Handbook for Oyster-Farmers

DIVISION OF FISHERIES CIRCULAR NO. 3

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION AUSTRALIA

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THIS HANDBOOK HAS BEEN written by Mr. J. M. Thomson, of the C.S.I.R.O. Division of Fisheries, as a guide to oyster-farming, primarily for oyster-men in the less industrially developed States. The only previous guides to Australian oyster-farming methods are articles in the "Fisheries Newsletter" and a booklet by Mr. T. C. Roughley, "Oyster Culture on the George's River, New South Wales", published in 1922. Many methods mentioned in the latter have subsequently been amended in the light of industrial experience.

As conditions vary from place to place and only experience can decide what problems are peculiar to any particular ground, this handbook cannot answer all the problems that confront the beginner. Local oyster-men and State Fisheries Department officers can give advice on local peculiarities, and any persistent difficulties may be referred to the Chief, Division of Fisheries, C.S.I.R.O., Marine Biological Laboratory, Cronulla, N.S.W.

The handbook opens with a description of the oyster as an animal. Then each phase of oyster-farming, from the selection of grounds to the harvesting and marketing of oysters, is discussed. Methods of cultivation are described, and after a section on the diseases and pests of oysters and a description of the equipment necessary for oyster-farming, the handbook concludes with a glossary.

C.S.I.R.O.
DIVISION OF FISHERIES
CIRCULAR No. 3

HOBART

Handbook for Oyster-Farmers

THE OYSTER INDUSTRY in Australia varies greatly in the stage of development attained in different States. There is a complete range in cultural practices from the primitive harvesting of natural oyster-beds to complex farming methods. Wherever the simple picking over of natural reefs has been adopted, resources have slowly dwindled and even prolonged resting has failed to restore the former number of oysters. On the other hand, where oyster-farming has been undertaken, resources have been conserved and despite higher initial outlay the profits are greater than those obtained by picking over natural reefs.

The gathering and marketing of oysters began in Australia soon after settlement took place. With the increasing demand which followed the continual growth of the population the natural oyster-beds along the southern, south-western, and eastern coasts were rapidly depleted. By 1870 restrictive legislation had been passed in New South Wales to prevent harvesting in the more seriously depleted waters for a period of years. By the end of the nineteenth century, however, the industry in New South Wales had been developed into a big business by the adoption of cultivation methods which were forced on the industry as a means of combating the prevalent worm disease.

Although the governments concerned did attempt to demonstrate the value of farming, in general the oyster-men in the other States waited for the natural beds to recover and then stripped them once more, thus providing a low-level, fluctuating industry. In more recent years interest has been displayed in these States in oyster-farming methods.

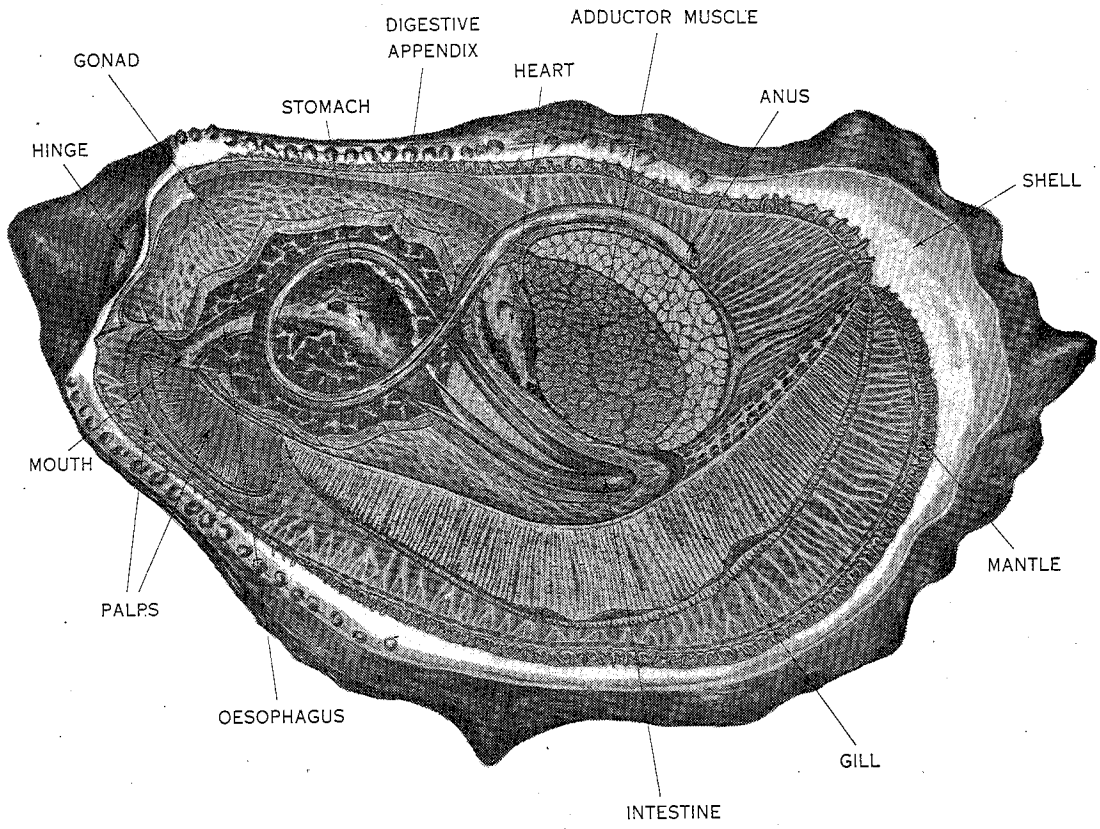
Not enough oysters are produced in Australia to cope with the home demand. Test shipments sent overseas, particularly to Singapore and Great Britain, show that a large overseas market could be built up.

Most of the grounds in the better-favoured estuaries of New South Wales have been taken up except those which are reserved as hauling grounds for net fishermen. Better use could be made of many of the beds. More intensive cultivation seems to be the only way in which the New South Wales industry can continue to expand. In Queensland, northern Western Australia, and Tasmania, many areas are suitable for oyster cultivation and could be farmed profitably.

Oyster-farming is a full-time job in which constant inspection and maintenance of beds will bring results. Elimination of waste by careful culling and the use of all trailings can lead to greater efficiency and bigger profits.

THE OYSTER AS AN ANIMAL

The oyster is an animal. It sleeps, breathes, eats, and produces young as do all creatures. The succulent meat within its hard shell is alive, the shell itself is only a by-product.



GENERAL ANATOMY OF THE OYSTER

The oyster is shown lying on its upper shell, with its left mantle and left outer palp cut away. Along the lower edge the mantle is against the shell and is covered in part by the gill and towards the hinge by the labial palps, which lead to the mouth. From the mouth a short oesophagus leads to the stomach, on either side of which lies the digestive appendix. From the stomach the intestine leads in a double loop to the anus, which is situated above the adductor muscle. The heart is between the intestine and the adductor muscle. The gonad is near the hinge and is shown here partly cut away.

THE HARD, STONE-LIKE SHELL OF THE OYSTER is, as it appears, dead matter, though with a thin, branching meshwork of living material through it during life. It is the succulent meat within that lives. The shell is a by-product of the oyster's activity. The body is attached to the shell only in the region of the large white muscle, which has to be cut to remove the animal from its shell.

This muscle is the most solid part of the oyster's flesh. Its round white shape is the most obviously differentiated portion of the meat. When first opened, the bulk of the oyster appears to be a plain white bag. This is the outer covering, known as the mantle, which surrounds the rest of the body like a cloak. The mantle has another important use. The shell is secreted from special glands on the edge of the mantle. Between the two sides of the mantle lies the main body. If a flap of the mantle is turned back the most obvious feature of the oyster's anatomy is the set of gills, often referred to as the beard. In appearance the gills are like a close-knit lattice or sieve. In effect that is what they are, for besides acting as gills for breathing they also strain out minute particles of plant and animal life from the water entering the shells.

The gills themselves provide the motive power for this food- and oxygen-bearing stream. All along the bars of the sieve are minute hairs called "cilia", which, beating oar-like in unison, pull the water into the shell, which is allowed to gape slightly for the purpose. The water is then pushed through the sieve of the gills and out at the farther side of the shells.

The food particles sieved out on the gills are pushed back by other cilia towards the mouth, which lies near the hinge of the shell. The mouth leads to an alimentary canal which has a slightly enlarged "stomach". On each side of the stomach there opens a kind of appendix in which the food is actually ingested. Waste material re-enters the stomach and continues down the intestine. The faecal matter is discharged from an anus close to the muscle mass on the side opposite the gills and is then removed from the shell by the water current expelled by the gills.

