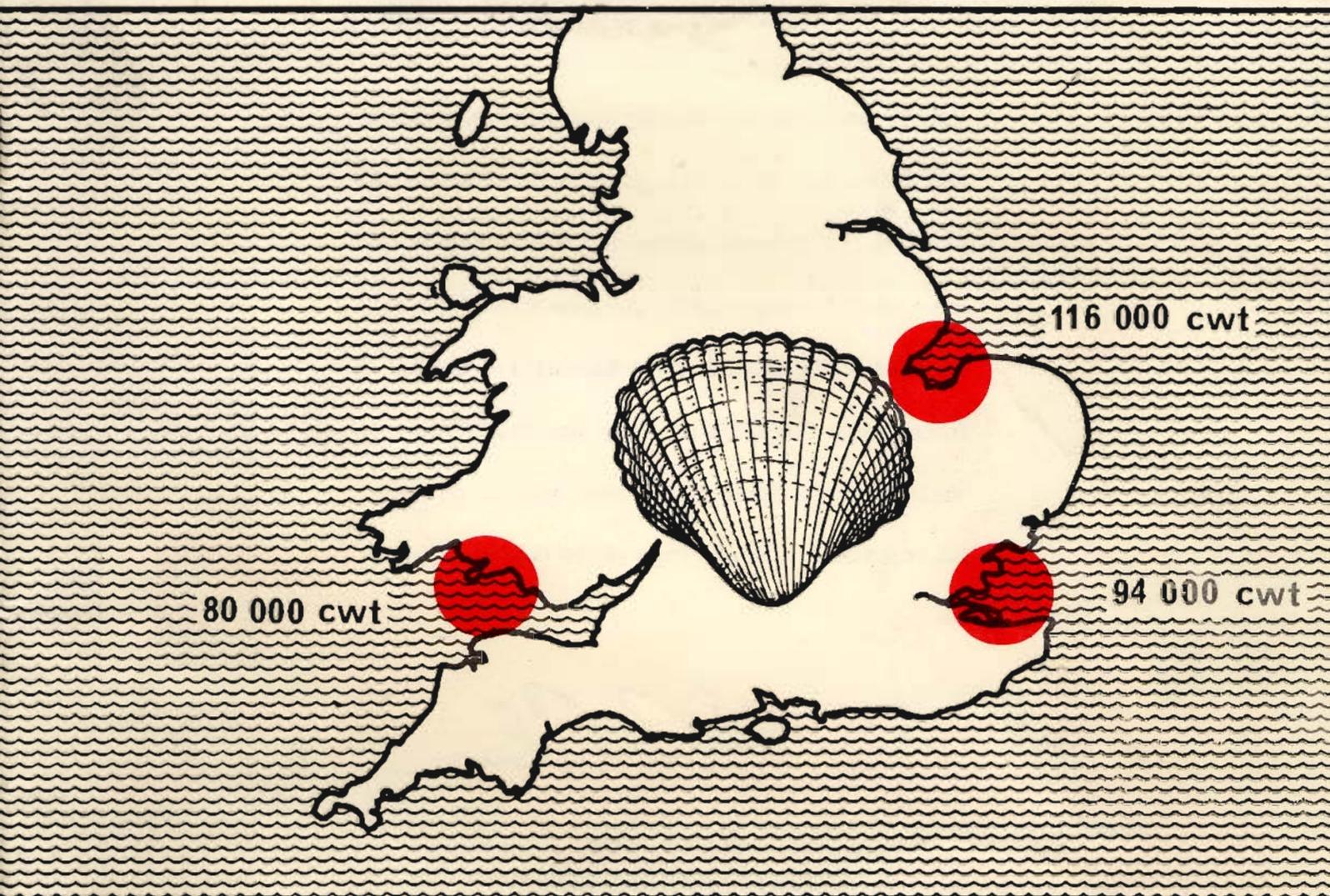


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MINISTRY OF AGRICULTURE, FISHERIES AND FOOD

# THE COCKLE

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# AND ITS FISHERIES

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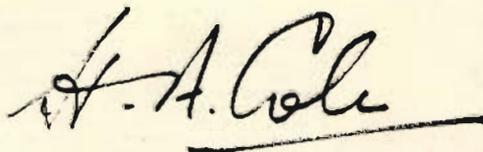
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Cockle fisheries are locally important in England and Wales and there is a growing demand for the product. No general survey of these fisheries has been published since 1927. Andrew Franklin's description of the special characteristics of the major fisheries in the Thames, Wash and South Wales is therefore very timely and is accompanied by a useful summary of the biology of the cockle.

A handwritten signature in black ink, reading "H. A. Cole", with a horizontal line underneath.

H. A. Cole

Director of Fishery Research

## CONTENTS

	Page
Introduction .....	1
Biology .....	1
Feeding .....	2
Life-history .....	2
Growth .....	3
(a) Shell growth .....	3
(b) Growth of soft parts (animal tissue) .....	4
Enemies .....	4
Parasites .....	5
The fisheries .....	6
A The South Wales fishery .....	8
B The Thames Estuary fishery .....	12
C The Wash fishery .....	18
D The Morecambe Bay fishery .....	21
Processing and marketing .....	22
(a) Processing .....	22
(b) Marketing .....	26
Conclusions .....	26
References .....	27
Appendix I .....	28
Appendix II .....	32
List of Laboratory Leaflets .....	34



## THE COCKLE AND ITS FISHERIES

### INTRODUCTION

The fishery for the edible cockle (Cardium edule L.) is at present (1971) the most valuable of the mollusc fisheries of England and Wales. More cockles are landed (around 300 000 cwt\* in 1970) than any other species of shellfish, and their first-sale value (over £250 000 in 1970) is exceeded only by that of the high-value crustacean fisheries.

The main aim of this leaflet is to describe the structure of this fishery, and details are given of catching methods, processing and marketing in all the main fishery areas. At the moment some aspects are of particular interest, such as the rapid changeover from simple hand-raking to continuous hydraulic dredging in the Thames Estuary fishery.

A brief description of the biology of the cockle is included, particular attention being paid to those aspects which directly influence the fishery, such as the settlement of the young, growth, and attack by enemies.

### BIOLOGY

Cockles occur all round our coasts in a wide variety of bottom substrates, from soft mud to stony gravel, but are most abundant on the intertidal flats of large river estuaries, where the commercial fisheries are concentrated. In these areas adult cockles can be found buried just under the surface, in densities sometimes exceeding 1 000 per square metre, especially between mid-tide level and low water of spring tides. Although more frequent in estuaries, the largest cockles are often found on open coasts, such as on the shores of Barra in West Scotland. Little is known about the distribution of cockles below low-water mark, but they often occur in high densities right down to extreme low water spring tide level. Cockles settling below this level are subject to continuous predation (i. e. they are eaten by other animals), which may be a factor limiting survival in any great numbers, though beds of cockles below low tide mark have recently been found in the Thames Estuary and these have been exploited by dredging.

The cockle is a mollusc with two equal cupped shells or valves, which are joined by a hinge and closed by the contraction of two muscles attached to the shells. The edges of the shells fit closely together except at one point, where there is a slight gape through which two fleshy tube-like structures, the siphons, emerge when the shells are slightly open. The main purpose of these siphons is to direct a flow of water through the animal for respiration and feeding. The head is rudimentary and there are no eyes or tentacles, but light-sensitive spots and

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\*Throughout this leaflet, landings are given in cwt; the metric equivalent of 1 cwt is approximately 51 kg.

abundant sensory cells are found round the siphon tips. A muscular wedge-shaped foot enables the cockle to make limited movements over the sea bed, but the main function of this organ is to maintain the animal's position just below the surface of the sand.

## FEEDING

When the cockle bed is covered with water, the cockle lies with the siphons projecting slightly above the surface of the bottom. A continuous current of water enters the shell cavity through the lower siphon and passes out again by the upper one. There is little rejection of suspended material at the siphon entrance and considerable amounts of sand, silt and other inorganic material are also taken in by the animal. The cockle is therefore described as a non-selective filter-feeder. Nourishment is obtained from food material contained in the water currents, including microscopic plants (flagellates and diatoms), plant debris and a few very small animals (protozoa and tiny Crustacea).

## LIFE-HISTORY

Unlike some other molluscs, cockles are either male or female, though there is little obvious difference and the sexes can be distinguished from each other only by dissection of the foot and identification of the eggs or sperm. Spawning occurs mainly in the spring, but may continue to some extent throughout the summer and autumn. Eggs or sperm are shed freely into the water, where fertilization and development of the eggs take place. The early stage or larva remains floating (planktonic) for a period which is thought to be about three weeks, after which settlement on the sea bed occurs when a size of about one millimetre is attained. The young cockles (called "spat" until the end of the first year) are dark in colour, with spines and threads to anchor them to the sand grains. They can be fairly easily moved about the sea bed by the tide until a size of about four millimetres is reached, when the young cockle is able in normal circumstances to remain in place by the activity of its foot; it is then unlikely to move about voluntarily for the rest of its life.

It is still not known whether the young cockles can select their place of settlement or whether they are distributed passively by currents. The presence of vast accumulations of cockle spat, often called "trail", in situations unsatisfactory for growth and survival, suggests that there is no selection of the area of settlement and that settlement occurs when the young cockles are large enough to sink to the bottom, probably in situations where the currents are weak.

The addition of young cockles to the stock, termed "recruitment", is usually very variable from year to year. In the Burry Inlet in South Wales, for example, the number of recruits, estimated in November after settlement has taken place, has varied from 11 000 million in 1963 to only 300 million in 1966. These numbers may appear to be very large but in fact the settlement of 1966 was almost a total failure. The factors responsible for these fluctuations are not yet known, but weather, tidal conditions and availability of suitable food at the time of spawning and settling are very important.

Cockles reach maturity and begin to spawn when they are about one year old, and in favourable conditions may live more than ten years. On commercially exploited beds a more common lifespan is around four to five years.

## GROWTH

### (a) Shell growth

Shell growth in cockles may continue throughout the year, but is usually greatly reduced in winter, and in some areas, such as the Burry Inlet, there is practically no increase in shell size for seven months (from October to April inclusive). During this period, the edge of the shell becomes thickened by additional layers and a "ring" is formed every winter. These rings can readily be seen on the outside of the shells, and they allow the age of the cockle to be determined accurately (Plate 1). The sharpness of the rings, and therefore the ease of age determination, varies from area to area. In South Wales, for example, the rings are normally distinct, but in Poole Harbour rings are less clearly marked, due to continuing growth in the milder winter conditions, and sometimes the first winter ring is not visible at all.

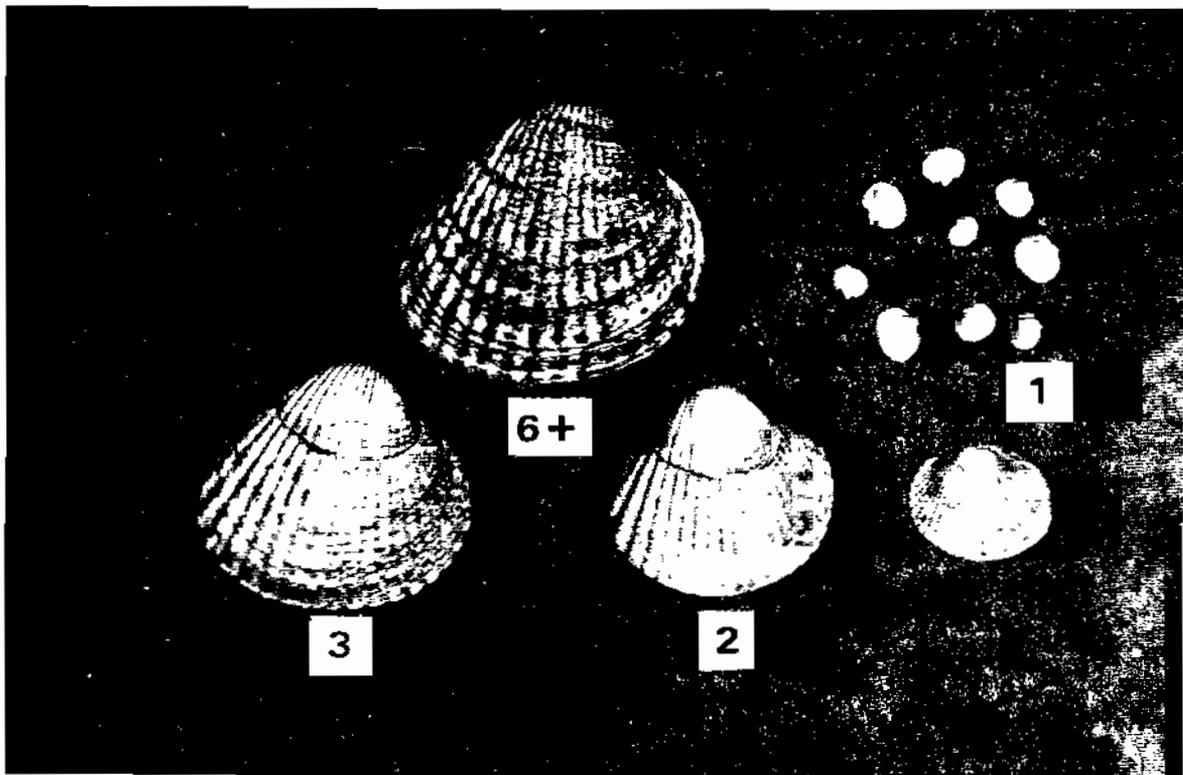


Plate 1 Cockles of various ages, showing the growth-rings.

