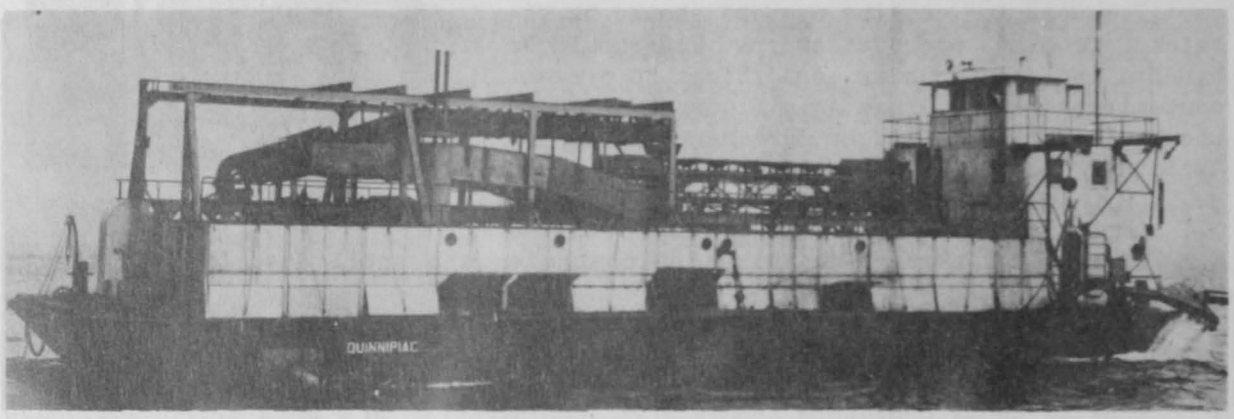
MECHANIZATION OF OYSTER CULTIVATION[1/]

PART I - RECENT DEVELOPMENTS AND IMPROVEMENTS IN OYSTER DREDGES

INTRODUCTION

The land farmer has many machines to choose from in carrying out the necessary operations of farming. He wouldn't use a spike tooth harrow to harvest potatoes. On the other hand, we in the oyster industry have been limited to one tool for all our cultivation work and much of our enemy control.

The conventional dredge has a great deal of merit, and properly handled it is a good method of harvesting oysters that are thickly planted, but it is not a good tool for controlling drills, and not efficient when oysters become scattered on the bed.



QUINNIPIAC - HYDRAULIC-TYPE OYSTER DREDGE IN LONG ISLAND SOUND

It is the industry's observation that, in the North Atlantic States, we are not raising over 10 percent of the oysters we start out with in the case of a heavy set. It is certainly a challenge to do better. No one machine is going to have all the answers to the problems of the oyster farmers any more than any one machine can solve the problems of the land farmers. The oyster industry will still have a long way to go before it handles oysters by machinery in as gentle a manner as hand tongs, and the gentle method of shoveling into baskets. The small operator who is doing that today puts out a sounder and better quality shell oyster than any of those using mechanical equipment can attain. It is well to keep in mind that oysters are living animals and that mechanical efficiency may cause damage to the oyster beds.

The entire oyster industry has for many years recognized that one of the greatest expenses in oyster production is the amount of hand labor required, and that is the reason why the industry, both on the Atlantic and Pacific Coasts, is developing mechanical means for reducing this overhead expense.

What is really needed is the development of a piece of equipment which would operate efficiently in all cases, regardless of type of bottom and depth of water.

1/ A composite of three addresses--Recent Developments and Improvements in Oyster Dredges, J. Richards Nelson; The New Flower Oyster Dredge, H. Butler Flower; The Brown Conveyor Dredge and Its Application, Dr. A. E. Hopkins, Director, Biloxi Oyster Laboratory--presented at the Convention of the Oyster Growers and Dealers Association, National Shellfisheries Association, and Oyster Institute of North America at Asbury Park, N.J., June 2, 1948. Photographs, unless otherwise noted, taken by Branch of Commercial Fisheries.

The several methods being suggested to date definitely represent an improvement over the traditional and time-worn harvesting practices.

New methods of harvesting shellfish are an absolute necessity, and the various developments being made at the present time are going a long way toward accomplishing more economic harvesting.

The term "oyster dredge", in one case, is used in this report to denote the actual dredge that is lowered to the bottom, and in another, the term is used in referring to the entire craft and its machinery. The subject matter will make the distinction apparent.

Three Classes of Oyster Dredges

For purposes of convenience, oyster dredges are generally divided into three classes:

1. The conventional drag or rake type that is towed on the end of a chain, rope or cable and collects its catch in a bag.

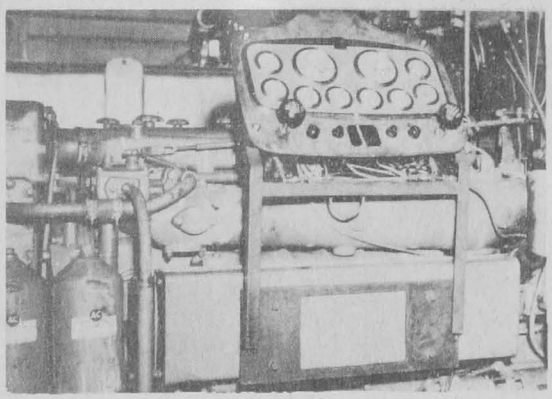
2. The mechanical dredge in which oysters are lifted mechanically from the bed and conveyed to the deck of the boat.