The oyster has a heart and a blood-stream. The heart may often be seen beating just behind the muscle but the blood is colourless so that the blood system is not obvious. There is even a nervous system. The brain is very primitive, being little more than a slight concentration of nerve-cells at one point along the central nerve-chain. The sedentary oyster safely enclosed in his rocky home has no need of the sharp senses required by more active and unprotected creatures.

At particular times of the year when food is abundant and when the temperature has reached a certain level, the oysters spawn *en masse*. The fortunate observer will see streams of milky white clouding the water over the oyster-beds. The gonads (the reproductory glands) penetrate all over the body and when ready for spawning give that white fullness which is known as "condition". After spawning, the gonad is shrunken and watery, and the oyster looks dark and is in poor condition.

Fertilization is effected in the water. Then for a brief two or three weeks the oyster is an animal free to move around. It is a minute creature visible only under a microscope. Gradually a shell forms and the animal is ready to settle down to its sedentary stay-at-home life. A clean, granular surface is required for successful settlement and if such a surface is not found the oyster is doomed and will die.

Oyster mortality rate is high, particularly during larval life and just after settlement. How long an oyster may live is uncertain but oysters have been known to reach 10 years of age.

The knowledge that the oyster is an animal, with the usual functions of an animal, should give a better understanding to the oyster-man of the origin of many of his problems. Oysters cannot be treated as growing pieces of rock.

GENERAL CONSIDERATIONS FOR

SELECTION OF GROUND

To some extent the type of ground desired depends upon which particular method of oyster-farming is to be adopted, but in general the following points are important:

- The beds should not be exposed to heavy wash, to gale-driven waves, or to strong flooding.
- The beds should not be built on pure sand.
- The best feeding-grounds are those on a mud-sand mixture with rather more mud than sand.
- Although there are many leases which both catch and grow oysters well, in general the best catching areas are towards the mouths of rivers and bays, whereas the best growing grounds are higher up the bays and estuaries in places where occasional freshets will reach them.
- The absence of natural oysters from an area does not necessarily mean that oysters will not thrive there. There may be no naturally occurring solid material for the young oysters to settle upon.
- Convenience of access is important. Time spent in reaching remote beds means less economic production. On the other hand, beds that are too easily reached may receive attention from professional or amateur oyster thieves. If the owner cannot live within sight of his oyster-beds it is desirable to have the cooperation of some nearby resident in protecting the area from pilfering.
- Nearby sewerage or industrial discharges will make oysters unfit for eating, so the adjacent area should be carefully inspected and information on such discharges obtained from the nearest Shire or Town Council offices before a site is selected.
- Certain areas are proclaimed public oyster-beds. To save time and disappointment the local inspector of fisheries or the Head Office of the Department of Fisheries should be consulted as to the location of these beds.

CATCHING LEVELS AND GROWING LEVELS

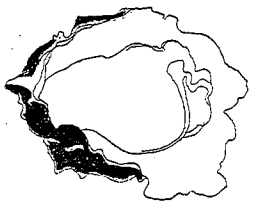
A fairly reliable guide to the best catching and growing levels is provided by naturally caught spat in the vicinity; usually the catching level is at about mid-tide mark. In many cases the growing level is the same but it is noteworthy that in Queensland, where the tidal range is greater than in New South Wales and the oysters are thus exposed to a hot sun for considerable periods, the best growing level is nearer low-tide mark, about three or four inches off the bottom or somewhat more if the bottom is of very soft mud.

SPAT COLLECTION

The oyster-farmer is well advised to catch his own spat where possible. The method adopted depends upon the type of subsequent cultivation which it is desired to carry on and upon such economic factors as the local abundance and price of materials. However, the following points are noteworthy:

- The surface of the catching material (or cultch) should be finely roughened, free from slime, and without secretions such as gums and resins which may be repugnant to the oysters.
- The cultch must retain the oysters until maturity or until they have grown to such a size that they can be transferred safely to shell beds or trays.
- The cultch itself must not break up under wave action or attack from boring organisms such as cobra (shipworm).
- When the oysters are to be harvested they must be separable from the cultch without being broken open.

OYSTER-FARMER



• The cultch material does not necessarily have to be close beside the parent oysters. The young oysters drift freely in the water for 10 days or more after spawning before settling down as spat. In newly-developed areas some idea of likely collecting spots may be obtained by examining natural cultch such as shells, stones, sticks, or mangrove roots for spat. Many areas of cultchless flats can, however, be used and may be tested by placing out small quantities of cultch before investing in commercial amounts of material.

• The cultch material is best set out not long before a catch may be expected. Local experience will indicate the likely times but in general there are two periods of particularly heavy falls of oyster spat, one in early summer (October-November) and one in autumn (April-May). In more northerly waters there is some spat-fall all the year but even in southern Queensland there are still restricted periods in spring and autumn when the spat-fall is greater than at other times. On the other hand, further south, as in Tasmania, there may be only one major spawning in mid summer.

• A local stock of parent oysters, whether natural or cultivated, is necessary. Few spawn will drift from one river to another.

• In the best of situations there are disappointing years when the catch is negligible. This may be caused by unusual cold, lack of food, floods immediately after spawning, or other natural phenomena.

• A poor catch may be supplemented from other sources. Some oyster-men catch oysters only to supply spat to growers. In most estuaries the natural catch on public oyster reserves or other forbidden areas, such as the retaining walls of harbours, becomes particularly heavy. In such circumstances the local inspector of fisheries generally has authority to sell off the surplus spat and the culture (i.e. the small oysters larger than the spat stage). When purchasing culture it is advisable to reject the stunted, sun-bleached oysters with many growth ridges as these are generally very old and, having lived under bad conditions for so long, do not grow fast even when set out in favourable circumstances.

GROWING OYSTERS

The important point in growing oysters is to keep the oysters separated so as to permit fast growth and a good shape. Regular inspection is essential so that any clumps may be culled out. Culling consists of separating any oysters which may have grown together in clumps and removing the young spat which may have settled on the older oysters, as well as any overgrowths such as sea squirts and anemones. It is inevitable that most of the young spat is killed during culling, but it is better to lose these than to allow them to grow and distort or smother the larger oysters upon which they have settled.

Regular inspection of the oyster-beds is necessary to detect the presence of pests or signs of collapse in the materials supporting the oysters and to recover the oysters which may have fallen to the bottom and be in danger of smothering.

The time taken for an oyster to reach marketable size varies from place to place, but along the New South Wales coast the average period is three years. Consequently for economic operation an oyster-farm should be divided into three sections to accommodate oysters of three different year-groups.

FERTILIZATION OF THE BEDS

A comparatively new technique which has had some success involves the fertilization of the bottom muds on leases. The mixture which has given satisfaction is a combination of

superphosphate and linseed oil meal in equal proportions, applied at the rate of 15 pounds per 100 square yards. The fertilizer may be broadcast over the mud and turned in by forking during low water, but it is probably more satisfactory to enclose the mixture in tins with perforated sides and to bury these in the mud so that the tops are just exposed. From the tins the fertilizer will slowly leach out into the mud. Recharging the tins two or three times a year is necessary.

The result of fertilizing is to increase growth, to bring the meats into condition earlier, and to hold the condition at a higher level than that reached by oysters on unfertilized areas. The method is particularly effective in semi-enclosed backwaters where a more perfect tidal oscillation occurs.

MARKETING OYSTERS

Oysters may be marketed in the shell or bottled. The best-quality oysters are sold in the shell; the bottled oyster trade depends upon the smaller or misshapen oysters, which are termed "seconds" as distinct from "firsts" of good quality.

Oysters of good quality have a ready market at all times and realize the best prices. Oyster quality is judged upon the shape of the shell and upon the condition of the meat. The most favoured oysters have deep, cup-shaped shells. An oyster in good condition has the meat white and fat. An oyster in poor condition is thin and dark in colour, with prominent "veins" or channels visible in the meat. Such oysters are in disfavour with the consumer and should not be marketed.

Some oysters seem to hold their condition longer than others. However, it should be realized that there would be no spat if the oysters never lost condition, as the "fat" consists mainly of the reproductive products and the loss of condition is the result of the act of spawning. The rapidity with which oysters regain their condition after spawning varies from place to place and at any place from time to time, in correlation with the abundance of food. The majority of the oysters on a bed spawn at the same time so that a small sample is sufficient to show whether the oysters are in condition.