One complication to this method of age identification is the presence of "disturbance rings", which are similar to winter rings but are formed whenever growth ceases, for example when the cockle is temporarily washed out of the sand, or when there is a sudden change in temperature. Although they are a source of confusion, disturbance rings are normally less distinct than annual rings, especially at the extreme edges of the valves, and with practice they can be distinguished.

Growth rates may vary considerably from area to area and also within the same bed, depending on the food available, the temperature of the surrounding water, the position in relation to tidal height, etc. Lowered growth rates are often seen where the cockles are overcrowded. Some examples of the average size (in millimetres) of cockles at various ages are:

Area	Age			
	6 months (1 ring)	1½ years (2 rings)	3½ years (4 rings)	5½ years (6 rings)
Wash	11	23	26	30
Burry Inlet	12	23	28	31
Poole Harbour	12	33	38	45+

Growth rates, and hence the average size of each year-class, in the Wash and the Burry Inlet, both of which are heavily exploited commercial fishing areas, are approximately the same. Poole Harbour, which is only lightly fished, is probably the best growing area in England and Wales. In the first two areas, however, densities of cockles often exceed 500 per square metre, compared with around 100 per square metre at Poole, where, despite the considerably higher growth rate, the yield of cockle flesh per unit area of cockle bed is much lower.

(b) Growth of soft parts (animal tissue)

The success of a fishery depends on the volume of meat obtained on processing the cockles, the accepted measure of the yield. When considering cockle meat yields, two factors of importance are the general increase in flesh volume as the animal grows older, and the seasonal changes in flesh content during the year. In the Burry Inlet, it has been found that a five-year-old cockle contains approximately two-and-a-half times as much flesh as a two-year-old, and seventeen times as much as a spat cockle.

Meats of individual cockles vary seasonally, especially during the winter, when although the volume of raw flesh decreases very little, the volume of the main commercial product, the boiled meat, may fall by one-third and the content of organic matter (proteins etc.) by one-half. From April onwards there is a sudden rise in the meat yield with the advent of better feeding conditions, and, despite spawning in May and June, the meats steadily improve until September, when overwintering losses commence again.

## ENEMIES

Since the cockle occurs in large numbers on intertidal flats, it is very vulnerable to attack both by marine enemies at high tide and terrestrial enemies at low tide. The main marine enemies are flatfish (flounders and plaice), shore crabs and starfish, which attack principally the smaller cockles and are thought to limit the distribution of cockles below low water spring tide level. Terrestrial enemies, apart from man, include birds, notably gulls and waders such as the oystercatcher. Normally gulls eat only cockles which have been disturbed during fishing or by bad weather conditions. Oystercatchers, on the other hand, cause great damage to cockle beds, especially in areas where huge flocks overwinter (as in the Burry Inlet). The oystercatcher can readily feed on cockles and has a preference for those in their second winter, just before they reach fishable size. The bird removes the cockles from the sand and carries them to a selected patch of harder sand, before hammering them open with its beak; this results in the

formation of "feeding-piles", large patches of empty cockle-shells scattered over considerable areas of the fishery (Plate 2). Since a single oystercatcher can consume up to 500 cockles per day, predation by the birds can severely reduce commercial catches from the affected beds, especially when cockles are fairly scarce.



Plate 2 Oystercatcher feeding-piles.

The enemies which have been listed are extremely important in the more stable fisheries such as the Burry Inlet, but are likely to be of less significance in certain of the larger fisheries such as the Wash, where the instability of the beds is a more common cause of heavy mortality. The importance of weather conditions when the young cockles are settling has been mentioned and, even when settled, the spat are extremely susceptible to adverse conditions: a whole year's spatfall can be completely wiped out during a spell of severe gales or hard frosts. Even beds of adult fishable cockles are frequently destroyed in a short time, especially in the Wash, where the substrate can change from fairly soft mud to coarse sand in a matter of months.

#### PARASITES

Cockles are affected by a number of organisms which have little known effect on commercial fisheries. However, for the sake of completeness, details are given here of the more commonly occurring ones:

- (a) Meiogymnophallus minutus (Cobbold), a parasitic flatworm whose encysted stages are found under the hinges of all cockles more than one year old in many areas, including the Burry Inlet.

- (b) Cercaria bucephalopsis haimeanus (Lacaze-Duthiers), a trematode which infests the reproductive organ and digestive gland and causes parasitic castration in a small percentage of cockles older than one year.
- (c) Paravortex cardii (Hallez), a flatworm found commonly in the intestine.
- (d) Other organisms found in association with cockles are Paranthesius rostratus (Canu), a copepod, and Trichodina cardii (Delphy), a protozoan, both of which commonly occur in the mantle cavity.

Any organisms attached to the outside of the shell are usually confined to the siphon end, where the shell protrudes above the sand surface; they include algae, hydroids, small anemones and barnacles. Since cockles are boiled before consumption, there is no question of any of the organisms mentioned in this section presenting a health risk to the consumer.

## THE FISHERIES

The main traditional fishing areas are found in the Wash, the Thames Estuary, the Burry Inlet in South Wales and the Dee Estuary/Morecambe Bay region, with smaller areas of local importance off the north Norfolk coast, in Poole and Emsworth Harbours and near Teignmouth. The four main fisheries suffered heavy losses as a result of the severe winter of 1962/63, but, except in Morecambe Bay, all subsequently recovered as a result of an exceptional settlement of young cockles in the summer of 1963. Cockle landings from the Morecambe Bay fishery have since fallen to negligible proportions and each of the other three main areas has supplied roughly one-third of the total landings in England and Wales. Recent examinations of the cockle stocks in the smaller fisheries have shown that their potential production does not approach that of the three main areas.

In Scotland, cockles are relatively unexploited, and no landings have been recorded in the last few years. Cockle beds are found at Barra in the Outer Hebrides, in the Firth of Clyde and in the Tongue district of Sutherland, but the cost of transport from these areas is normally prohibitive. In exceptional circumstances, however, large quantities of cockles may be fished there, as occurred in 1963, when cockles in England were very scarce and fishermen from north-west England gathered over 4 000 cwt from the Scottish beds in under six months.

In Europe, fisheries for cockles exist in Spain and Portugal, France and Holland. The fishery in Holland is of special interest because it is operated by British cockle merchants and the cockles are sent to Britain at highly competitive prices. Fluctuations in the quantity of cockles entering Britain from this source provide a complicating factor in the marketing of the home-produced product.

Cockle landings for England and Wales during the last forty years are shown in Figure 1. Landings have oscillated around 150 000 cwt per year, except during the late thirties, when they exceeded 200 000 cwt for several years, and during the last few years, when record landings have been achieved. The value of the fishery has risen steadily over the years and currently is well over £200 000 per annum.

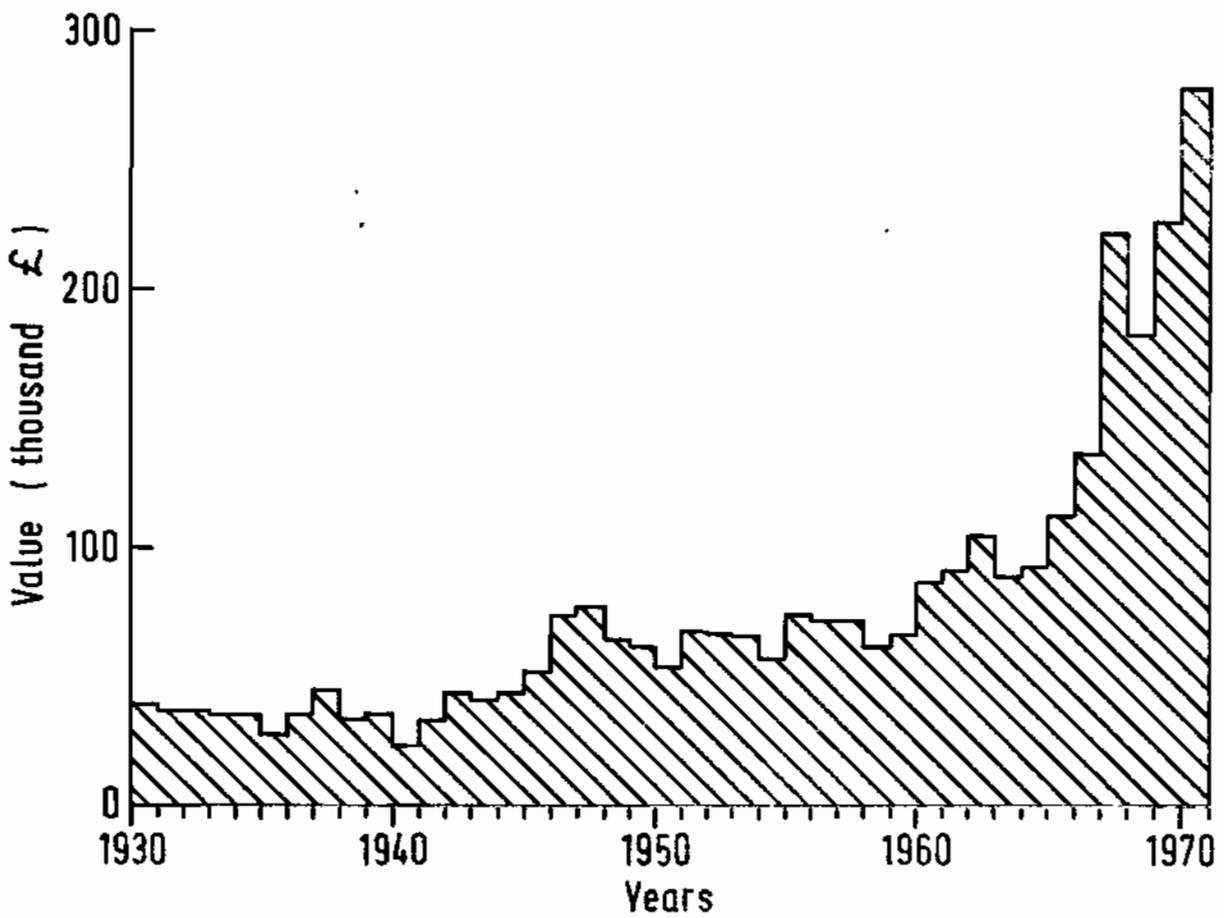
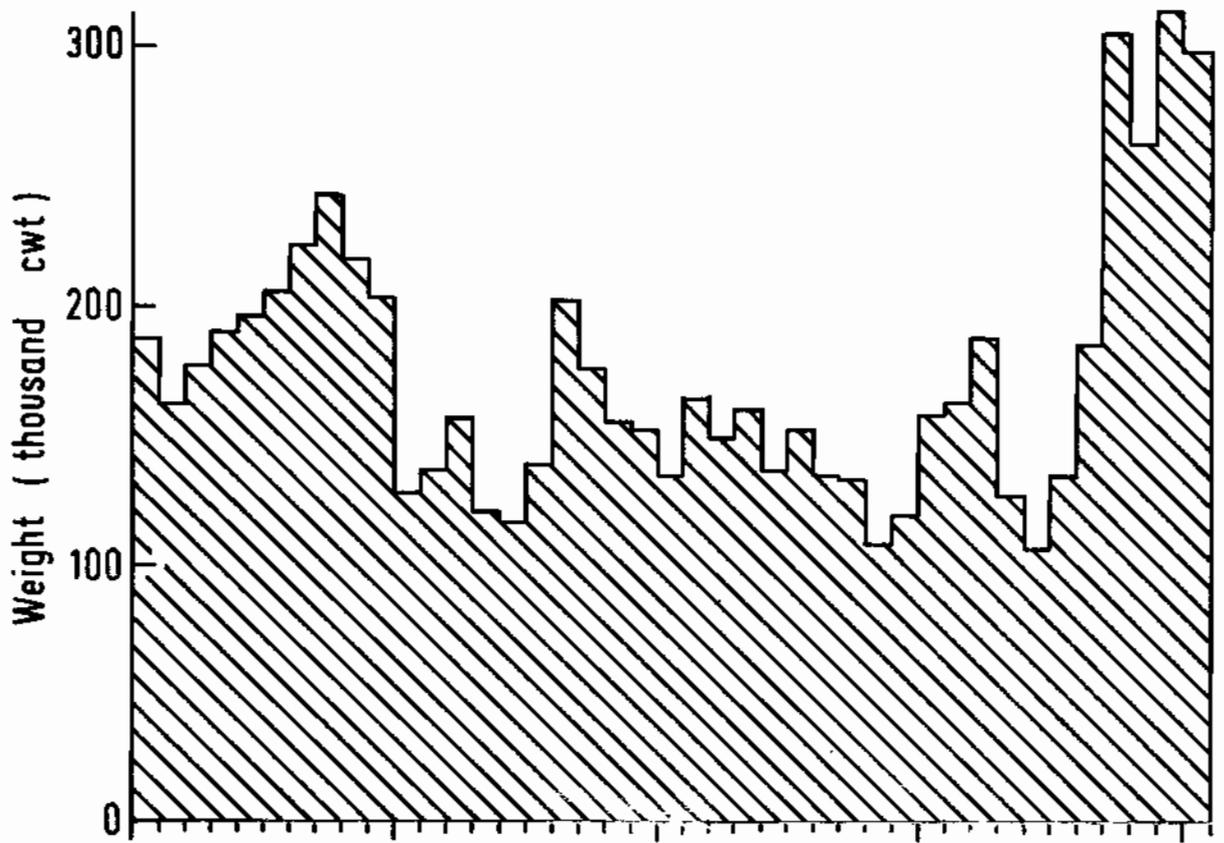


Figure 1 Cockerle landings for England and Wales.