3. The hydraulic dredge that depends on water in motion to lift the oysters from the bed and bring them to the deck of the boat.

In the first class, the recent developments have been along the lines of a stronger, lighter dredge using special steel and welding techniques in its construction. The new Flower oyster dredge falls in this category and it will be described later.

Considerable work has been done at Bivalve, N.J., to develop a lighter dredge for the New Jersey oyster industry. Another development in this lighter dredge is the dredge bar with renewable teeth; both the bar and teeth are made of special steel.

The second class is represented by the Brown Shellfish Harvester which will also be described later. According to reports, the possibilities for the use of this piece of equipment in the areas for which it is designed to work are excellent.



PUMPING EQUIPMENT ABOARD QUINNIPIAC THAT OPERATES DREDGE

The third class is represented by the Bailey dredge, developed and used on the West Coast. It really is a combination of classes two and three. Water in motion is used to lift the oysters from the beds, and a mechanical conveyor brings them from a point close to the bed up and onto the vessel.

Four Hydraulic Oyster Dredges

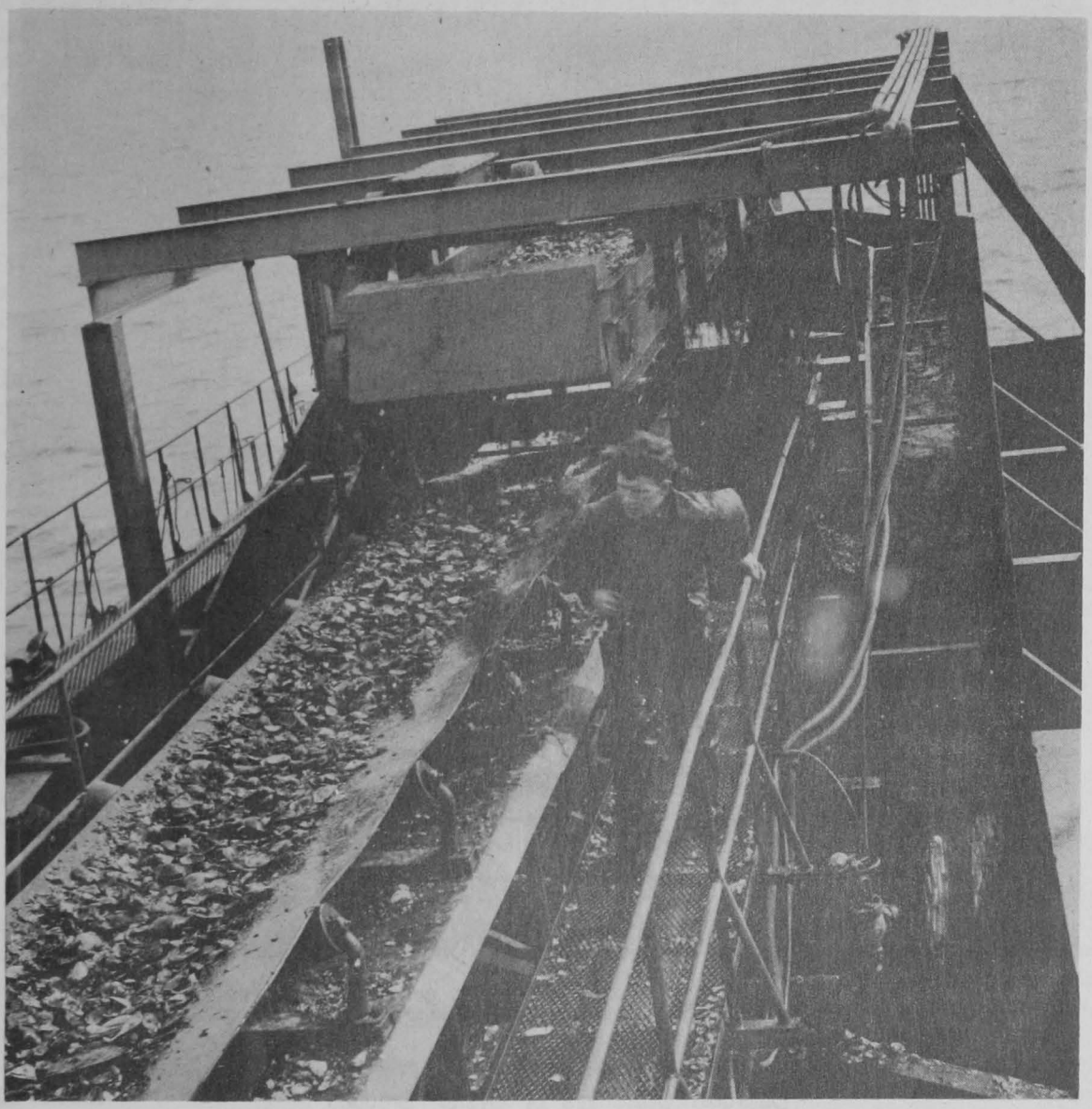
There are four hydraulic or suction oyster dredges in existence today that were designed and built for dredging oysters. The first was the Flower dredge in the Northeast using a six-inch suction pump to lift the water and oysters from the bottom.