Before being marketed, the oysters must be cleaned by the removal of weeds, limpets, sea squirts, and other marine growths and culled out so as to separate the marketable-sized oysters from seconds and from spat and dead shell. The ideal for the trade in oysters in the shell is a pack of single oysters.

Dead or weak oysters should not be packed, as the resulting smell is disagreeable to the customer and to all who handle the containers. The dead oysters are easily picked out during culling as they give a hollow sound when tapped with the culling iron.

The sale of oysters in bottles is generally not as profitable as the sale of oysters in the shell, and takes up more time for the producer. However, it is a good outlet for the poorer oysters which may be misshapen and yet contain good meats.

The oysters are shucked (i.e. opened) by holding them in one hand and with the other forcing a specially made oyster-knife between the shells, usually at the thin end or lip of the shell, though with the right technique the oyster may be opened from the hinge end with less damage to the shell. Once the shell is forced open the large white muscle joining the two shells is cut in each side against the shell and the meat can then be lifted free.

The meats should be drained and washed quickly in fresh water to remove adhering pieces of shell and dirt. It is common practice to transfer the meats directly to the bottles after shucking, but this is unhygienic and is the cause of the rapid loss of quality in many bottled oysters. The standard oyster bottle of New South Wales usually holds a dozen oysters. No standard container exists in other States.

Each State has regulations concerning the method of marketing oysters. Regulations exist to control the size of containers, the branding or marking of containers, and the minimum size at which oysters may be marketed. The Fisheries Department of the State concerned should be consulted on these points.

The handling of oysters, particularly the bottling process, is also subject to the regulations of the State Departments of Health. These relate principally to the cleanliness of the operators and of the premises used. Other regulations govern the type of vessel in which the bottles and other containers may be washed. It is an offence to take oysters from an area which has been declared contaminated by sewage or industrial wastes.

METHODS OF CULTIVATION

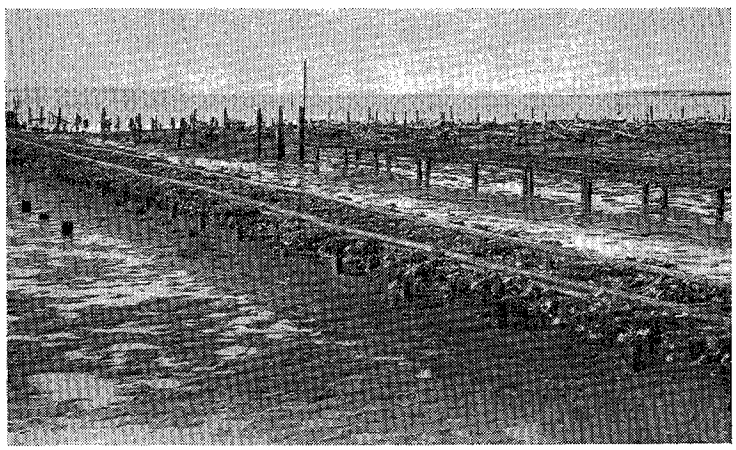
In general, it may be said that there are three types of oyster-bed: those where the oysters lie on the sea bottom, whether intertidally or completely submerged; those where the oysters are caught and grown on a fixed base; and those where the oysters are caught and grown on a movable base. Material which is set out for oysters to settle on is called "cultch". A better catch is likely from cultch deliberately set out than from natural cultch as the latter is easily fouled and is scattered. Movable cultch materials have the advantage of being readily handled and can be transferred with little trouble from one bed to another, but fixed cultch is less likely to be affected by gales and floods.

Stick Cultivation

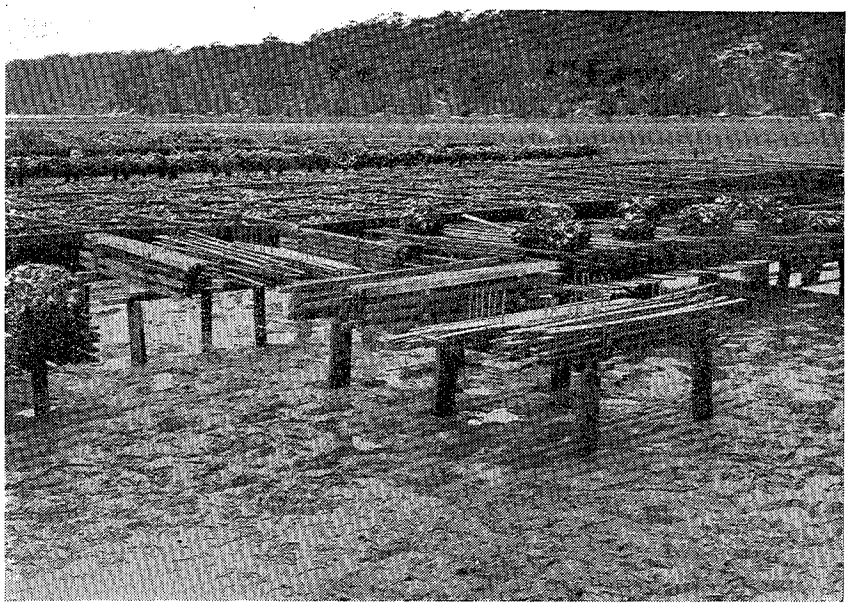
UNDER THIS HEADING MAY BE INCLUDED A number of materials which are all treated in the same general way, although the details of setting out and handling may differ owing to the peculiar properties of the material.

CATCHING

The sticks are set out on racks consisting of parallel runners of two inch by one inch hardwood held at the catching level by two inch by two inch uprights stuck in the bottom mud. The distance between the runners depends upon the length of the sticks used, but usually is from two to three feet. In sheltered areas the sticks may be simply set out on racks, but in more exposed situations where wash may be expected the sticks may have to be wired on to the racks or held down by large stones put on top to weight them. To protect the newly settled spat from marauding fish such as bream, it is necessary to set the sticks out in bundles or batteries. This method is



Black mangrove sticks depoted in foreground; tarred timber battens nailed out in mid background.



Typical zostera mud-flat with several types of cultch in view. In the foreground are fibro-cement slats; in the middle distance are frames of tarred timber battens weighted down by rocks. Behind these are wire trays holding shell cultch and in the background are bundles of black mangrove sticks on racks.

also economical of space. The best catches are obtained by keeping the sticks as close as possible, say half an inch apart.

The principal sticks used are the black mangrove, the orange mangrove, black wattle, white cypress, swamp oak, and jarrah; also used are tarred sawn timber slats, fibro-cement slats, metal rods, and brushwood of various kinds. Other timbers have proved to be objectionable for one reason or another. For setting out, the mangrove sticks and other natural timbers which are not too straight may be tied in bundles of from 10 to 20 sticks by heavy-gauge galvanized wire. Sawn timber slats are best nailed in a framework where one-inch battens are nailed six inches apart on two cross battens and then piled in a battery so that the battens of one frame fit between those of the frame beneath. They are then tarred and left to weather for a week or two before setting out.

Fibro-cement slats are also set out in batteries. The slats can be kept in place by boring holes through the ends and threading them on dowels which are set in the frame of the racks, each layer of slats being kept apart by a slat set at right angles. A battery five layers high is a useful size.

Metal rods and bars, particularly electrical conduit and well-rusted rods, may be set out in batteries which are wired together.

All these sticks can be set out in other fashions, for example either vertically or at an angle, stuck in the bottom or piled in stooks. But these methods are not recommended, since a portion of the cultch is buried in the bottom, the sticks stretch over a great depth of water, and usually only a section catches well; furthermore, being in direct contact with the bottom they are easily accessible to pests of various kinds.

DEPOTING

If the sticks catch well during the spring, the oysters may be large enough for the sticks to be nailed out the following autumn. If the heavy catch does not occur until mid summer or later, the oysters will be too small to expose with safety and it will be necessary to resort to depoting, which consists of leav-

ing the sticks in bundles but transferring them to growing areas. Depoting can be avoided and the sticks nailed out immediately if the area can be fenced in by wire netting to exclude the fish from the beds. Sticks can be moved for depoting within two to three months after catching, but the spat is very delicate at this stage and the sticks should be handled carefully and kept from any unnecessary jarring.

NAILING OUT

Some months after depoting, generally in the following autumn, when the oysters are judged to be strongly shelled enough to withstand the onslaughts of the bream, the sticks are nailed out singly on racks of the type used for holding the bundles for catching. A distance of six inches between sticks is suitable.