The landing figures of the last ten years demonstrate clearly the variability of the fishery. Landings were fairly high in the early sixties, but the severe winter of 1962/63 wiped out much of the stock and catches fell. There was, however, an exceptionally good spatfall in the summer of 1963 and many of the survivors began to contribute to the catches in 1965. Landings then increased steadily and by 1967 had risen to more than 300 000 cwt. By this time the cockle population in the country as a whole was already beginning to decline from the maximum fishable stock of 1966 and landings fell in 1968. Increased catches were made in 1969, however, partly as a result of the contribution to cockle stocks by the 1967 spatfall, but mainly due to increased fishing effort, which again raised the landings to over 300 000 cwt. The increased effort was due to the failure of the Dutch cockle fishery in 1969, which resulted in increased demand for British cockles, with subsequent high prices. Catches continued to be good during 1970, but the present stocks are insufficient to sustain fishing at the same rate for much longer.

#### A The South Wales fishery

In South Wales, cockle fishing is mainly concentrated in the Burry Inlet, with an area of secondary importance in the "Three Rivers" district, that is, the estuaries of the Rivers Gwendraeth, Tawy and Taf (see Figure 2). The cockle beds of the Three Rivers area tend to be of a temporary and unstable nature, whereas, in the main, the larger Burry Inlet beds are stable, with a reasonable settlement of spat cockles in most years. The Llanelli side of the Burry Inlet only irregularly produces commercially fishable stocks. The area fished in the Burry Inlet is considerably smaller than that in the east coast fisheries and covers only three to four square miles. Despite this, the fishery has in recent years maintained a regular production of around one-third of the total cockles landed in England and Wales. Since 1924, records of landings for South Wales show a variation between 20 000 and 50 000 cwt per year (see Figure 2), but, as a result of the large number of cockles available on the sands from the outstanding 1963 spatfall, landings rose to a record 140 000 cwt in 1967. Current landing figures (1969-70) are high at around 80 000-90 000 cwt.

One important point, when considering the landing figures, is that the landings up to 1960 were based on railway despatch records. In the late 1950s, an increasing proportion of cockles were transported by road, and the official landings shown bear no relation to the true figures for these years.

One of the characteristics of the Welsh fishery is the comparatively large number of people involved. Bulstrode (1911) estimated the number of people in the fishery, including those involved in the processing side, to be around five hundred, and Wright (1927) quoted figures of five hundred to six hundred families. The modern fishery certainly does not employ such a large number, though at present there are almost one hundred gatherers fishing in the Burry Inlet alone. Unlike the fishery of the 1920s, which consisted mainly of women earning money to augment the family income, the present number consists of regular full-time gatherers, including a fair proportion of men, all of whom hold licences granted to them by the South Wales Sea Fisheries Committee under a Regulating Order.

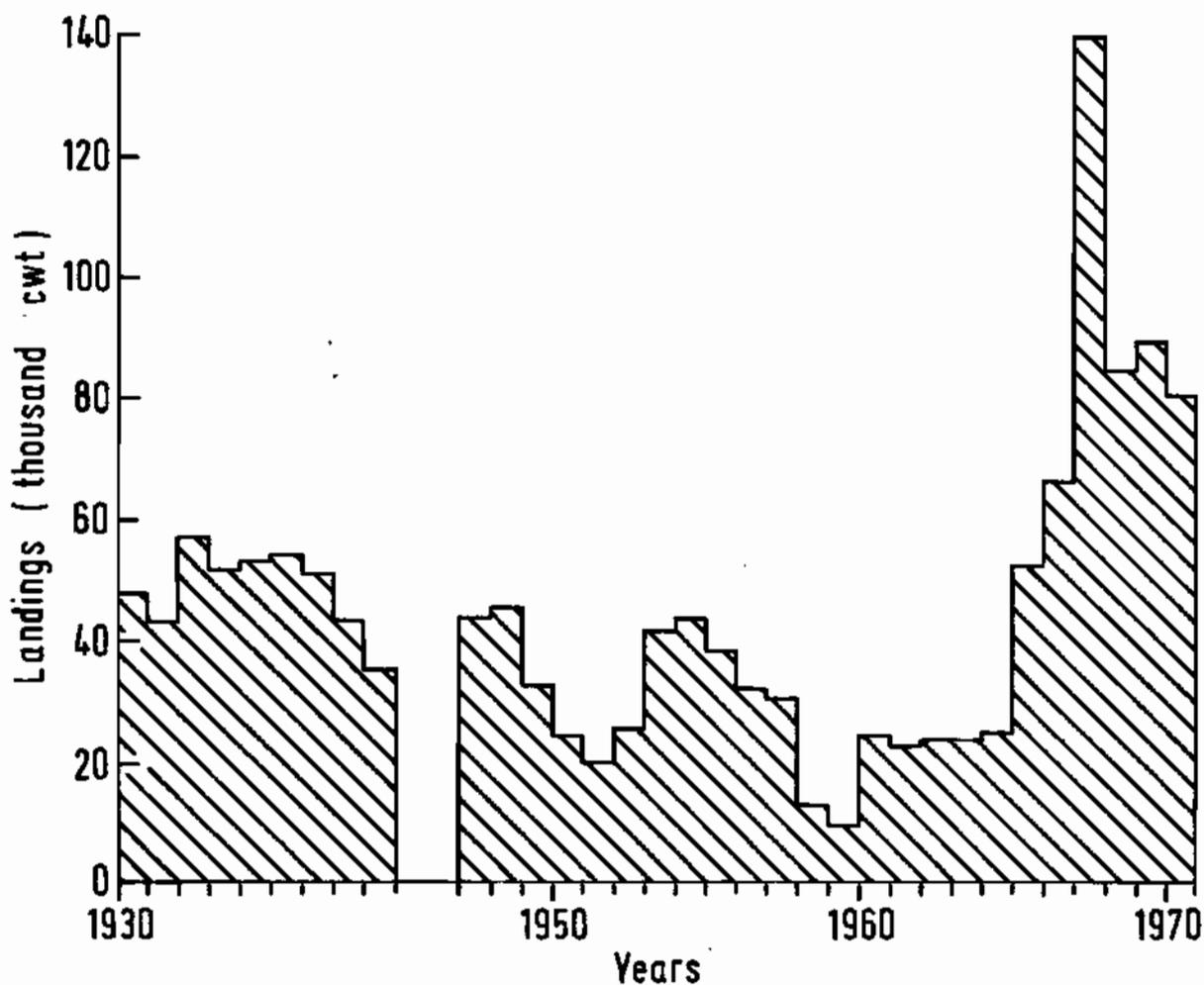
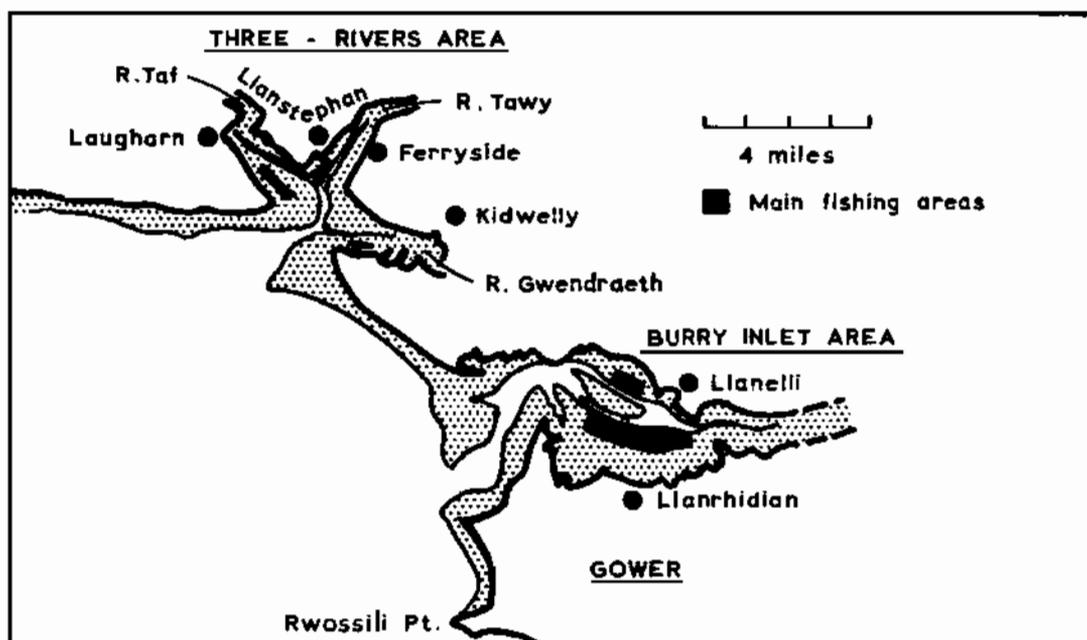


Figure 2 The South Wales cockle fishery. Landings up to 1960 are based on railway despatch records only and are incomplete (see text); landings after 1960 are from direct observation by the Fishery Officer of the South Wales Sea Fisheries Committee.

The method of fishing is very simple. Access to the cockle beds is from the land, and transportation, formerly by donkey, is now by horse and cart, since mechanical vehicles are not allowed on the cockle beds. Gathering is entirely by hand, aided by a "scrape", a curved blade which is used to break up the sand surface before raking (Plates 3 and 4). The cockles are raked into piles, sieved through a circular wooden sieve with  $\frac{3}{4}$  inch square or oblong wire meshes (the minimum legal landing size of cockle is any which will not pass through a gauge  $\frac{3}{4}$  inch square, temporarily reduced to  $\frac{11}{16}$  inch in the summer of 1971), and washed with any water available on the beds to get them reasonably clean. The cockles are then put into sacks holding approximately one cwt and loaded on to carts for transport to the boiling sheds for processing.

A hand dredge was developed and used at Llanelli for many years. It consisted simply of a toothed blade fixed in front of a rectangular diamond-meshed box-frame to hold the catch. The operator moved backwards, pulling the handle of the dredge towards him with sharp sideways movements which caused the cockles to be lifted by the blade into the bag (Plate 5). The dredge was intended for use in several inches of water, where cockles in the catch would be washed free of sand, but it was frequently used on dry sand. There were many complaints that the dredge caused damage to young cockles and to the cockle bed itself, and permission for its use was withdrawn by the Sea Fisheries Committee in 1969.

The by-laws of the South Wales Sea Fisheries Committee relating to cockles (shown in Appendix I) include laws covering minimum size, fishing methods, the means of transport, and time spent fishing. In addition, the Committee is responsible for the administration of a Regulating Order, granted under the Sea Fish Industry Act 1868 and known as the Burry Inlet Cockle Fishery Order. This became effective in June 1965 and gave the Committee power, amongst other things, to issue licences for cockle gathering. Under this licensing scheme, the quantity of cockles taken from the fishery each year is controlled by limiting the number of gatherers and the daily quota each may take. At the time of writing (1971), cockle stocks are less abundant than previously and the quota has been steadily reduced from 10 cwt per day in 1968 to 5 cwt per day. In 1966, when cockles were plentiful, no quota restrictions were enforced.

A special factor in the South Wales fishery is the presence of very large flocks of overwintering oystercatchers. The numbers of these birds in the Burry Inlet have increased greatly during the past four years and in the period August 1969 to March 1970 averaged 13 000, with a maximum of almost 20 000 birds in November 1969. Observations have shown that each bird can eat up to 500 cockles per day and it has been calculated that the oystercatchers can consume far more cockles than are taken by the fishermen. In 1969, for example, it was estimated that the oystercatchers removed the equivalent of around 150 000 cwt of cockles, compared with 90 000 cwt removed by the fishermen.

When cockle stocks are low, there is direct competition between the birds and the gatherers. The oystercatchers normally eat cockles which are just below the minimum legal size, and in some years the amount remaining to grow and enter the fishery is so reduced that catches are severely affected. Research has been undertaken to develop a satisfactory means of controlling the numbers of these birds, but the introduction of control measures has proved to be very difficult, due mainly to objections from bird protection interests, and the oystercatcher continues to take substantial quantities of cockles from this area.



Plate 3 South Wales cockle gatherers.



Plate 4 South Wales cockle gatherers.