Later, a West Coast company built a much larger craft, the Bailey Dredge, that uses two eight-inch suction pumps. Both of these dredges are successful and are doing the work for which they were designed. During the past year, two other companies built hydraulic dredges, using instead of suction pumps to pick up the oysters, force pumps discharging into a siphon or eductor which, in turn, creates the necessary suction to bring the oysters from the bottom to the deck of the vessel. Both of these dredges are quite similar as far as hydraulic equipment is concerned, but are different in respect to the type of vessel in which the equipment is used. One of these dredge vessels, the Rowe, is designed to catch its load, store it in the hold, safe from freezing, and transport it considerable distances at a rapid rate of speed. At the destination, the vessel unloads automatically on its own conveyor system. Many problems were met and solved in this dredge and a number of these solutions were useful in the development of the hydraulic dredge vessel, Quinnipiac, built by a New Jersey company.

UNLOADING OYSTERS AND SHELLS IN TRANSPLANTING OPERATION ABOARD THE QUINNIPIAC

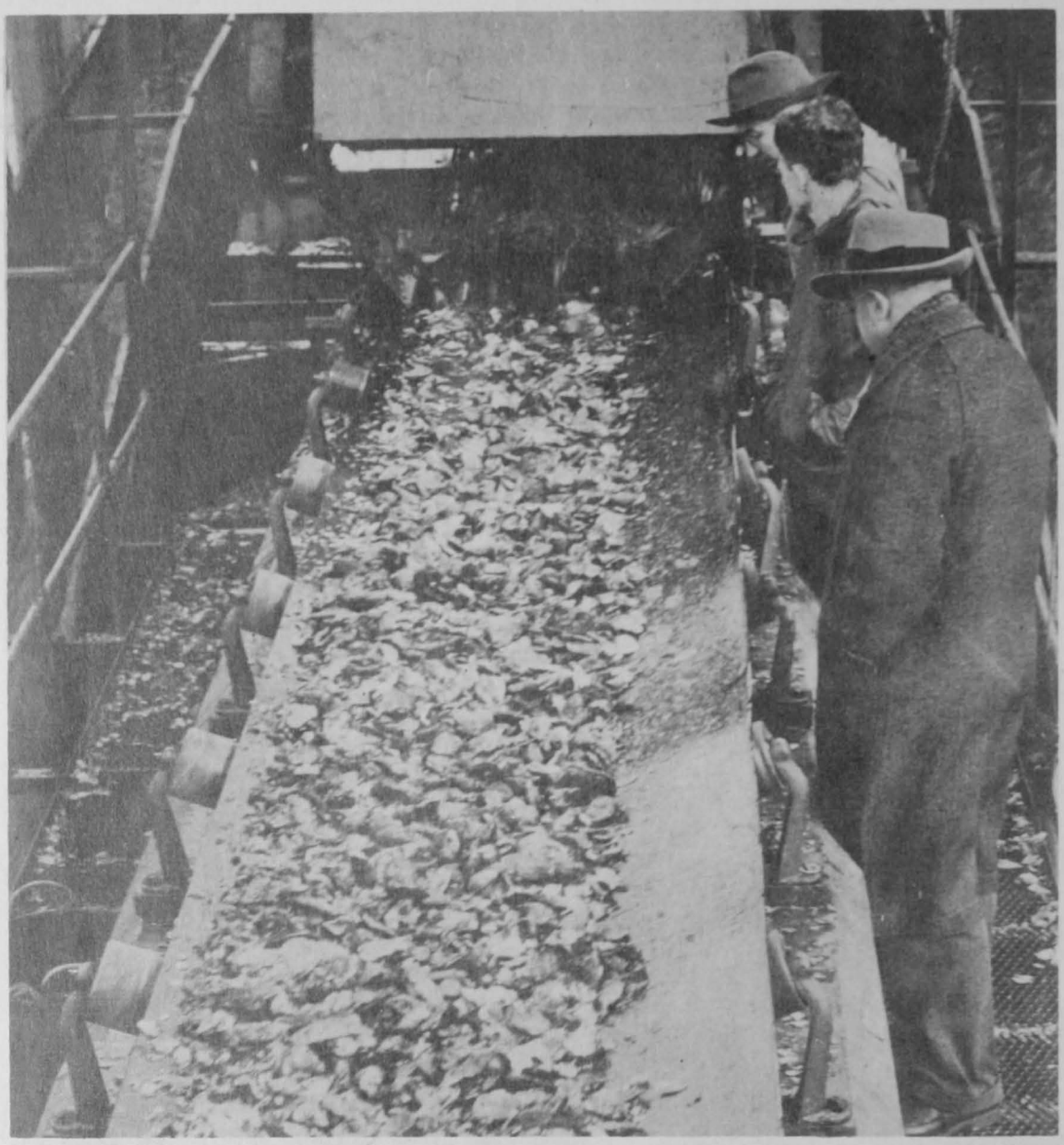
The Quinnipiac was designed primarily as a cultivating machine to be used in local areas and not for the purpose of transporting loads over long distances. Though it carries a large load, its value on the beds for controlling the oyster drill is too great to have it spend time transporting oysters.