The tarred sawn timber battens can be rapidly and easily nailed out in their frames, up to a dozen battens being nailed out in one operation.

When the oysters are carried right through to market size on the sticks, the sticks must be removed from the rack for culling. As they are pulled off, a certain number of oysters will fall. To make the task of retrieving them as light as possible a small punt may be pushed along under the rack to catch the dislodged oysters. The sticks are taken in oyster-punts to the depot to be culled for market.

It is not essential to take the oysters right through to market size on the sticks, though it is probably more economical to do so. But where the cobra, or shipworm, is bad the sticks may collapse before the three or four years' growing period is over. However, the oysters will have grown to such an extent that they can be safely transferred either to shell beds or to trays. In any event it is recommended that some trays be used in conjunction with sticks, as inevitably some of the sticks will collapse and the fallen oysters may be saved by lifting them from the bottom on to trays or alternatively by putting them on a shell bed.

One of the qualities necessary in the sticks is that the oysters should be readily removable from them on maturity. Oysters are easily culled off mangrove sticks and rusty iron. Off tarred battens and other sticks they come rather less readily, so that a somewhat greater proportion is damaged during removal. However, the number is not large enough to cause a serious loss.

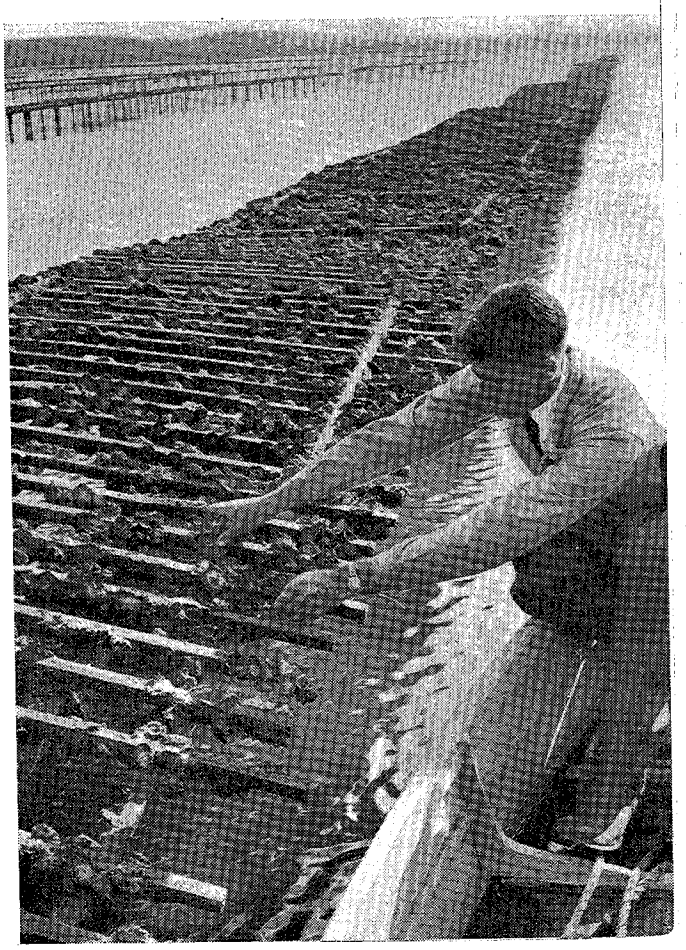
ADVANTAGES

- One form or another of this type of cultch is readily obtainable.
- Sticks are easily moved.
- Sticks catch well.
- Sticks retain the oysters till maturity.
- The oysters are easily culled off.

DISADVANTAGES

- The method requires time, labour, and material for building racks and bundling the sticks.
- Timber is subject to attack from cobra and borers and so needs replacing regularly.

Tarred timber battens with catch of oysters ready for harvesting.



Tray Cultivation

THE PRINCIPLE OF TRAY CULTIVATION IS TO lift the oysters above the bottom, where they are most susceptible to attack from various pests and to smothering by silt deposition or by movement of sand. It is generally acknowledged that tray oysters are of the best shape and quality.

The tray method is used in conjunction with one or other of the various cultch methods to obtain the spat. Generally the oysters are held in the trays for only nine months or so before marketing so that they are in a fairly advanced state of growth when they are put out on the trays. These oysters ("culture") may be obtained from a number of sources, including the trailings, sticks, stones, and other trays; also from sea walls, mangrove roots, and shell beds.

CONSTRUCTION OF THE TRAYS

The trays may be made of various sizes, but experience has shown that trays 9 feet by 3 feet are convenient to handle; 3 inch by 1 inch timber is generally used, though in some places 2 inch by 1 inch is used with success. The trays are best made up on a work bench specially constructed for the purpose. The work bench should be blocked with care so that the trays can be formed into the correct rectangular shape rapidly and easily. If the trays are knocked together haphazardly many will be askew and the wire netting will not cover them properly. Each tray requires two pieces of timber 9 feet long, two pieces 3 feet $1\frac{1}{2}$ inches long for the ends, and two pieces 3 feet long for the "spreaders" in the centre.

The two end pieces are nailed by $2\frac{1}{2}$-inch (11 gauge) nails to the ends of the 9-foot lengths so that they overlap the ends of the longer pieces.

The wire netting should be of the mesh best suited for the size of the "culture" being put out ($\frac{1}{2}$ to $1\frac{1}{4}$ inch, but usually $\frac{3}{4}$ inch) and of the heaviest gauge obtainable. It is best handled by being put on a roller attached to the end of the work bench so that it can be drawn over to cover the frame of the tray. The wire is attached to the frame at the stage mentioned above, using $\frac{1}{2}$-inch galvanized staples. Then the tray is turned over and the 3-foot spreaders are put in approximately 3 feet from each end. As they are inserted the two side pieces are forced apart and the wire netting is pulled taut. The wire is then stapled to the spreaders. By this means a three-compartmented tray is produced which is strong and taut-bottomed so that the wire does not sag and thus allow the oysters to collect in a heap.

TARRING

After construction the trays need tarring to ensure long life. The tarring protects the timber from cobra and borers and also seals over the wire, delaying rusting. Cold or hot tar may be applied. It is claimed for cold tar that it seals the wire better where the meshes twist. On the other hand, the hot tar penetrates the wood better. The cold tar can be applied by a brush, but a tarring tank where the trays may be dipped gives better results, and is essential for hot tar.

The tarring tank should be of a size such that the trays fit in easily, with a few inches to spare all round. Black sheet iron is the best material with which to build it. The tray must be set on bricks, or elevated by some other method so that a fire can be built underneath to heat the tar; better still is an electrically-heated tar vat. The trays should be swung up by block and tackle and lowered into the tank. They should be left in the hot tar for only a minute or so. A still more protective mixture may be made by dissolving a pound of copper oleate in half a gallon of kerosene and mixing this solution with each gallon of tar. Creosote cannot be recommended for wood near oysters.

The trays should be stacked to drain and to weather for some weeks before putting out and should be placed in the water a week or two before the oysters are put on them. The process of weathering the trays and exposing them to water before adding the oysters seems to be necessary to get rid of impurities in the tar which are repugnant to the oysters.

THE TRAY LEASE

Tray cultivation is pre-eminently carried on over soft mud, above which the trays must be lifted on stakes. The stakes are driven into the mud sufficiently far to stand firmly and to hold the trays at the "growing level" as previously determined. The stakes should be of 3 inch by 2 inch hardwood.

The exact arrangement of the trays varies somewhat, but they are generally set out as a single or double row with adjacent trays meeting at one stake in the corners. The trays may be set out with only the trays at each end fastened on to the stakes, as this suffices to prevent the trays from sliding sideways and facilitates their later removal. The trays are better placed with their long sides adjacent to one another, the greater width of the row thus achieved helping to minimize the effect of wash.

It is not advisable to mass together more than a double row of trays, otherwise the centre rows become inaccessible. Between the rows a space should be left sufficiently wide to allow a punt to be manoeuvred.

The "culture" should be spread out as evenly as possible over the trays. The oysters should not fill the compartments, since they need room to grow; for the same reason they should not be more than one layer deep. Approximately a kerosene tin (four gallons) per compartment or three kerosene tins per tray is a good allowance. This amount would permit about 20 dozen oysters per compartment to be harvested.