Plate 5 South Wales hand-dredge

#### B The Thames Estuary fishery

The area worked by this fishery includes extensive sandflats, covering an area of almost 70 square miles off both the Essex and Kent coasts (see Figure 3). Most of the fishing boats are based on Leigh-on-Sea, and work the vast stretch of sand comprising Southend Flats and the Maplin Sands. On the Kent coast, grounds are worked off the Isle of Grain, the Isle of Sheppey and Whitstable, partly by Leigh fishermen, but also by gatherers from Whitstable and Faversham. In times of relative scarcity, some of the offshore sandbanks, such as the Buxey and East Barrow Sands, may also be fished. Although extensive cockle beds are found on the Maplin Sands, gatherers are allowed only limited access, because the sands are used as a gunnery range by the Proof and Experimental Establishment of the Ministry of Defence.

An interesting development is the proposal to site London's third airport on the Maplin Sands. From information at present available, it appears that the installation would be built over the area which at present provides the bulk of the cockles landed at Leigh, and the scheme is the cause of concern to fishing interests.

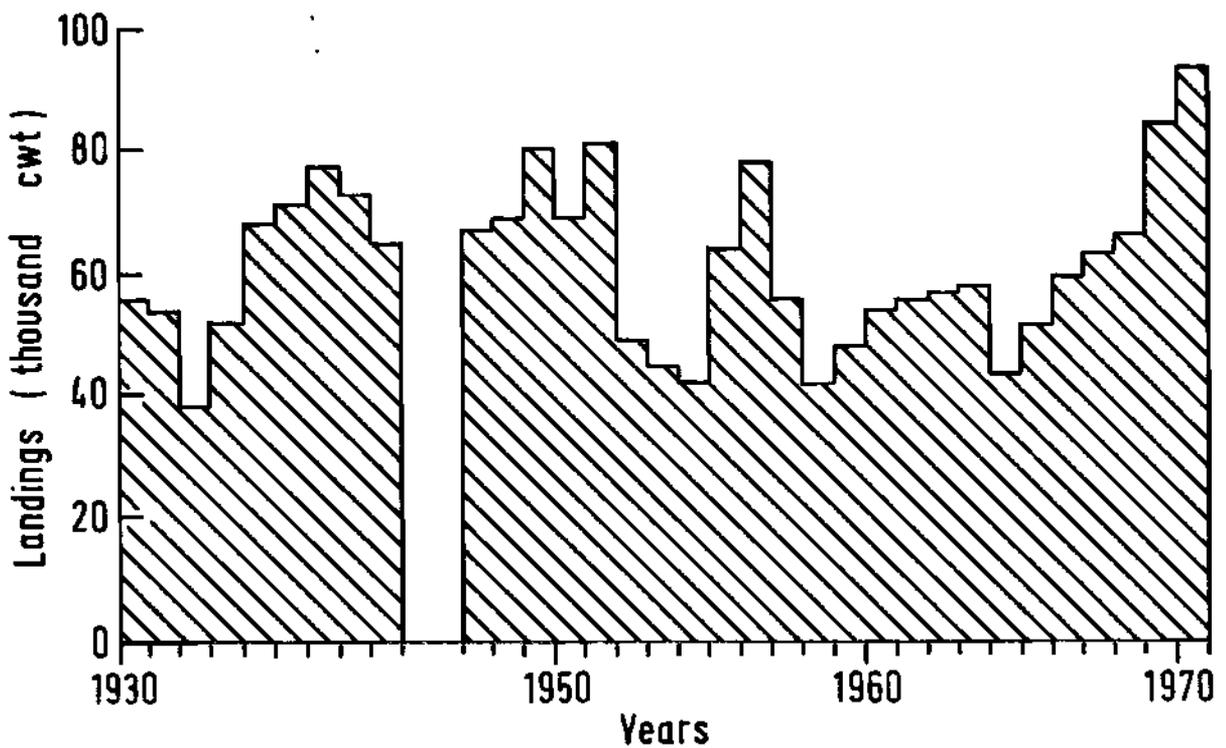
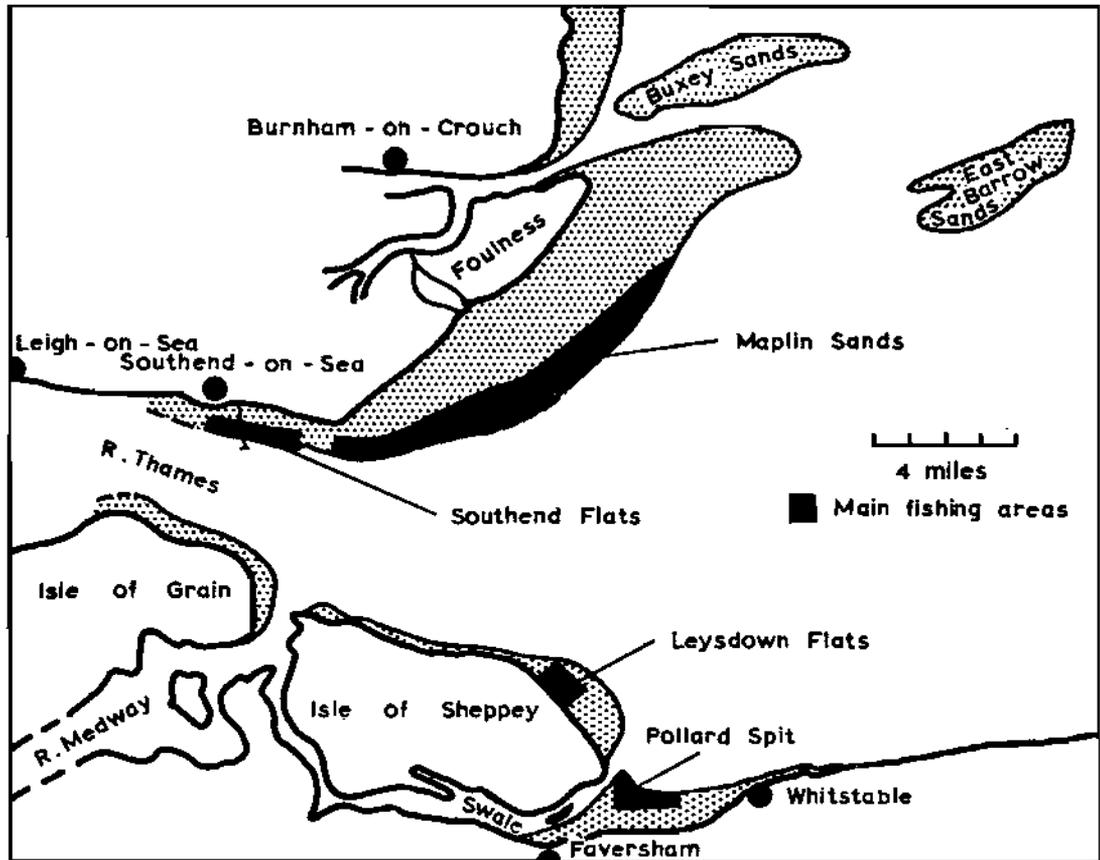


Figure 3 The Thames Estuary cockle fishery.

The Leigh fishermen always use boats for transport to and from the cockle beds, but there is some gathering from the land on the Kent side. Of the original seven boats working out of Leigh, only one still retained the traditional method of hand-raking in 1971, which differs from that described for the Burry Inlet only in the use of a net instead of a sieve. Six boats use the continuous hydraulic cockle dredge which has been developed by engineers of the White Fish Authority Industrial Development Unit (Plates 6, 7 and 8) (for a detailed description see WFA Research and Development Bulletins Numbers 25 and 25/2). This dredge removes cockles from the sea bed continuously, and lifts them on to the deck of the vessel, by pumping water at high pressure down a small-diameter pipe to the dredge resting on the sea bed. The pump has three main functions:

- 1 it supplies a series of jets which wash the cockles out of the sand ahead of the dredge;
- 2 it washes sand and small cockles out between the bars which make up the bottom and sides of the dredge;
- 3 it lifts the larger cockles up through a large-diameter pipe on to a delivery screen on deck.

After a series of trials in South Wales, a dredge fitted with a 12 inch blade was introduced into the Thames Estuary in May 1967 and used experimentally until October 1968, a period which included a year's commercial trial on one vessel. From October 1968 onwards, another five boats took up dredging and now dredges fitted with 18 inch blades are the main means of fishing in the Thames. In addition to the six boats from Leigh, one boat was specially built for dredging and began fishing out of Whitstable towards the end of 1970, and in 1971 two further local vessels were fitted with dredges and began fishing the area. The one boat which fished cockles by hand-raking ceased fishing in 1971.

In some areas, such as the Burry Inlet and the Wash, the method of fishing, and the type of gear, is strictly controlled by by-laws (see Appendix I), and hydraulic dredges cannot be used. In the Thames Estuary there are at present no by-laws controlling cockle fishing, and to date it is the only area where dredging is permitted. Dredges have been used in the Dutch cockle fishery for some time, but there the hydraulic principle is used only in so far as water jets disturb the sand and cockles in front of the blade. Otherwise the dredge is conventional and has to be periodically hauled to the surface for the removal of the catch (Plate 9).

From the statistics available, the Thames Estuary is the most consistent of the main cockle fisheries. Annual landings have very rarely fallen below 50 000 cwt, and they rose to around 100 000 cwt in 1970 (see Figure 3). The lack of any wide fluctuation is probably due to the huge expanse of cockle-bearing sands available to the fishermen, and also explains why the fishing was not so severely affected by the 1962/63 cold winter, though landings did fall to just over 40 000 cwt.

In a survey made in 1967, it was estimated that there were approximately 70 square miles of sand in the estuary, of which about 27 square miles contained cockles in densities fishable by dredge (100 or more per square metre). The total stock in these beds was estimated at 17 000 million cockles, equivalent to just under 2 million cwt; nearly all of these were survivors of the exceptional 1963

spatfall. Since 1967 the stocks have declined considerably, even though spatfalls occurred in 1967 and 1969. The cockle population on Southend Flats, one of the main traditional fishing areas, has almost completely disappeared, due in part to disturbance caused by bait-digging, and fishing is now confined mainly to the Maplin Sands, though some beds on the East Barrow Sands, near or below low water mark, were fished in 1971 and an extensive unexploited stock in commercial densities was recently located on the Buxey Sands. In 1969, the first full year of dredging by commercial vessels, the recorded catch increased to over 85 000 cwt, though part of the increase was due to an improvement in the collection of statistics, and in 1970 there was a further increase, to 100 000 cwt. The potential of hydraulic dredging, and the absence of by-laws to regulate the fishery, could lead to further substantial increases in fishing effort and reduction of stocks. This fishery is therefore being closely studied to determine the effect of dredging on cockle grounds and stocks, and legislation is being considered to allow for the conservation of the cockle stocks, if this should prove necessary.

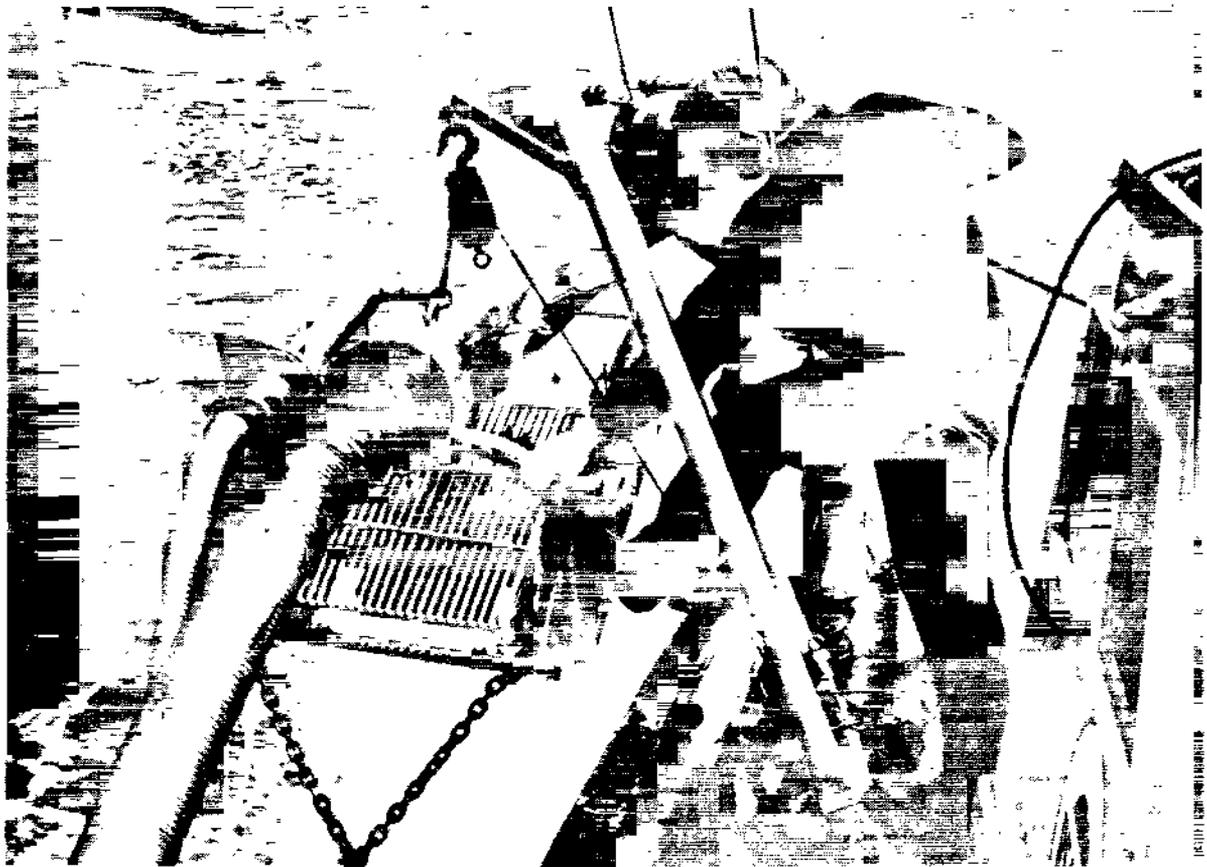


Plate 6 Hydraulic dredge.