The Rowe and the Quinnipiac both use a nozzle at the lower end of the suction hose equipped with a six-foot dredge blade so that oysters and other material are raked from the bottom as they would be in the case of a conventional dredge. They are then propelled by water in motion up the suction hose and onto a screening conveyor.



OYSTERS COMING ABOARD THE QUINNIPIAC ON CONVEYOR BELTS

The eductor or siphon principle has been used for many years in various applications, such as in bilge pumps and in the dredging of gravel and other highly abrasive materials that would cause excessive wear on pump impellers. It is believed that the use of the eductor or siphon principle does less damage to oysters and there is less wear on the equipment than would be the case with the use of an impeller pump. Another advantage of the eductor is the possibility of unloading hydraulically which can be quite advantageous, particularly in the case of shells.



CLOSE-UP VIEW OF OYSTERS AND SHELLS BEING DUMPED FROM UPPER TO LOWER CONVEYOR BELT ABOARD QUINNIPIAC

Desirable Objectives of Oyster Dredges

Recent developments in oyster dredges should accomplish the following desirable objectives:

1. More efficient catching.
2. Ease of dumping the conventional type dredge.
3. Saving of manpower.
4. Minimum damage to the crop.
5. The ability to control starfish, drills, and other oyster pests.

Objectives four and five should be the most important.

PART II-THE DEVELOPMENT OF THE FLOWER OYSTER DREDGES

Suction Dredge Developed to Combat Oyster Pests

The suction dredge was mainly developed by a private company to combat oyster drills, a common enemy of the oyster. In fact, at one time they were so bad that it was estimated that they killed well over one-half of the company's oysters each year. The drills were so plentiful that it was not infrequent for this company to screen 200 to 300 out of a dredge full of shells and oysters. Rotary screens were installed on some boats in order to screen the oysters. The drills were screened out of the oysters, but it was not possible to catch all of them off the beds. A different mode of attack was planned on this oyster enemy, the drill, also known as the screw-borer.

A nozzle was made; some second-hand hose was purchased; a common centrifugal water pump,two pulleys,and some belt was borrowed;and all of these parts were connected to a boat. After the first ten minutes of pumping with this equipment, the deck of the boat was filled with mud, sand, shells, oysters, and drills, all mixed together, and it took the balance of the day to shovel it off. It was a most successful trial, as it proved that it was possible to catch drills and do it very quickly.

Then started the process of developing and improving the suction dredge, and as a result, this company has complete control of the oyster drills on all its oyster beds. In addition, almost all of the sulphur sponge along with the fine material that has been on the beds for years was cleaned up. This company's suction dredge boat,the Pine Island,carried only 30 yards of sand, and it was loaded eight to ten times a day when the company started cleaning up their beds. In fact, it would take as long to cart it away as it would take loading it. After having cleaned up the beds the first time, it was very much faster when it became necessary to clean them again, according to reports by the company.

Uses of the Suction Dredge

Several different things have been noticed in working with the suction dredge.

First, the drills don't seem to be able to stand being pumped. It is believed that they have a weakness in their structure whereby they die after being sucked up. This has been discussed with a scientist and it is expected that some experiments will be made to see if it is the vacuum or pressure that the drills go through in being pumped up by the suction dredge which causes their death.

The oysters are also affected by this suction and pressure, but it does not kill them.

Large oysters, after being taken out of the water, are made weak for a day or two, but then they do close up tight again. From our experience, large oysters caught by the suction dredge are not too good for shell trade but are satisfactory for shucking. For handling large oysters, the new dredges being developed now should be almost as fast and easier on them.

Small oysters and set are just the thing for the suction dredge. It will handle them and cause less damage than the old conventional dredges. The suction and pressure does not harm them at all. Handling these oysters after they leave the water should be done just as carefully as when handling eggs. In fact, they

should be handled more gently as the shells are thinner and more easily broken. However, the suction dredge is first and foremost a means to clean up the oyster beds of drills, sulphur sponges, crabs, mussels, starfish, or anything else on the beds.