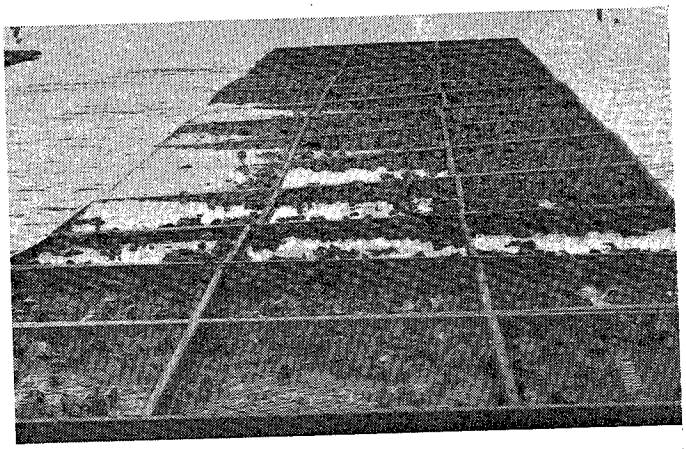
MAINTENANCE

The trays require regular inspection for signs of collapse either in their supporting stakes or in the framework of the trays. The wire of the trays is liable to rust through after a time and may be patched with wire or, more temporarily, with string if the trouble is localized. Violent water movement during gales may dislodge a tray or heap the oysters to one side, or even wash them over on to the bottom. Octopus or stingrays may pile the oysters into "nests" or knock them off the trays. If retrieved from the mud reasonably soon, the oysters will be saved from smothering.

Periodically the oysters need culling, for as they grow the shells tend to cement to each other and spat settles upon them from time to time. Culling, or separating the oysters from the bunches, produces the fastest growth and the best-shaped oysters.

When the oysters are of marketable size and in good condition the trays may be taken by punt to the oyster-man's depot and culled for market as described on page 6.

Trays are seldom left for more than about nine months in the water. They are then taken ashore, dried out, repaired, and dipped in tar before being used again.



Oyster trays, Georges River, New South Wales.

ADVANTAGES

- The bottom needs no preliminary preparation and need not be firm.
- The growing level is easily attained.
- Silt deposition is relatively slight.
- A large number of oysters can be handled simultaneously.
- The oysters are relatively free from pests.
- The oysters produced are well shaped.
- The trays may be moved easily from one ground to another.

DISADVANTAGES

- Both wire and wood need replacing at regular intervals.
- Handling tarred materials is not always pleasant.

Rock Cultivation

THE SECOND TYPE OF CULTIVATION IN WHICH the substrate is more or less fixed is exemplified by rock or stone cultivation. Only easily worked rocks such as sandstone and loose shales are suitable for this type of cultivation. Oysters catch well on other rocks, such as ironstone, but are extremely difficult to remove when mature.

In rocky foreshore leases the rock may often be cut from local stone. Otherwise the rock must be obtained from quarries, and the price of the rock and transportation costs will determine whether its use is economically feasible. This type of cultch is particularly useful on narrow foreshores where the quick fall away to the channel makes it difficult to use other methods.

Stones 2 feet by 1 foot by 4 inches may easily be handled. In practice great variations occur. The larger stones are heavy and difficult to handle, though as catching and growing are done on the same beds this is not a great handicap.

THE ROCK BEDS

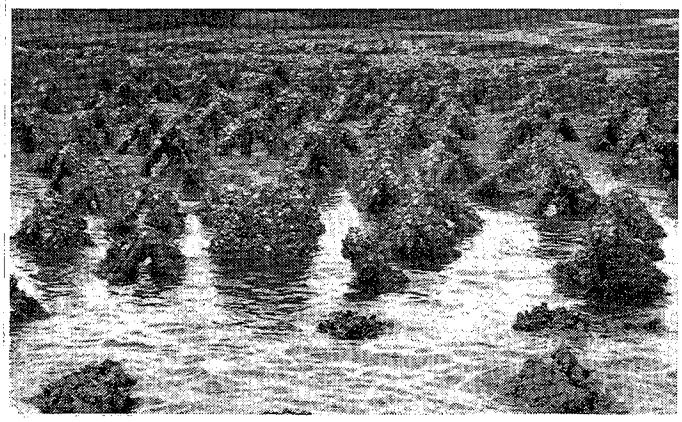
There are four chief methods of putting out the stone:

- Two or three stones may be piled together to support each other at about a 70° angle to the bottom.
- On rather soft ground the bottom may be hardened by the addition of sand, gravel, small rocks, old shells, etc., over which are placed lengths of hardwood timber upon which the rocks are put with the long axis horizontal.
- The rocks may be lifted above the bottom on racks similar to but narrower than those used for sticks.
- The rocks may be held above the bottom on tripods of small stakes thrust in the ground.

A certain amount of the rock-face will be lost to use in the first method owing to sinking into the substrate. Usually this is not very serious, but where it becomes so one of the other methods must be adopted. The rocks become easily fouled with silt in the second method, but they are generally kept clean if there is a good tidal scour. If there is no hard layer within a foot or two of the surface of the mud substrate there is always the danger that the rocks and the timber may cause subsidence into the mud. The other two methods avoid this possibility of smothering but sooner or later the wood, whether in the form of racks or of stakes, will have to be replaced as cobra eats it out.

Whichever way the rocks are set out, they should be set in rows with a space between them along which a man may move easily to work upon them. Every 10 rows or so a wider channel should be left to allow the passage of oyster-punts.

Rock lease, Georges River, New South Wales.



CATCHING SPAT

The treatment of the rock slabs depends somewhat upon the time of year at which the spat-fall occurs and upon the density of the spat-fall. The upper surface of the exposed rock slab quickly becomes fouled with silt and weed. The heavy spat catch occurs on the lower surface. If a heavy catch occurs in spring or early summer, the rocks may be turned over towards the end of the following winter or in early spring in order that the other surface may catch. But if the spat-fall does not occur until late summer the small oysters will not be hard-shelled enough to be exposed to the marauding bream or to the strong sun by the end of the winter, and the stones cannot be turned until the following year. Also, if the catch is slight it is better to leave the rocks turned as they are till a further catch takes place.

MAINTENANCE

The leases require constant attention to restore rocks which may have fallen down or racks which may have collapsed. Heavy growth of weeds on the rocks should be removed by scrubbing with a stiff broom, since the final death and decay of this weed are likely to kill or injure the oysters with the poisonous products of decay. Rocks on the bottom are susceptible to attack from drills and borers so they should be inspected regularly for signs of these pests.

The marketable oysters are usually removed from the rocks at the lease by working on the falling tide with a punt alongside so that the oysters can be thrown into it. The oysterman starts with the rocks highest up on the foreshore and works down with the falling tide.

ADVANTAGES

- Stone slabs provide a good catching surface.
- Two crops of successive years may be grown on the one slab.
- The oysters are retained until maturity.
- The oysters are easily culled off.
- The slabs may be used time after time so that the initial expense is the main one.

DISADVANTAGES

- The stones are heavy to handle.
- Placed on the mud the stones are easily accessible to oyster pests.
- The stones are liable to sink into soft bottom.

Fibro-cement sheets or tiles about 18 inches by 12 inches by $\frac{3}{4}$ inch coated with a lime-cement mixture of about equal parts sand, cement, and slaked lime may be used in much the same way as the stone slabs.

Shell Beds

A SHELL BED REQUIRES A FIRM BOTTOM INTO which the oysters cannot sink; nor must the bottom move so as to smother the oysters. Such conditions are not common in nature, since most apparently firm bottoms move about under the stress of gale- or flood-driven waters. Artificial shell beds are desirable for the best results.

CONSTRUCTION OF A SHELL BED

A shell bed may be constructed on any bottom which is soft only to a depth of two feet or less. A firm layer of shells or rock beneath the surface is necessary for a firm foundation. The area of the proposed bed should be marked out with stakes. The bed should then be covered by boughs and twigs from convenient trees, of which the tea-tree (*Melaleuca ericifolia*) and the swamp oak (*Casuarina glauca*) are most useful. Outside the boundary of the bed channels are dug in the mud until a firm layer (usually shell-grit and sand) is found. This material is shovelled on to the timber so as to raise the bed about a foot above the surrounding bottom. The surface is raked over to level it and then the bed is left to settle. After some weeks a final layer of old clean shells can be added and the bed is ready to hold oysters. The exact dimensions of the bed do not matter, being largely a matter of convenience and depending upon the slope of the bottom and the ease of working.

SOURCES OF CULTURE

Oyster spat for shell beds may be collected locally on empty shells broadcast about, on shells bundled into wire baskets, or on cement-coated egg-case fillers also held in wire baskets. The main source of culture for the shell beds is usually the trailings from the market cullings derived from this and other methods of oyster-farming. "Culture" may also be obtained from sea-walls, mangrove roots, and so on.