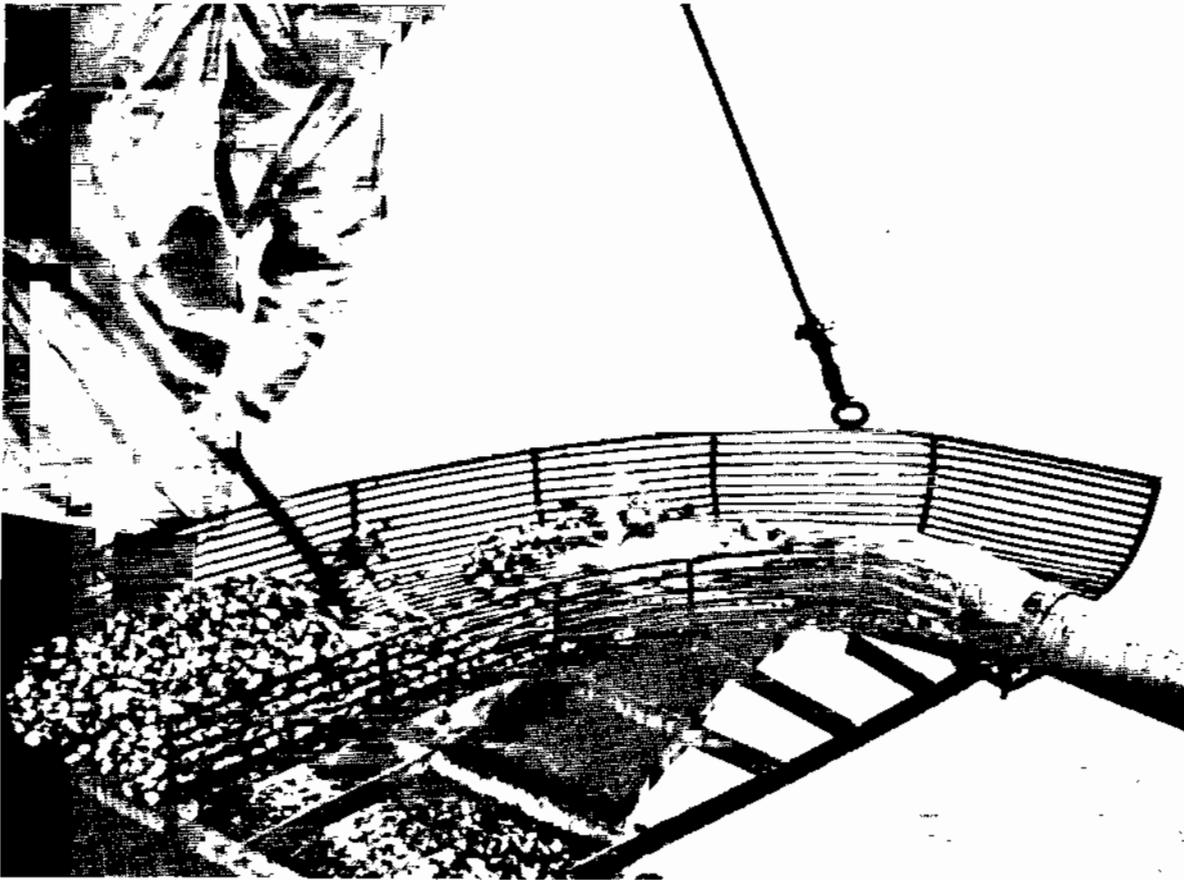


Plate 7 Hydraulic dredge - showing the delivery of the cockles to the collecting screen.



Plate 8 Hydraulic dredge tracks.

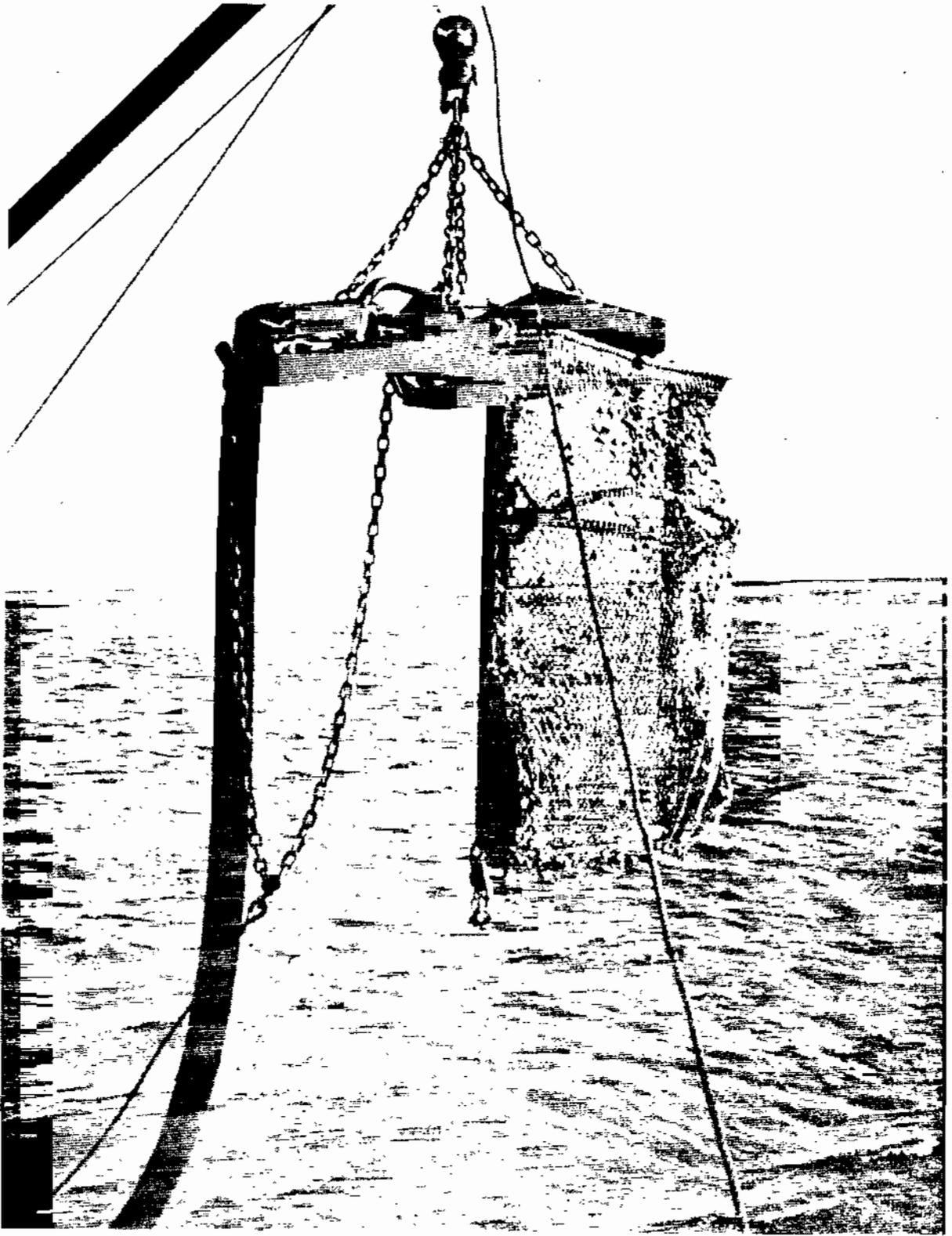


Plate 9 Dutch cockle dredge.

## C The Wash fishery

The Wash cockle fishery is based on the two ports of Boston in Lincolnshire and King's Lynn in Norfolk (see Figure 4). Traditionally King's Lynn has been the more important of the two, but in recent times landings have been more evenly divided between the ports, and in 1968, 1969 and 1970 well over half the cockles were landed at Boston.

Records of landings of cockles from the area during the past forty to fifty years have shown great variation, from over 100 000 cwt in the late thirties to around 20 000 cwt in the mid-fifties (Figure 4). Landings during the past decade have been equally variable. In the early sixties, 60 000-70 000 cwt were landed annually, but a drop to 30 000-40 000 cwt occurred after the cold winter of 1962/63. A remarkable increase followed, as survivors of the outstanding 1963 spatfall entered the fishery, and landings reached more than 100 000 cwt in 1968, 1969 and 1970. The high landings of the last few years were obtained from a declining stock and were the result of intense fishing, stimulated by the heavy demand for cockles and the high prices. In 1967, twenty-one boats, manned by just over sixty men, were engaged in the fishery; by early 1970 this had risen to around forty boats, though some of these were not working full time. In addition to the main fishery worked by boats from King's Lynn and Boston, there is a small one, worked by between four and six men, from Heacham in Norfolk, where access to the beds on Stubborn Sand is by tractor from the land.

Cockles are gathered by hand at low tide (Plate 10) and the Wash is now the only fishery where boats are used simply as a method of transport for men and catch, though in recent years it is believed that many of the fishermen have practised a method of fishing known as "ploughing-out", which contravenes the by-laws of the Eastern Sea Fisheries Joint Committee. The boat is anchored over the cockle bed in two to three feet of water and then driven in circles around the anchor; an aerial photograph of these "ploughing-out" rings is shown in Plate 11. The anchor rope is drawn in at intervals to decrease the turning circle, and cockles are blown out of the sand into a large central pile by the action of the propeller. The quantity of cockles disturbed is often much greater than is required for the fishermen's needs and wastage is considerable, since cockles of all sizes are often left in heaps up to one foot deep.

In a survey of the Wash in 1967-68, cockles were found to be present over nearly all the sandbanks in the area, though the main commercial beds were confined to the Roger, Main, Black Buoy, Thief, Daseley, Pandora and Stubborn Sands (Figure 4). These sandflats contained large beds of cockles, often in densities of over 1 000 per square metre. It was estimated that of the 39 square miles of sandbank covered by the survey, over 9 square miles could be classed as cockle beds, that is carrying more than 100 cockles per square metre. These areas contained a total of about 10 000 million cockles, equivalent to around 1.1 million cwt.

Since 1968, stocks have become considerably reduced as a result of fishing and natural losses. Recruitment has been poor, though some spat settlement and survival took place in 1965 and 1967. A heavy settlement occurred in the autumn of 1969, but very few survived until the following summer; such catastrophic natural losses seem, unfortunately, to be a feature of the Wash area.