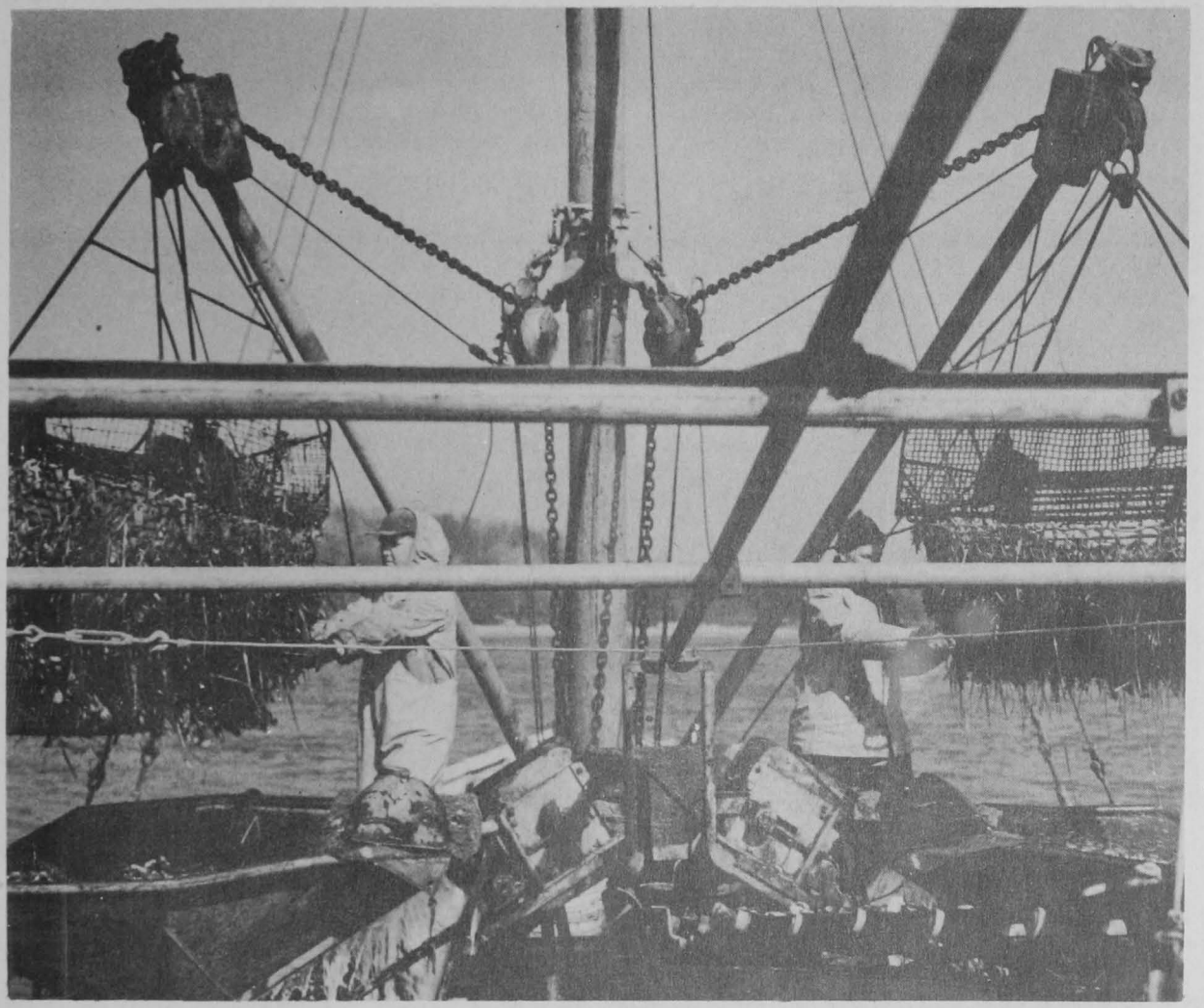
Secondly, this suction dredge can and is used to catch oysters. The suction nozzle does not have teeth. Teeth were tried, but this company found they were not needed on their beds. The suction dredge is used on all types of bottom, even on very soft mud.

Development of New Type Oyster Dredge

This same company for some time now has been working on a new type of self-dumping lighter oyster dredge to be handled on booms. The specifications were

BOW VIEW OF TWIN HARBORS

for a light, very strong, self-dumping dredge to handle five or six bushels of oysters. The booms were made with special chain blocks that would grip the chain and hold up the dredge when the second pair of hoists pulled up the booms.