MAINTENANCE

The shell beds should be raked over periodically to free the silt, which tends to settle. Following this the bed should be washed down. The most efficient method is to use a fine spray worked by a small engine, or more simply, but more laboriously, water may be thrown over the beds from buckets. The surrounding ditches should be kept in good

repair and any tendency of any part of the bed to sink should be corrected by the addition of more solid material.

The oysters ready for marketing must be picked out by hand at low tide or by tongs when the water is over the bed.

Natural shell beds occur in places, mainly where there occur numbers of the large hercules whelks, which form a cultch material for the oysters to settle upon. It has been the practice to strip the beds of these oysters, including the whelks. It is often many years before more whelks work onto the beds. It would provide a more stable industry if the oyster-men working such beds deliberately broadcast shell for the oysters to settle on.

ADVANTAGES

- Once constructed, shell beds are easily maintained.
- The smallest spat from the market trailings can be set out to grow.

DISADVANTAGES

- Shell beds silt up easily.
- The beds are easily reached by oyster pests.

Dredge Beds

NATURALLY OCCURRING DREDGE BEDS CAN BE located only by exploring for them. There are few known dredge beds left in Australia today. In general, it may be said that the dredge beds are easily destroyed by the accelerating siltation that is occurring in the estuaries and by the constant removal of shells from the beds.

Certainly some of the old dredge beds would not have been destroyed had they been managed properly, but few of them are capable of being restored.

Firm bottom is required for dredge beds. It is essential to broadcast new cultch material onto the dredge beds each year to replace the material removed by fishing. Without solid materials to settle upon there will be no fall of oyster spat.

MAINTENANCE

In early spring the dredge beds should be cleaned by harrowing with a stout-toothed rake dragged behind a boat. This treatment digs the shells up from the bottom. The harrowing should be done during a strong run of the tide so that the disturbed silt will be swept away.

LAYING OF CULTCH

Oyster and other mollusc shells make good cultch material, but pebbles and small rocks of various kinds may be used. The shells should be weathered on a clean bank, preferably pebbly, for some weeks so that the sun and rain may clean them. The shells should be sown after the harrowing has finished and a week or two before a spat-fall can reasonably be expected. They should be spread as evenly as possible at the rate of 3000 four-gallon tins per acre on ground with few shells present, or at a lower density if shell is present. The quantity in such a case can be judged only by experience. The ideal is to cover the bottom with a layer of shell.

HARVESTING DREDGE BEDS

The crop from a dredge bed is taken by dredging systematically over the area. The oysters gathered may be culled on the boat and the trailings sent overboard, or they can be taken ashore for sorting. Dead shells should be taken to the bank for drying and bleaching so as to be put out as cultch the next season. Care should be taken not to return to the water any pests such as starfish or drills.

It is a good rule, especially where oysters are otherwise scarce, to work only one-third of the dredge-bed area per year, so as to make certain that there is a brood stock to provide spat for the following year.

ADVANTAGES

- Dredge-bed construction and maintenance are relatively cheap, as shell is readily available from shucking establishments.
- Little maintenance work is necessary.

DISADVANTAGES

- Silt deposition may destroy many oysters.
- The oysters are difficult to work in order to cull the clumped oysters.
- Oysters on dredge beds are very open to attack from oyster pests.

DISEASES AND PESTS

Like all animals, oysters are subject to disease and to attack from various predatory animals.

THE TERM "OPENING DISEASE" IS WIDELY USED to cover several conditions where the oyster, through sickness or attack, finally gapes owing to inability to contract the muscle which holds the shell.

WINTER MORTALITY

The most destructive of mortalities in Australian waters is known as winter mortality, which reaches its worst towards the end of winter or in early spring. It appears to be confined to New South Wales rivers from Port Stephens southwards, but it does not occur in all rivers and the incidence of the disease varies from year to year.

The cause of the mortality is obscure, but it is almost certainly assisted by lack of resistance following lack of food during mid winter.

When the onset of the disease first becomes apparent, oysters will be seen "weeping". This is caused by the failure of the muscle to close the shells properly, so that the shell fluid slowly oozes out. If opened, the oysters may be seen to be in fairly good condition, but inspection will show little flecks of black and yellow pustules here and there on the gills and body. As the oyster weakens it becomes totally unable to close the shell, so that secondary disease organisms may enter to attack the shell-fish and various small animals may enter to feed upon the oyster flesh. The maximum killing occurs during early September and is associated with the first hot sunny days when the beds are bared in the middle of the day.

There is no known remedy for winter mortality. It can be cut to a minimum by moving the trays up high so that they are covered by the water only for a short time each tide. Another method which effectively cuts out mortality is to transfer the oysters to lagoons which may be dammed off by sluice gates or valves so that the oysters remain covered by water for prolonged periods during the winter and are cut off from the main water mass.

SUMMER OPENING

In all areas some few oysters die during the summer, and an unusually hot day with a low tide during the sunshine hours will cause an increased number of deaths.

FLOODING

It is beneficial for oysters to be subject to periodic freshets of short duration. The oysters themselves close up and suspend activity, but pests such as drills and worms which prey upon oysters are killed by the fresh water. However, a prolonged flood may kill large quantities of oysters because eventually the oysters must open and will be unable to adjust themselves to the fresh water.

SMOTHERING

A killing which is sometimes referred to as an opening disease is actually due to the appearance of oysters which have been covered and smothered by moving sand or mud. This is a quite common occurrence with whelk-caught oysters and on shell beds, where sand movements and silt deposition are marked and frequent shell-bed and dredge-bed operations are impossible.

POLLUTION

Pollution from industrial wastes has not yet become a problem of great importance in Australia. Port Jackson, which once produced oysters, has been spoilt by industrial wastes and by the discharge of oil from ships. More important, but still only a minor problem, is the pollution by sewage. In restricted localities this has been serious enough to have the cropping of oysters forbidden. The State departments controlling fisheries can advise where these areas are. In taking up new leases in the vicinity of townships it is advisable to make inquiries from the local council and to investigate personally to make sure no sewage is being discharged adjacent to the proposed lease. Sewage pollution is, however, rapidly diluted in sea-water and the area affected is generally restricted to the immediate vicinity of the sewage outlets.

Oysters living in a polluted area purify themselves in a matter of a few days if transferred to clean water. If the State laws permit, such oysters may quite safely be removed for growing purposes.

The tingle whelk.

MUDWORM

The mudworm (*Polydora*) affects mainly oysters on shell beds and dredge beds, although those on other forms of cultivation are not immune from attack, particularly when set below mid-tide mark. When the worm is abundant it is useless putting out cultch close to the ground. However, cultch lifted on racks is relatively free from this pest, particularly if set where a strong current can wash any settling mud off the oysters.

The worm becomes apparent as a mud-coloured blister on the inside of the shell of the oyster. It enters as a minute larval form in the food current created by the oysters and makes its way between the oyster's body and the shell where it settles down to build a tube of mud from particles brought in on the food current. The oyster is irritated by the worm's activity and secretes a layer of shell material over the worm and its tube, which is then enclosed in a sac of oyster shell; its only connexion with the outside world is at the edge of the shell where the tube ends.

The mudworm is not a parasite, but is a competitor for food. When infestation is heavy the oyster spends too much of its food reserves in keeping the worms encased, and growth and fattening of the oyster are delayed.

The worst feature of the mudworm is that its presence makes the product unattractive to the consumer. The mud blisters are easily broken open during oyster shucking, thus mixing the mud with the oyster fluid and imparting a bad taste.

The most satisfactory treatment seems to be to expose the oysters on the river bank for a week or 10 days. The worm will be killed but oysters in good condition will be able to stand the exposure. If they are in poor condition, however, loss may occur. Transference to fresh water for about two days also kills off most of the worms without harming oysters whose shells are undamaged.

WAFER

The wafer is a flat-worm, a thin slimy creature oblong or oval in shape, mottled light and dark brown above and cream or grey beneath. When alive, the animal is covered by a sticky mucous slime. Flat-worms are common at times on oyster-beds, and have frequently been blamed for the destruction of oysters. However, it is probable that the wafer can enter the oyster's shell only when the oyster has already sickened or died and so is unable to work the adductor muscle to close the shell valves together. Then the wafer undoubtedly finishes off the victim, but it is not responsible for the primary weakness which allows ingress. Treatment is difficult. Exposure to fresh water would be as fatal to the sick oyster as to the wafer. However, the periodic freshets to which estuarine oyster-beds are subject kill off the wafer at intervals.