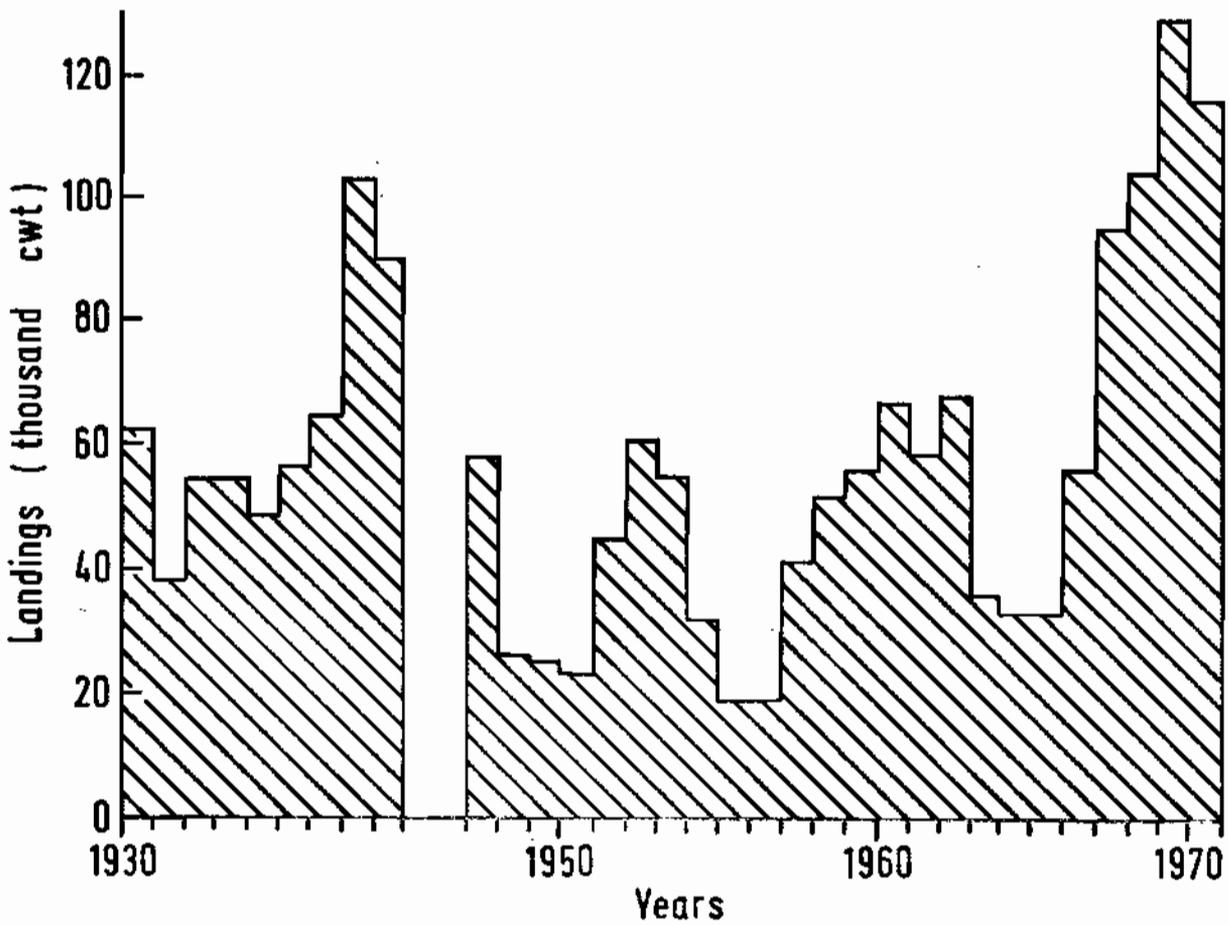
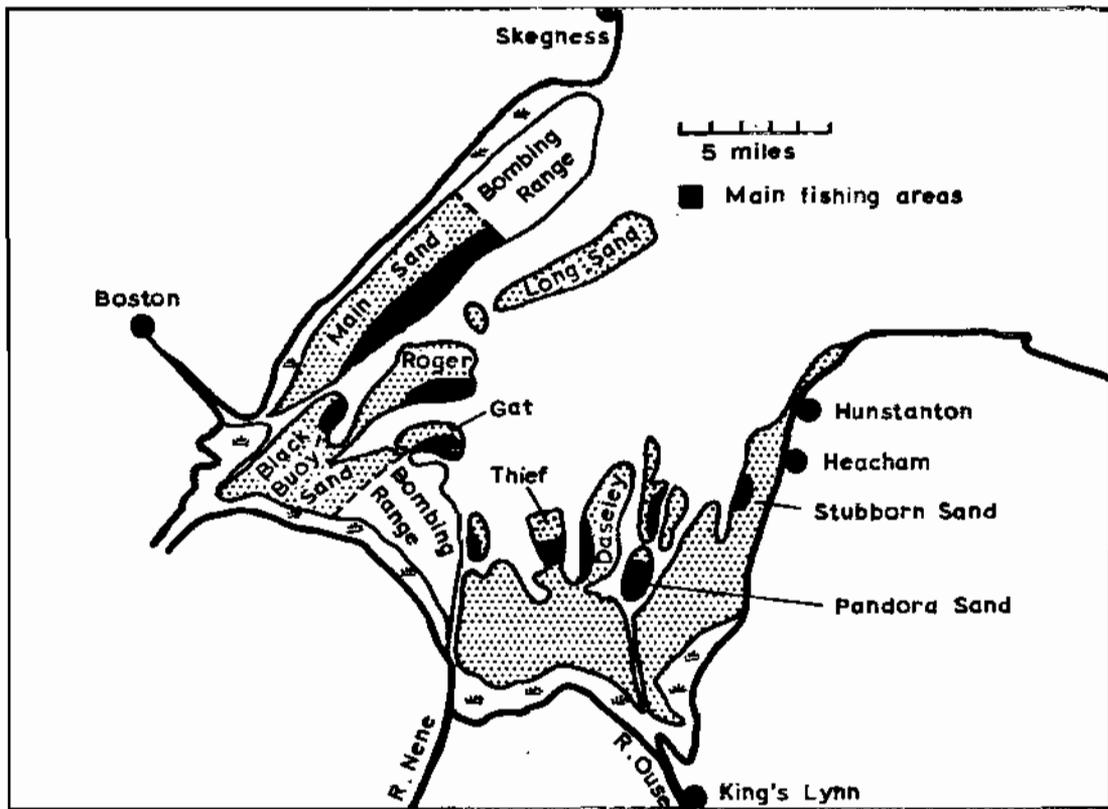


Figure 4 The Wash cockle fishery.



Plate 10 Wash hand gathering.

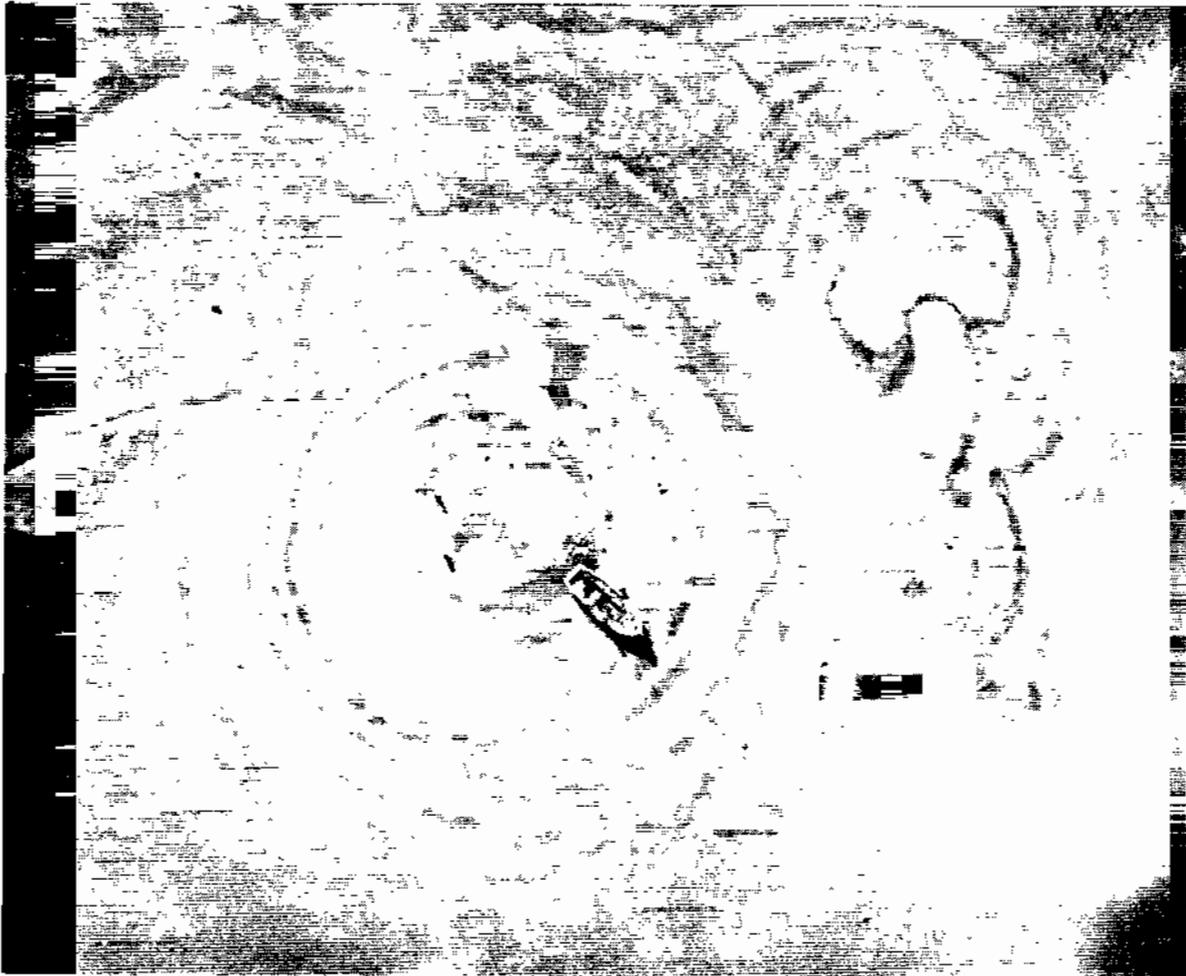


Plate 11 Wash "ploughing-out" rings (aerial photograph).

D The Morecambe Bay fishery

The gear used in this fishery was peculiar to the area. Usually a "craam" was employed; this is a metal three-pronged fork, with a handle about 18 inches in length (see Figure 5). Skilled manipulation of this allows cockles to be fished individually and enables fishermen to exploit cockles in very low densities. Other forms of fishing are restricted by the by-laws of the Lancashire and Western Sea Fisheries Committee (see Appendix I), except between October and March, when a device known as a "jumbo" may be used. This is simply a wooden frame with a base of wood measuring 4 feet 6 inches long, 14 inches wide and 1 inch thick (approximately 137 x 36 x 2.5 cm), which is rocked on the sand as it is drawn forwards. This action liquefies the sand and brings cockles to the surface where they can easily be gathered.

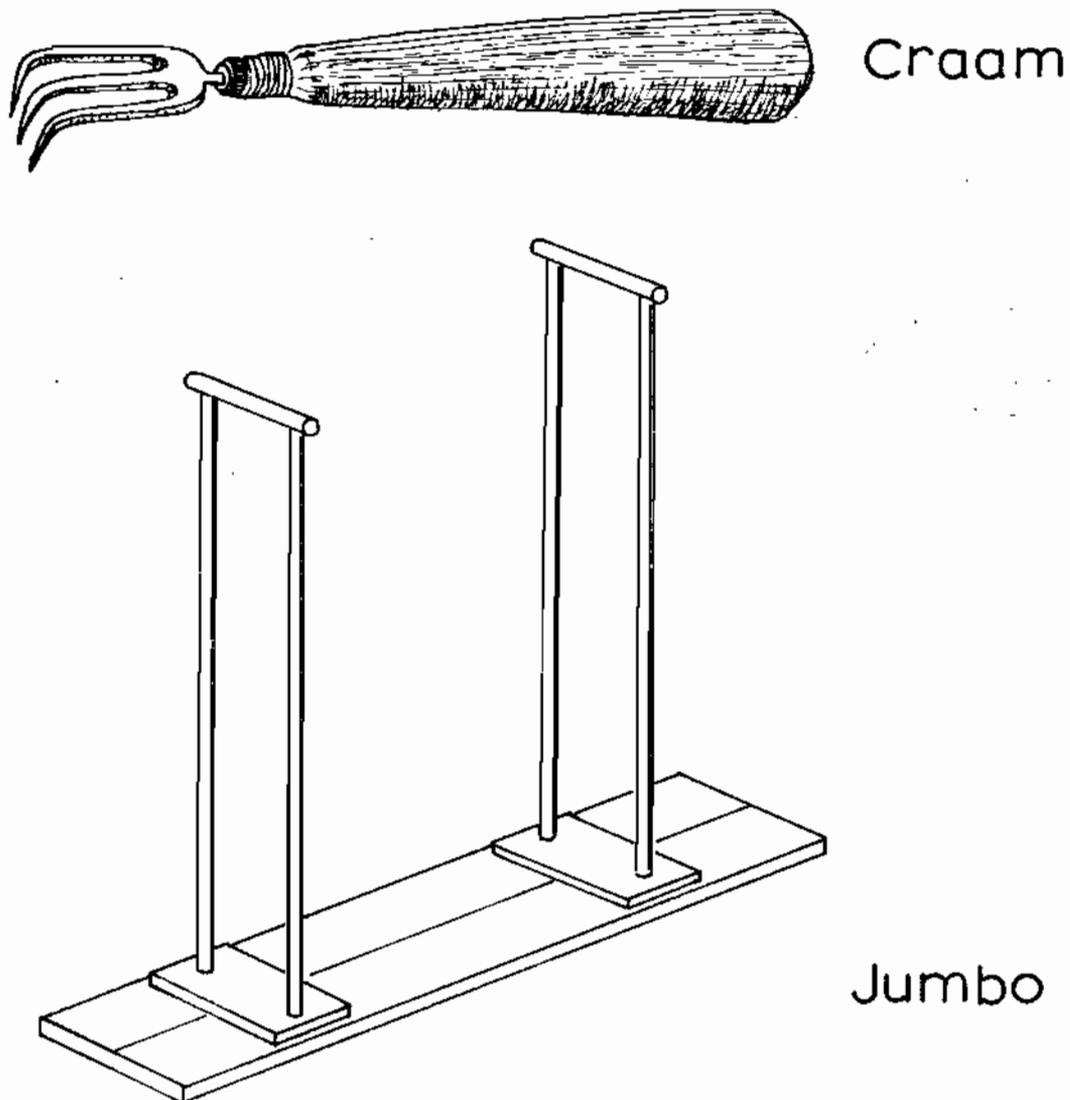


Figure 5 Specialized gear used for cockle fishing in the Morecambe Bay/Wirral areas.

Until very recently, Morecambe Bay was traditionally the site for one of the four main cockle fisheries of England and Wales. As far back as 1877, Buckland and Walpole estimated the annual landings from the Morecambe Bay beds to be almost 80 000 cwt, and Bulstrode calculated that in 1890 over 60 000 cwt of cockles were despatched annually from the main railway station at Cark. He estimated that there were 69 square miles of cockle bed in the Morecambe Bay and Duddon areas.