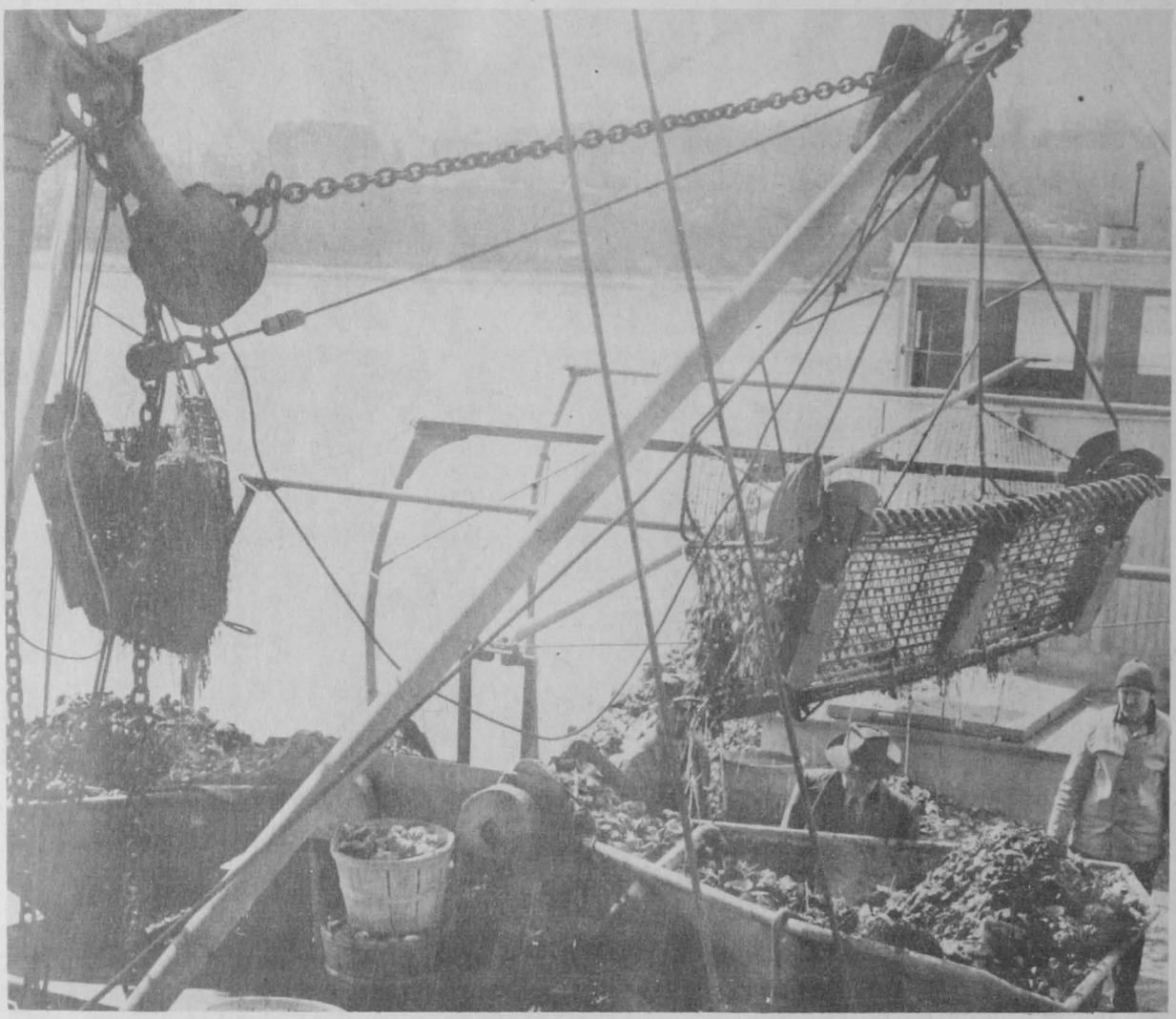


TRIPPING DREDGE DOORS FOR UNLOADING INTO HOPPERS ON TWIN HARBORS

After it was assembled, this new light dredge was tried out, but the first attempt to use it was a failure. It was then realized that the reason for making the conventional dredge so heavy was so that enough weight could be put on the teeth to dig down under the oysters. It was after very many trials and weeks later that finally a pair of chains were put on each dredge in such a way that all the weight was carried on the teeth. Also, stationary cut-boards were added. The additions were just what were needed. These dredges are the ones several different oystermen have already copied and they are very successful. They act very much like the regular dredge in regards to the length of chain needed to catch oysters at their best. In other words, they are sensitive to the length of chain, type of bottom, etc. This work was all carried out on a small boat, The Ida May. This same dredge is still in use on this boat.