STARFISH

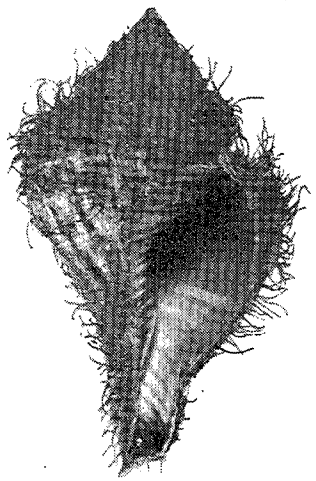
In places towards the seaward end of estuaries starfish are often a pest. The starfish attacks by wrapping its arms about the oyster and exerting a strong pull on the shells. The oyster shell has no catch upon it, being kept closed only by the power of the adductor muscle. When a strong continuous pull is exerted against it the muscle tires after a time and the shell can be pulled open. In this way the oyster meat is exposed to the starfish and is consumed. Starfish attack oysters of all ages, but are most destructive to the small spat.

Preventive treatment is to set out cultch material above the bottom where the starfish cannot reach it. Treatment of infested beds is more difficult. Whenever seen, starfish should be picked up and thrown ashore above high-water mark. Exposure to the air for a day or two will kill them. It is useless to tear the starfish to pieces and throw them back in the water. The animals have marvellous powers of regeneration and at least one piece of the dismembered starfish will recover and grow new arms to be as active as ever.

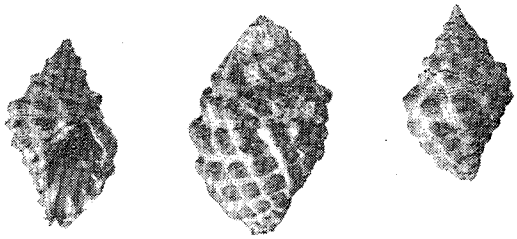
Starfish can be dredged from dredge beds by towing a mop made of three- to four-foot lengths of cotton waste hanging on wire traces from a metal frame. The spines on the starfish catch on the fluffy material and the animals can be hauled up and deposited ashore.

A more effective method is the spreading of quicklime over the beds as uniformly as possible at the rate of 500 pounds per acre. Granulated quicklime is more effective than coarse.

The damage done by starfish can be very great as one of them can eat 20-25 oyster spat, or two or three large oysters, per day.



The hairy whelk.



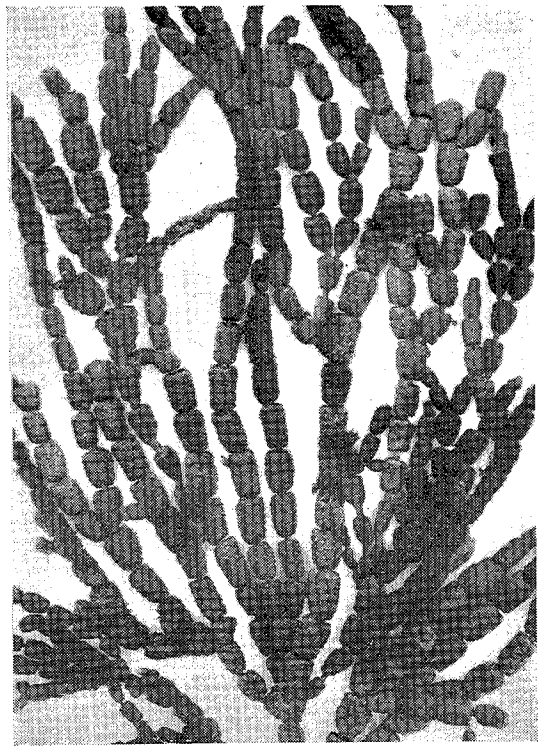
The mulberry whelk.

OYSTER DRILLS OR BORERS

There are a large number of sea snails which may at times attack oysters. Three in particular are troublesome along the eastern coast of Australia, namely the tingle whelk, also called the common borer (*Xymene hanleyi*), the mulberry whelk (*Morula marginalba*), and the hairy whelk (*Monoplex australasiae*).

Although they are sometimes found together, these three types occur on rather different bottoms. The mulberry whelk is common on intertidal rocky foreshores. The tingle whelk is not so common on the rocks, but is common on sandy mud bottoms where it seems to be attracted by wooden posts, etc., up which it climbs in search of oysters. The hairy whelk may occur in both these habitats but is most common on permanently submerged beds.

None of these drills is resistant to fresh water, and floods tend to eliminate them from an area. The tingle whelk and the mulberry whelk attack the oysters by boring a neat round hole through the shell. The hairy whelk attacks by chipping away at the edge of the lip of the oyster and thus making a somewhat rectangular hole into the shell cavity. After the hole is made a digestive



Bell weed, a pest on some oyster beds.

juice is secreted into the oyster and kills and partly digests the oyster meat, which is then sucked by the drill.

When drills are seen they should be removed to above high-water mark to die. Oysters after exposure to the air for several hours may be thrown against a screen of one-inch wire mesh. The whelks (other than the hairy whelk) will fall through and be separated from the oysters, which are retained by the screen.

FISH

Certain fish destroy oysters. Bream feed voraciously on the soft-shelled spat. Rays occasionally cause havoc on tray and shell-bed cultivation. The system of depoting to avoid destruction from the bream is described on page 8. Where rays are common the only preventive measure is to construct brush or wire fences around the oyster-beds. Other fish such as toados and oystercrackers occasionally eat oysters but they are not so frequent a pest as the bream and rays.

Mullet and various plankton-feeding fish are believed to consume many larval oysters.

CRABS

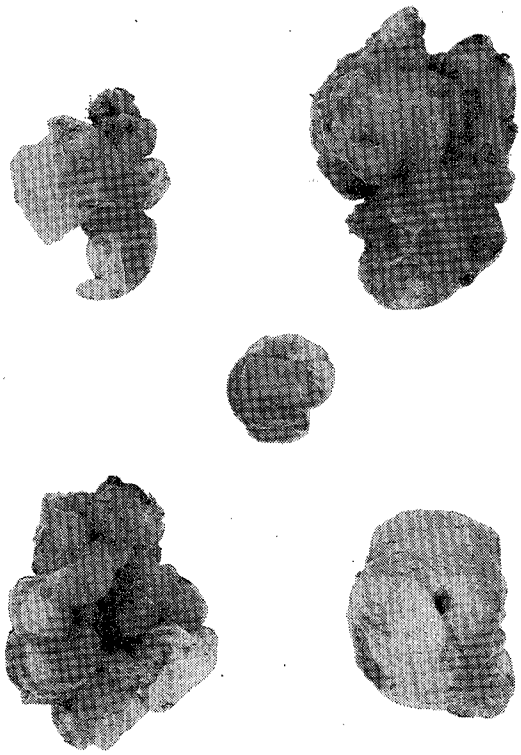
The mangrove crab (*Scylla serrata*) has powerful claws, which crush the oysters with ease. They are denizens of the muddier areas. They are a nuisance also as they burrow alongside the stones or stakes which, becoming undermined, finally collapse.

Continual trapping with baited crab-pots will keep the oyster-beds clear of crabs.

Other crabs consume oyster spat, but the mangrove crab is the most harmful and is capable of opening large oysters.

OCTOPUS AND CUTTLEFISH

These creatures are pests for they gather the oysters into heaps to make nests or hides for themselves. The oysters, being piled together, smother each other and a big loss can occur.



Balloon weed, which floats the oysters off the trays if permitted to grow upon them.

Immediate spearing of the octopus is necessary as soon as a nest is discovered. The heaped-up oysters should be relaid in a single layer.

BELL WEED AND BALLOON WEED

Occasionally these weeds, which possess large floats, become nuisances. They attach to the oysters and the gas in their floats causes them to become so buoyant that finally the oyster attached is lifted off the tray or shell bed and drifts away with the tide.

Removal of the weed, by scrubbing with stiff-bristled brooms as soon as it is detected, is the best remedy. Where the oysters are bared by the tide for a long period, treatment with a spray of copper sulphate or sodium arsenite may be effective.

SLIME

Various filamentous algae are included in the term slime. Their worst feature is that they may settle on the cultch material before there is a spat-fall and thus effectively block the spat from settling. The treatment is similar to that for bell weed. Exposure in the air for several days will kill most kinds, but some low encrusting forms will survive as long an exposure as the oysters. Chemical treatment seems to be the only solution.