From these figures, Morecambe Bay was obviously a very important centre for cockling at the turn of the century, but such high landings have not been recorded in more recent times. Accurate records are not available for this particular fishery, but estimated landings have not exceeded 30 000 cwt during the last twenty years; in 1962 around 30 000 cwt were landed, representing just under one-fifth of the total landings for England and Wales in that year. During the following winter large numbers of cockles died or were rendered moribund by the cold. The vast flocks of overwintering oystercatchers, which normally feed on younger cockles in the area, found the gaping adults an easy prey and the cockle population was nearly exterminated. The last few bags of cockles landed commercially were removed from the Morecambe Bay area in March 1963. Unlike the other areas of commercial importance, Morecambe Bay did not receive a good spat-fall after the severe winter of 1962/63, and there has been no recruitment to the fishery to date.

The role of the oystercatcher in this fishery is as important as in South Wales. Although the birds now feed mainly on the mussel beds in the area, most of the cockle spat settling in the last few years have been eaten by the birds long before they have had a chance to reach fishable size. The complete failure of the fishery during the past seven years must be regarded very seriously, and future prospects look bleak.

## PROCESSING AND MARKETING

### (a) Processing

Nearly all the cockles sold in this country are heat processed and the meats are then sold freshly cooked or preserved in some way. The heat processing of cockles is essentially the same throughout England and Wales and has been described in a leaflet issued by the Torry Research Station of the Ministry of Agriculture, Fisheries and Food.

Heat treatment cooks the meats and allows easy separation from the shells. Any form of heat processing may be used, but in areas where the beds are subject to pollution by sewage, the processing methods must conform to the Public Health (Shellfish) Regulations 1934 (Appendix II). All premises used for the processing of cockles or other shellfish intended for sale to the public are subject to the provisions of the Food and Drugs Act 1955 and the Food and Drugs (Food Hygiene) Act 1955. Under these Acts, the premises, the method of processing, and the final product must be approved by the local public health authority after inspection and testing of the final product. Usually the cockles are cooked in a flow of steam under pressure for not less than six minutes (Plate 12). The meats are then washed and sold locally as the freshly-cooked product, or preserved in brine or vinegar for longer-term storage or transport.

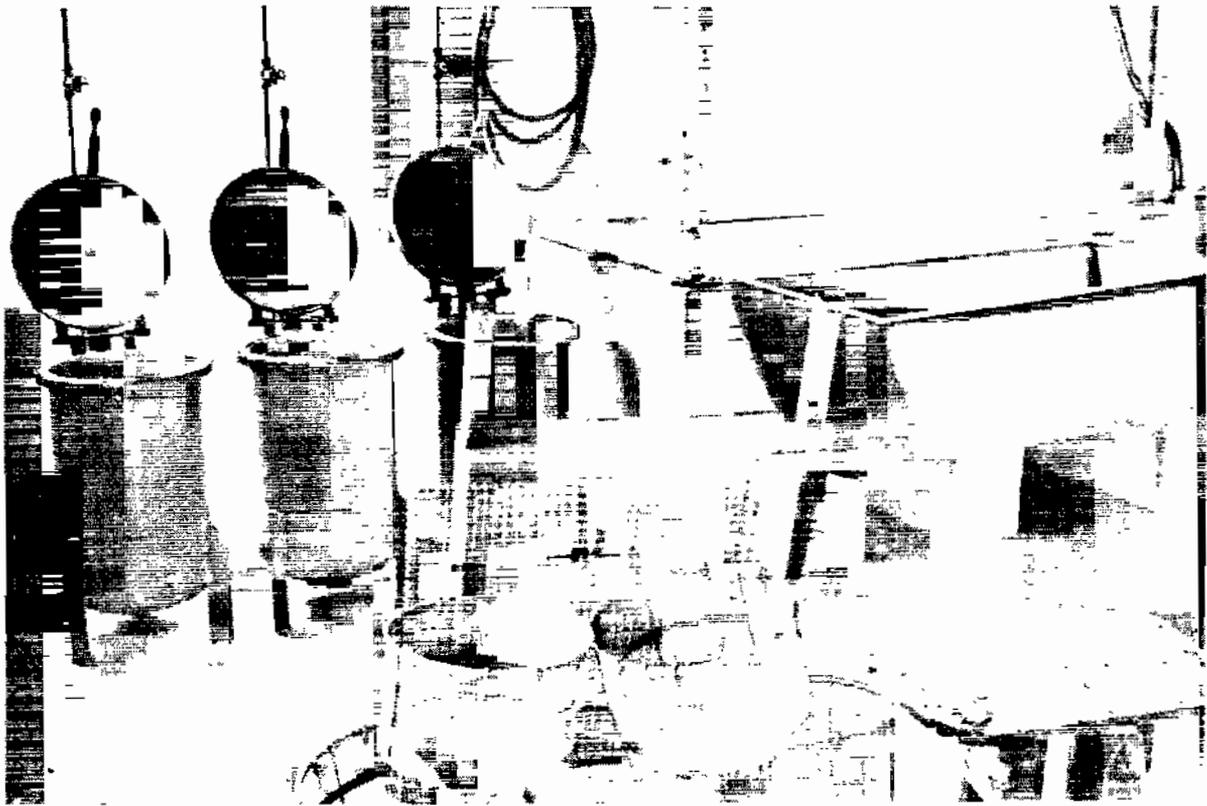


Plate 12 Processing - steam cookers at Leigh.

Despite basic similarities, there are considerable differences in the sophistication of the equipment used for cooking from place to place. At Penclawdd in South Wales there are several fairly large but simple plants, which process the catches of the hundred or so cockle fishermen and women. In a typical plant, cockles are transferred from sacks into circular baskets, which are placed two at a time in a small steamer for six minutes, the shell liquor that is released when the shells open running away through a drain. Each steamer holds about 8 gallons (36 litres), and usually two or three steamers are worked in rotation. After cooking, the cockles are transferred through a hopper into a revolving cylindrical wire-mesh screen. The meats fall through the meshes of the wire into trays, while the shells continue to the lower end of the screen where they fall into a chute leading to the outside of the building (Plate 13). The meats are washed in a series of containers of fresh water to cool them and to remove any grit or shell fragments. Cooked cockles that are not for immediate consumption are preserved in salt.

In the Thames Estuary, processing methods are very similar to those in South Wales, but the men working each of the seven boats have separate small boiling sheds. The cockles are cooked in the same type of steamer, but the meats and shells are separated by rocking a large square hand sieve set on a frame. The meats are soaked in brine if they are to be sent any distance.

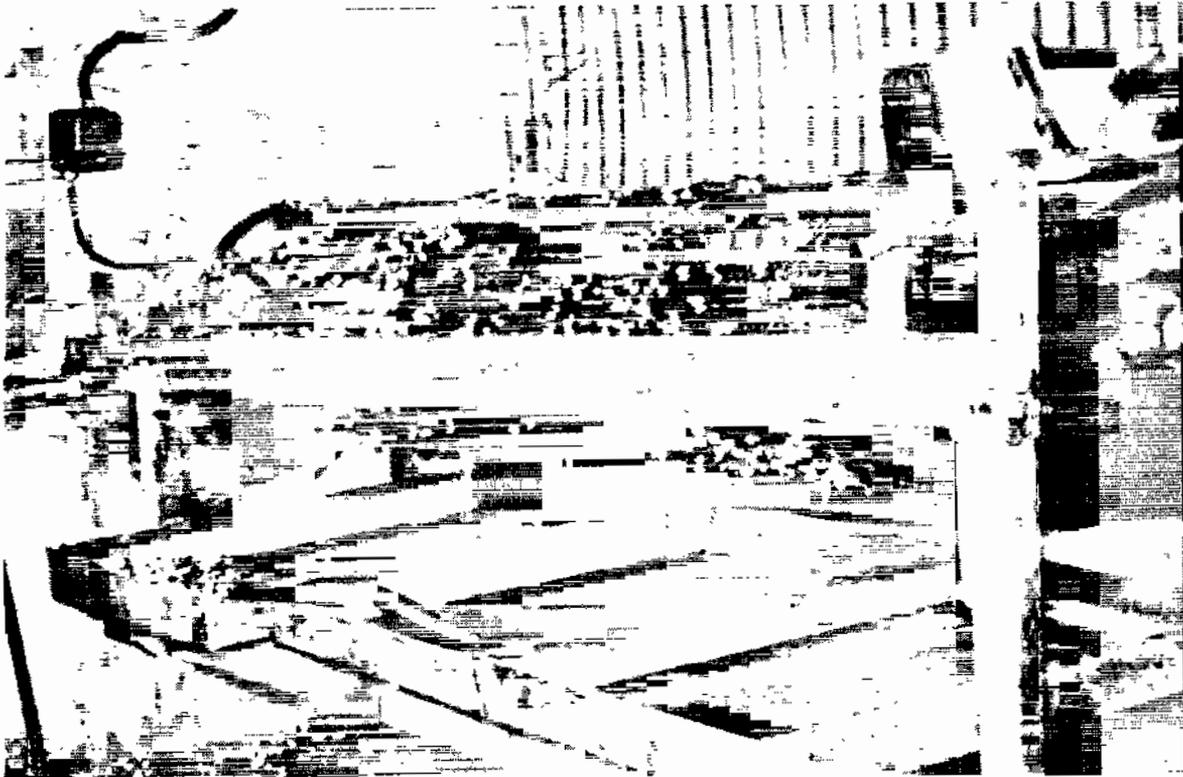


Plate 13 Processing - Welsh revolving screen for separating the meats from shells.

In the Wash, processing is mainly carried out by a few merchants who have large boiling plants (Plates 14 and 15). More sophisticated machinery has been developed here, the impetus for which has probably been the exceptional demand for Wash cockles in the last few years. In the Wash, scientists of the Torry Research Station have advised several merchants on improved methods of handling, and a plant has been designed which uses disinfectant barriers to separate that part of the plant where the cockles arrive and are boiled from the washing and packing area. The main development in handling has been the continuous boiler, two of which have already been installed, one in Boston and another of different design at King's Lynn. Each of these boilers uses a conveyor belt which passes through a vat of boiling water carrying the cockles with it. At Boston, cockles are unloaded straight from heavy duty polythene bags, each holding 6 stones (84 lb or approximately 38 kg) and called a "strike", into a hopper. From the hopper they pass through a preliminary sorting device, which rejects much of the rubbish in the catch, on to the conveyor belt and thence through the vat. Cockles coming out of the vat pass through a second sorting machine, which separates the meats from the shells, the latter being carried directly by conveyor belt out of the plant and on to a lorry for disposal. The meats are washed by hand, but it is expected that this step will be automated in the near future.

Cockle shell is a valuable by-product in the Wash and the Thames Estuary, where it is ground up for poultry grit, or used as a rough base for paths. The sale of the shell can add 10 per cent to the value of the catch, but in recent years the demand has fallen and, in South Wales especially, disposal of the shell presents a problem.



Plate 14 Processing - modern Wash plant - continuous boiler.



Plate 15 Processing - modern Wash plant showing the area where the meats are washed and packed.

(b) Marketing

Each of the main fishing areas has many local outlets and generally supplies the centres of population in the immediate vicinity. The failure of the Morecambe Bay fishery has left the markets in the north-west dependent on the other three fisheries for their supplies. In South Wales, there are considerable local sales in the Welsh valley towns, with large quantities also being sent to Swansea, Cardiff, Bristol, the Midlands and Lancashire. The Thames Estuary fishery, too, has important local markets, especially the seaside trade in the summer, but most of the catch is taken to Billingsgate, which is also the main market for cockles from King's Lynn and in recent years from Boston. This is a result of the unusual demand; the normal markets for Boston cockles are the Midlands and Liverpool.

Large quantities of cockles are normally imported from Holland, but, with the present decline in this fishery, merchants who once depended heavily on Dutch supplies are now buying from the English fisheries.

Cockles are retailed in a variety of ways. In South Wales they are sometimes sold for consumption alive in the shell, but this is now unusual. When presented for local consumption, cockles are often sold as simple boiled meats, either untreated, or, if they are required to keep for several days, packed in salt or in brine. Most, however, undergo a further stage of preservation, the most common of which is pickling in vinegar, though a more modern development is canning in brine. The latter product has a longer shelf-life than the pickled one and has the additional advantage that the cockles can be re-cooked in a variety of ways.

The larger cockle merchants are continually seeking new retail outlets and some have already had considerable success with presentation in small cans and jars, which have been distributed throughout the country by supermarket chains. Some companies have also been successful in exporting cockles to France and Spain.

## CONCLUSIONS

The cockle industry of England and Wales is now based mainly in the Thames Estuary, the Wash and South Wales. Landings from these areas during the past few years, following an initial drop after the 1962/63 severe winter, have risen to a very high level. This has been mainly due to the vast stocks of cockles which resulted from the 1963 spatfall, but another factor has been the great demand for cockles in Britain due to the failure of the Dutch fishery.

Surveys in 1967-68 demonstrated the great abundance of cockles in the main fishery areas at that time (3 million cwt in the Thames Estuary and the Wash alone), but, in the absence of a successful spatfall since then, cockle stocks have been considerably reduced and cannot be expected to sustain heavy fishing for much longer.