A Self-loading and Unloading Oyster Dredge

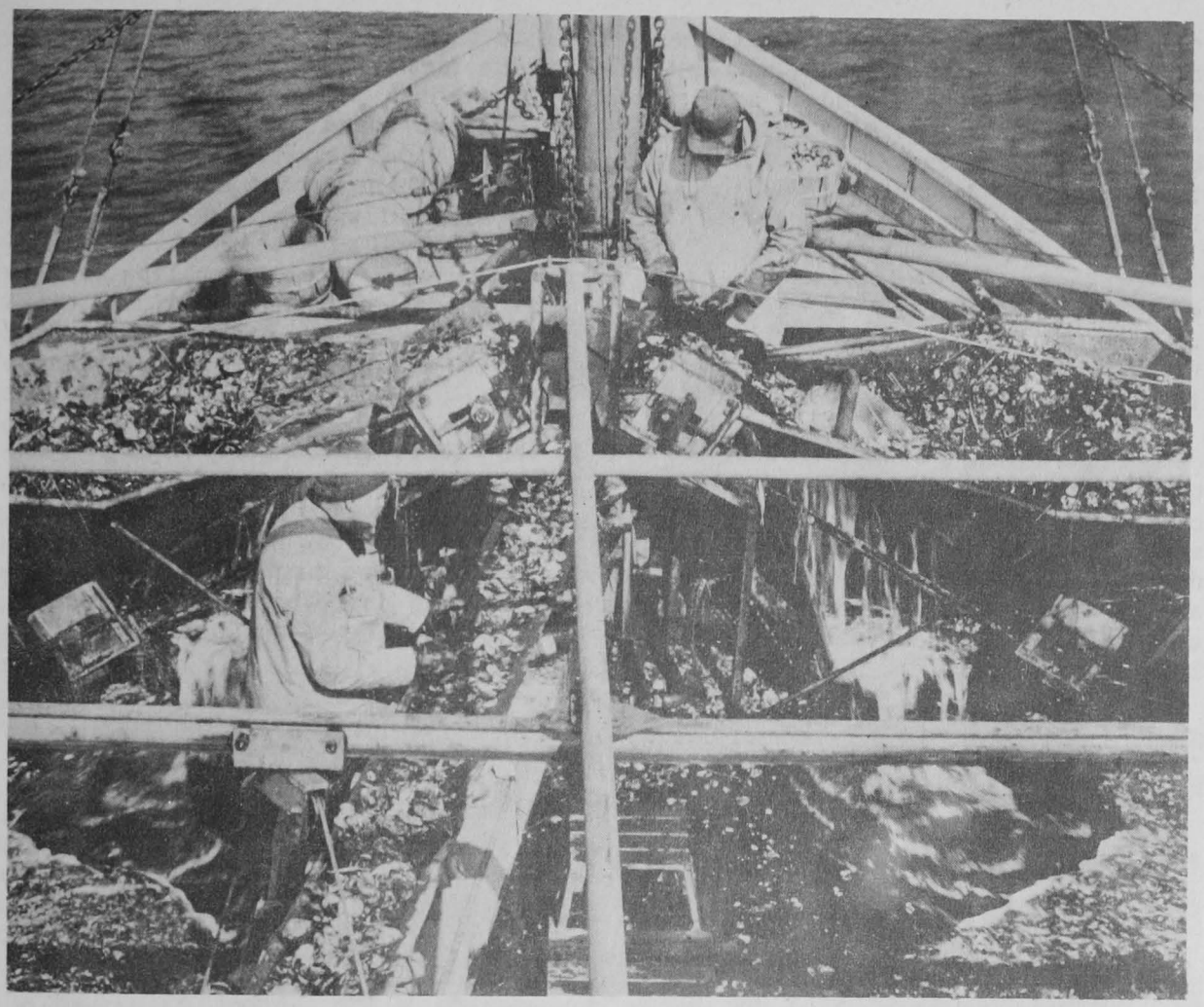
The next step was the use of self-loading and unloading machinery, but it was then necessary to have a larger boat. This machinery and a new type of oyster dredge was built. The Twin Harbors is the up-to-date result. This new dredge has some features found in the old type dredges, but not many. The teeth on this dredge are always in contact with the bottom at exactly the same angle regardless of the length of chain. The former link and ring bottoms are replaced with bars and all ride on three skids instead of dragging along the bottom. It was especially designed for uneven bottoms. It has the peculiar ability of clearing itself of mud and sand.



LOOKING AFT TOWARD PILOTHOUSE ABOARD TWIN HARBORS

Operation of New Dredge

The new dredge, however, is still too heavy, and it is intended to make the final ones out of special metals to have them light but still very strong. This dredge does not depend on its weight to catch oysters. In fact, the weight has a tendency to make it dig too much at times.



OYSTERS CONVEYOR SYSTEM. SHOWS WASHING AND CULLING PROCESS ABOARD THE TWIN HARBORS

When regular dredges are lowered to the bottom, they must have enough weight on the teeth to hold the teeth down in contact with the bottom to catch successfully. When the bag is filled with oysters, there is a drag that has a tendency to cause the teeth to be lifted off the bottom. Then the oysters on the bed go under the teeth and are mauled by the full bag being dragged over them. In the opinion of the company that built this dredge, this is the main reason for the mauled condition of the last oysters taken off the beds.

The new dredge does not act that way. The new dredge is lowered to the bottom and is pulled along by the chain the same as a regular dredge. Immediately the cut-board goes into action and pushes the teeth down on the bottom, the oysters filling up the bag section, also causing weight to be put on the teeth. As the oysters fill the bag, or rear section, it causes the cut-board to go up and out of action. That is where the weight takes over and holds the teeth down in contact with the bottom. Should any oysters go between the teeth, the rear section or bars do not touch them as there are five or six inches of space under them. This rear section rides on the skids that also control the angle of the teeth.

The first of these dredges had teeth that could be easily adjusted. Testing the angle that the teeth should be set on the bottom, it was found that on this

company's hard bottom they should be vertical to catch the best. On soft bottom they should slant back. The softer the bottom the farther back they should slant. The company's present dredges have stationary teeth just back of vertical. These new dredges also have adjustable cut-boards. The cut-board also helps keep the boat going at an even speed. The exact angle isn't known as yet. It is believed they should be automatically adjusted by the speed of the dredge as well as the length of chain used. This sounds complicated, but really is not.