SPONGES

A yellow boring sponge, *Cliona*, infests the shells of oysters in some areas. Eventually the sponge penetrates right through the shell of the oyster, which gains a bitter, unpleasant flavour.

The only treatment is exposure to the air for some days to kill off the sponge. Dredge beds are especially subject to this pest and the dredging of practically the whole bed to expose the oysters to the air is the only possible remedy in badly infected places.

MUSSELS AND BARNACLES

These animals are competitors with the oyster for food and space. Either of them may settle on the cultch before the oyster spat. The placement of the cultch at mid-tide level is reasonably effective in preventing a fall of mussels as these animals generally live lower down in the tidal zone. Barnacles may catch at any level. Oysters may catch on top of the barnacles, particularly if the latter die, but catching is most unlikely once mussels get established. As competitors for food, mussels and barnacles in heavy concentrations are a danger on the oyster-beds.

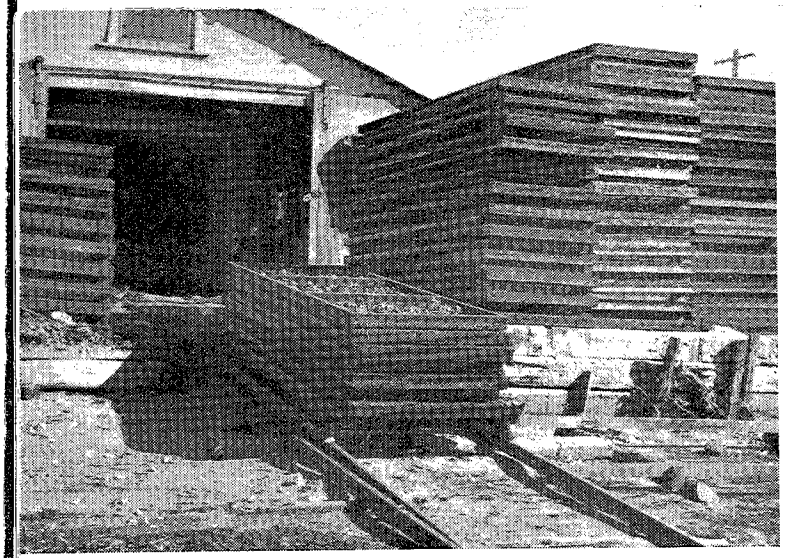
Removal of the animals is the only treatment. They can be knocked off with culling irons or an iron bar, or by hand-picking or raking from shell beds.

TOOLS AND EQUIPMENT

Some of these tools are indispensable; others are useful aids which make for more efficient work.

THE DEPOT

Every oyster-farmer needs a depot where oysters may be culled and bagged, trays may be tarred and repaired, sticks may be bundled and stored, and punts and other boats may be painted. The extent and nature of the depot may vary from a small shed on piles over the water to a large building solidly placed ashore. The depot must be convenient in location and give some comfort, if only shelter from bad weather. A useful adjunct is a slipway with a winch to haul up the boats or trays into the shed for working. In other situations it is more convenient to have a roofed-over dock into which the boats can float at high water for loading or unloading.



Portion of Lewis Bros.' depot, Georges River, N.S.W., showing oyster trays being winched into shed on a trolley running on rails over the mud flat. Note the tarred trays weathering after being dipped in the tarring tank.

OYSTER PUNTS

Oyster punts are flat-bottomed punts whose dimensions are determined largely by the purpose for which they are intended. A punt or barge to carry trays will need more unencumbered space than one used to carry sticks or rocks. A punt fitted with a derrick for lifting trays, bundles of sticks, and so on, is a very useful piece of equipment. A small electric winch makes light work of the lifting.

A small punt about two feet wide and three feet long is handy for sliding along under the racks when sticks are being removed for culling. Most of the oysters jarred off during removal of the sticks are thus caught and prevented from falling to the bottom.

All boats should be of shallow draft, including the launch which will be needed to tow the punts onto the oyster-beds.

CULLING IRONS

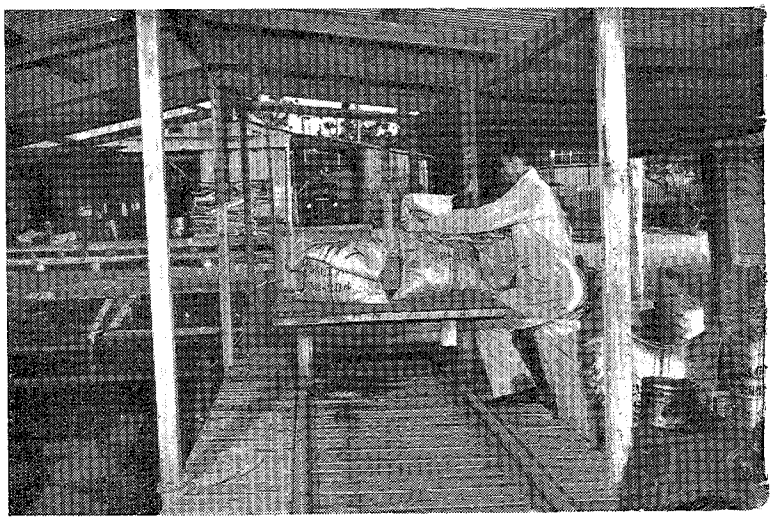
A culling iron is a flat iron bar about a foot long, with a flat surface about an inch in width and a narrow edge about one-eighth of an inch. A two- to three-inch portion at one end is turned at right angles to the main bar, which acts as a handle. The turned portion is the culling head, which is gradually tapered to a blunt edge. At times a plain bar is used which is tapered and bluntly sharpened at one end. A 12- or 14-inch file is used as a culling iron by some oyster-men. A geological hammer is useful for chipping oysters from rocks.

OYSTER-KNIVES

Oyster-knives are bluntly pointed metal knives with symmetrical edges attached to a handle which may or may not be protected by a guard.

GENERAL

Besides special tools, the oyster-man needs ordinary carpenter's tools. The extent to which he invests in these depends upon the type of cultivation adopted. The use of power saws and drills will lighten the labour of much of the carpentry work.



Portion of Melbourne Oyster Company depot, Port Stephens, N.S.W., showing trolley on rails for moving bagged oysters. Oyster punts are visible in the dock to the left.

Glossary

BORER.—A boring marine snail that attacks oysters; also an isopod crustacean which tunnels into wood immersed in sea-water.

BUNDLING.—The process of tying sticks together in bundles.

CATCHING LEVEL.—The range over which the cultch material is set out, usually about mid-tide level.

COBRA.—The shipworm, which bores into and destroys wood.

CONDITION.—The quality of an oyster, being good when fat and white, poor when dark and thin.

CULLING.—The act of separating clumps of oysters from each other, from marine growths, or from the cultch material.

CULLING IRON.—The implement used in culling.

CULTCH.—The material set out to catch spat.

CULTIVATION.—The oysters set out to grow.

CULTURE.—Partly grown oysters taken to set out on a growing lease.

DEPOTING.—Setting out the sticks in bundles in a growing area to protect the spat when young.

DISEASE.—Refers to several conditions, including winter mortality and worm attacks.

DRILLS.—Marine snails that bore through oyster shells and feed on the meat.

FIRSTS.—Oysters of good shape and condition, fit for marketing in the shell.

HAIRY WHELK.—A boring drill distinguished by rows of hairy projections on the shell.

MARKETERS.—Equivalent to "firsts".

MUDWORM.—A worm that forms a mud chamber or tube inside the oyster's shell.

MULBERRY WHELK.—A boring drill distinguished by rows of knobs on the shell.

REEFERS.—A type of boring drill.

SECONDS.—Oysters of marketable size but poorly shaped or too small for the oyster-in-the-shell trade; used for bottling or put back onto beds.

SHUCKING.—The process of opening oysters and removing the meats.

SPAT.—The young oysters immediately after settling and while still a small size.

SPAWN.—The eggs and sperm set free by the oyster.

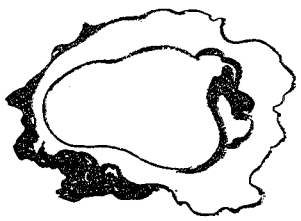
STOOKS.—Bundles of sticks set upright in conical piles.

TINGLE WHELK.—A boring drill.

TRAILINGS.—The small oysters and shell remaining after marketable oysters have been culled out.

WAFER.—A flat-worm an inch or two long, alleged to attack oysters.

WINTER MORTALITY.—An oyster killing which occurs in winter in New South Wales rivers south of Port Stephens.



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