The probable fall in the number of cockles available from the major areas may result in the greater utilization of the minor cockle resources present in areas such as the Humber and North Wales, though no large-scale production could be expected from such areas.

Future supplies of cockles from Holland are uncertain, since the 1970 spat-fall was reported to be a failure. Considerable quantities of cockles were sent to Britain from the north of Holland in 1971, but these beds have now been worked out and the boats will have to fish in the south in 1972. The size of the cockle beds in this area is unknown.

The presence of an ever-increasing number of oystercatchers on many of the main cockle beds is a serious threat to production, especially on the west coast. Some form of control of these birds would improve recruitment to the fishable stocks and consistency of supplies.

Although fishing in this country is still carried out in some areas by the old traditional methods, the industry is fast becoming modernized and more efficient, with recent developments in the use of the hydraulic dredge, in processing by the continuous boiler, and in marketing. These developments should enable the industry to respond quickly to the characteristic fluctuations in supply and demand, and thus ensure the efficient utilization of this valuable natural resource.

#### REFERENCES

- BUCKLAND, F. and WALPOLE, S., 1879. Report of the Commissioners for Sea Fisheries on the Sea Fisheries of England and Wales.
- BULSTRODE, H. T., 1911. Shellfish other than Oysters in Relation to Disease. Supplement to the Thirty-ninth Annual Report of the Local Government Board, 1909-10. Command 5313, HMSO, London.
- WRIGHT, F. S., 1927. A report on the cockle beds and the cockle industry of England and Wales. Fishery Invest., Lond., Ser. 2, 9 (5), 45 pp.

**APPENDIX I      By-laws of the Sea Fisheries Committees in relation to  
cockle fishing (made under the Sea Fisheries Regulation  
Act 1966)**

- |   |  |   |
|---|--|---|
| 1 | Northumberland Sea Fisheries Committee<br>Clerk's Office<br>1 Mosley Street<br>Newcastle-upon-Tyne 1 | From the Scottish border to<br>the southern boundary of<br>Northumberland |
|---|--|---|

No by-laws for cockles.

- |   |   |   |
|---|---|---|
| 2 | North Eastern Sea Fisheries Committee<br>County Hall<br>Beverley, Yorkshire | From the southern border of<br>Northumberland to Donna<br>Nook Beacon in Lincolnshire |
|---|---|---|

"No person shall use for the purpose of taking cockles any instrument other than a rake or other like instrument not exceeding twelve inches in length and having spaces of not less than three-quarters of an inch between the teeth."

"No person shall remove from the fishery any cockle which will pass through a gauge having a square opening of thirteen-sixteenths of an inch."

- |   |  |
|---|--|
| Eastern Sea Fisheries Committee<br>Norwich Union House<br>26 Tuesday Market Place<br>King's Lynn<br>Norfolk | From Donna Nook Beacon to<br>the southern boundary of<br>Norfolk |
|---|--|

"No person shall use for the purpose of taking cockles an instrument other than a rake or other like instrument not exceeding 12 inches in length and having spaces of not less than three-quarters of an inch between the teeth, or a hand dredge not exceeding 3 feet in width used when the cockle bed is covered with water otherwise than from a moving vessel."

"No person shall use any method of ploughing or ridging of cockle beds prior to gathering, and for the purposes of this Byelaw it is expressly forbidden:-

- (i) to navigate any vessel round and about over any fishery at such a state of tide that the consequential turbulence will disturb the cockle beds, or
- (ii) to cause the propeller of any vessel to rotate when the vessel is grounded on any cockle bed, or
- (iii) to tow over any cockle bed from any vessel, any plough or instrument other than a trawl."

- 4 Kent and Essex Sea Fisheries Committee From Dovercourt to  
County Hall Dungeness  
Maidstone, Kent

No by-laws for cockles.

- 5 Sussex Sea Fisheries Committee From Dungeness to Hayling  
Lloyds Bank Chambers Island Coastguard Station  
28 Grand Parade  
St. Leonards-on-Sea, Sussex

No by-laws for cockles.

- 6 Southern Sea Fisheries Committee From Hayling Island Coast-  
108 Old Christchurch Road guard Station to the  
Bournemouth, Hants Dorset-Devon border

"No person shall fish for or take from a fishery any cockle between the 1st day of February in any year and the 30th day of April in the same year, both days inclusive."

"No person shall fish for or take from a fishery any cockle except:-

- (a) by hand picking or
- (b) by a rake or other like instrument not exceeding 12 inches in length and having spaces of not less than seven-eighths of an inch between the teeth or
- (c) when the cockle bed is covered with water by
  - (i) a dredge not exceeding 18 inches in width or
  - (ii) a scoop not exceeding 18 inches in width and having spaces of not less than seven-eighths of an inch between the wires forming the bag."

"No person shall remove from a fishery any cockle which will pass through a gauge having a square opening measuring fifteen-sixteenths of an inch along each side thereof."

"Any person who shall use a riddle or other like instrument for the purpose of riddling, sorting or sifting any cockles taken from a fishery shall forthwith spread thinly and evenly upon the cockle bed the riddlings, sortings and siftings arising therefrom."

- 7 Devon Sea Fisheries Committee From the eastern to the  
6 Bedford Street western boundary of Devon  
Exeter, Devon

"No person shall remove from a Fishery any cockle that will pass through the gauge of a riddle or like instrument used for the purpose of riddling, sorting or sifting cockles having an aperture of  $\frac{3}{4}$  of an inch on each of the four sides."

- |   |  |   |
|---|--|---|
| 8 | Cornwall Sea Fisheries Committee<br>County Hall<br>Truro, Cornwall | From Rame Head to the<br>northern boundary of<br>Cornwall |
|---|--|---|

No by-laws for cockles.

- |   |   |   |
|---|---|---|
| 9 | South Wales Sea Fisheries Committee<br>15 The Kingsway<br>Swansea | From Rhymney River,<br>Cardiff to Cemaes Head<br>in Pembrokeshire |
|---|---|---|

"No person shall fish for cockles except:-

- (a) by hand; or
- (b) with a hand-rake or hand-spade; or
- (c) with the written authority of the Committee a dredge or appliance of an approved pattern. "

"No person shall remove from a fishery any cockle that will pass through the gauge of a riddle or like instrument used for the purpose of riddling, sorting or sifting cockles, which has an aperture of  $\frac{3}{4}$  of an inch square, provided that it shall not be an offence under this Byelaw to remove cockles from a fishery in accordance with the written authority of the Clerk to the Committee or as permitted by his appointee present at the time of removal. "

"No person shall cause or permit any mechanically propelled vehicle to stand on or pass over any cockle bed without the written authority of the Committee. "

"No person shall fish for cockles on a Sunday except with the written authority of the Committee. "

"No person shall fish for cockles between half-an-hour after sunset on any day and half-an-hour before sunrise on the following day. "

"No person shall bring cockles ashore from any fishery otherwise than on the day on which they were gathered. "

"No person shall remove more than two cwts. of cockles in any one day from the area regulated by the Burry Inlet Cockle Fishery Order, 1965 except as permitted by the provisions of a licence in that behalf or by the written authority of the Clerk to the Committee or by the appointee of the Clerk present at the time of removal. "

"In the area of the Burry Inlet Cockle Fishery Order 1965 which lies to the east of a line drawn from the eastern bank of the Llanrhidian Pill in the south, true north until it meets the western extremity of the Great Western Dock, Llanelli, in the north, no person who is not the holder of a licence under the Order shall remove from a fishery more than 16 lbs. of cockles in any one day and these cockles shall not be offered for sale or processed for sale. "

10 Lancashire and Western Sea Fisheries  
Committee  
16 Walton's Parade  
Preston, Lancs.

From Haverigg Point in  
Cumberland to Cemaes  
Head in Pembrokeshire

"No person shall fish for cockles, except

- (a) by hand; or
- (b) with a craam, rake or spade.

Provided that between the first day of October and the last day of March following both inclusive, it shall be lawful to use an instrument locally known as a Jumbo not exceeding four feet six inches in length, fourteen inches in width and one inch thickness provided that such instrument shall be constructed entirely of wood and shall not be dragged across the cockle beds or artificially weighted."

(At other times and at certain places this Jumbo can also be used if permission is obtained from the Clerk or the Superintendent of the Fisheries Committee.)

"No person shall remove from a fishery any cockle which will pass through a gauge having a square opening of thirteen-sixteenths of an inch measured across each side of the square."

11 Cumberland Sea Fisheries Committee  
The Courts  
Carlisle

Haverigg Point to Sark Foot  
at the mouth of the River Sark

"No person shall remove from a fishery any cockle which will pass through a gauge having a square aperture with a side of three quarters of an inch."

## APPENDIX II Public Health Regulations related to cockle processing

Areas and dates where orders have been made under the various public health regulations, in which the treatment of cockles is mentioned, are listed below:

Abergele 1944	Llanelli 1959
Alnwick 1947	London (Port of) 1936 and 1957
Barrow-in-Furness 1947	Medway 1936
Beaumaris 1948	Newhaven 1941
Blythe 1947	Pegwell Bay 1925
Brightlingsea 1933	Plymouth 1937
Chailey, Sussex 1948	Portsmouth 1918
Cowes 1923	Redcar 1946
Dalton-in-Furness 1943	Rhyl 1944
Exeter 1939	Saltburn 1946
Faversham 1920	Seaford 1934
Gosport 1954	Shoreham 1916
Kingsbridge and Salcombe 1934	Southampton 1953
King's Lynn 1952	Tees Port Authority 1932
Lancaster 1918	Truro 1949
Liverpool 1951	Weymouth 1922

The order made by the Rural District Council of Alnwick, under the Public Health (Shell-fish) Regulations, 1934, is given in full as a typical example of wording and content.

### Public Health (Shell-fish) Regulations, 1934

Order made by the Rural District Council of Alnwick

In pursuance of the powers conferred on them by the Public Health (Shell-fish) Regulations, 1934, the Rural District Council of Alnwick hereby make the following Order:-

- 1 In this Order, "prescribed area" means:-  
  
River Coquet mid-way between Amble and Warkworth on the South Bank of the River (Tidal Water),  
  
River Coquet North Bank at Helsay Point, Warkworth (Tidal Water), and Silver Carrs, immediately south of Low Hauxley [near Low Hauxley (near Low Water Mark)].
- 2 A person shall not sell, or expose or distribute or offer for sale, or have in his possession for the purpose of sale for human consumption, any shell-fish taken from within the prescribed area, unless such shell-fish have been -
  - (i) subjected to a satisfactory process of cleansing at an establishment which is for the time being approved by the Minister of Health for the purpose, or

- (ii) relaid in pure water for such period and in such places as may from time to time be approved for the purpose by the said Council, or
  - (iii) subjected to a process of sterilisation by steam under pressure for at least six minutes in an apparatus which is for the time being approved by the said Council.
- 3 This Order shall come into operation on the 21st day of February, 1947.

GIVEN under the Common Seal of the Alnwick Rural District Council this 27th day of January, 1947.

L. S.

(Sgnd.) J. M. Craster.  
Chairman.

(Sgnd.) Richard Rothwell.  
Clerk.

## LABORATORY LEAFLETS (NEW SERIES)

- No. 1 Newfoundland Fishing. December 1962.
- No. 2 Spotlight on the American Whelk Tingle. December 1962.
- No. 3 Yorkshire Crab Investigations 1962. May 1963.
- No. 4 Trawling Prospects off West Norway. September 1963.
- No. 5 Notes on Escallops, and Details of the Baird Sledge Dredge and its Handling. February 1965.
- No. 6 Studies with the Woodhead Sea-Bed Drifter in the Southern North Sea. February 1965.
- No. 7 The West Greenland Cod Fishery. March 1965.
- No. 8 Future Prospects in the Distant-Water Fisheries. May 1965.
- No. 9 The Cornish Pilchard and its Fishery. December 1965.
- No. 10 Protecting British Shell Fisheries. April 1966.
- No. 11 North Sea Plaice Stocks. April 1966.
- No. 12 The Norfolk Crab Fishery. July 1966.
- No. 13 Lobster Storage and Shellfish Purification. August 1966.
- No. 14 Tuna Fishing. October 1966.
- No. 15 Whelks. January 1967.
- No. 16 Spurdogs. May 1967.
- No. 17 Yorkshire Crab Stocks. September 1967.
- No. 18 The Torrey Canyon Disaster and Fisheries. February 1968.
- No. 19 Oyster Pests and their Control. May 1969.
- No. 20 The Production of Clean Shellfish. September 1969.
- No. 21 Fishing for Sandeels. March 1970.
- No. 22 Cornish Crawfish Investigations. March 1971.
- No. 23 Mackerel of the South-West. April 1971.
- No. 24 Marine Fish Farming. January 1972.
- No. 25 Genetics and Fish Farming. March 1972.
- No. 26 The Cockle and its Fisheries. April 1972.
- No. 27 The Status and Potential of Prawn Culture in the United Kingdom.  
(In preparation.)

### NOTE

Although the complete list of Laboratory Leaflets is given to show the scope of the series, it will be appreciated that many of these leaflets are topical and therefore of interest chiefly at the time when they are written. For this reason most of the earlier ones are being allowed to go out of print when present stocks are exhausted; few copies are available of those prior to No. 13.