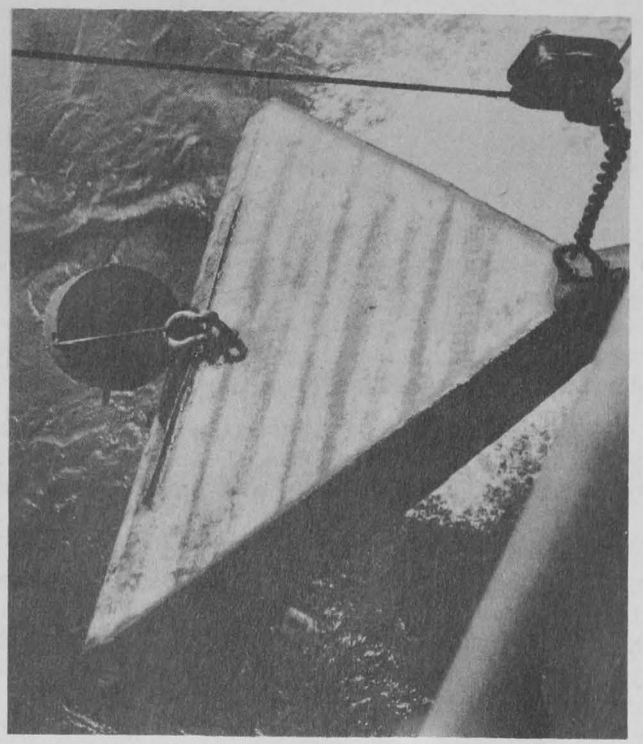
These dredges are more or less in two sections. The front or pulling framework has the cut-board and this fact causes the change in the angle of the cut-board when the depth of water of the length of chain varies. Linking this cut-board up with the rear section in such a way as to compensate for the variances that occur is possible.

These dredges always go down right side up. It is almost impossible to get them over on their backs. Occasionally they will come up the wrong way, but it makes very little difference. They are dumped just the same and a slight pull at the right time on their way down turns them right side up again. They have doors in the back of the bag section that are swung open to dump them. A pair of simple catches are all that are opened to release the doors, and when they are swung closed, they automatically catch. They can be dumped out and closed in less than two seconds. They are almost self-dumping.

WASHING OYSTERS AS THEY LEAVE HOPPER ON CONVEYOR BELT

If an easy way to dump them from the pilot house could be found, it will be possible to load a boat with just a captain on board. Of course, that's not quite practical, but it has possibilities.

At present, the dredges are handled on booms, but a lot of research is still necessary to perfect them. At present, in a heavy seaway, they must be handled with caution. The booms should not be pulled aboard while the boat is wallowing in the trough of the sea, as they will swing around. The boat should head up into the sea or go with it when the dredge leaves the water to be dumped in the hopper or on deck. Controlled booms to handle them in a heavy sea are practical and possible. Booms can be held up out of the way, leaving the deck clear of the dredges and chains. In dredging with booms, it is not necessary to turn the boat when the dredge under the boat is to be pulled. The boom holds the block out away from the boat, keeping the chain clear of the bottom. This rig is especially good for dredging in very shoal water as the dredge is well outside of the bilge, making it easy to turn without getting on the dredge.



WORKING END OF THE SUCTION OR HYDRAULIC DREDGE SHOWING TEETH. ROUND AIR CHAMBER SHOWN HELPS STABILIZE AND LIGHTEN DREDGE.

The company that invented this improved dredge is more than pleased with it, since it has proven well worth all the trouble in developing it. Not only the dredge had to be designed and tested, but the booms and machinery to handle them also had to be built.

PART III-THE BAILEY OYSTER DREDGE

On the Pacific Coast in the Puget Sound and Willapa Harbor regions, the usual method of harvesting oysters is to stake a barge over an oyster ground at high tide, and when the tide is low to throw the oysters onto the barge with pitchforks. Since Olympia oysters are grown in diked areas, this method is satisfactory, and the growers can afford, because of high prices, to use a system of this kind. That procedure, incidentally, has been used very extensively for harvesting the larger Pacific oysters imported as seeds from Japan.

Such a method is necessarily rather expensive and is not usually adaptable in other parts of the country because on the Atlantic and Gulf Coasts, the range of tide is not sufficient. Most of the oyster beds on the Pacific Coast are exposed at low tide, but there are not many localities on the Atlantic and Gulf Coasts where one may walk over the oyster grounds and make a minute inspection of the oysters, as well as of any predators such as starfish and snails.

The Bailey oyster harvesting equipment was developed to eliminate as far as possible a large amount of the hand labor required to harvest oysters even on the West Coast. It is very likely that these same ideas are applicable also to certain localities on the Atlantic and Gulf Coasts.

THE BAILEY OYSTER DREDGE

The principle of the Bailey dredge is the use of water in motion to lift the oysters from the beds, and the use of a mechanical conveyor to bring them from a point close to the bed up and onto the vessel.

There is very much to be said in favor of the hydraulic type oyster harvester. It is a great step forward, not only because it takes up oysters efficiently, but also because it gives the producers an opportunity to eliminate such predatory animals as starfish and drills. In the opinion of the Director of the Biloxi Oyster Laboratory, equipment of this kind reaches its full degree of efficiency on firm, solid, clay bottom.

PART IV - THE BROWN SHELLFISH HARVESTER

Operation and Mechanics

Most of the beds on the South Atlantic and Gulf Coasts consist only of a relatively thin crust of shell on top of an extremely soft mud bottom. The ordinary oyster dredge which is dragged behind the boats is likely to do permanent damage to this superficial crust. Therefore, several States on the Gulf Coast have found it necessary to regulate dredging operations. Only at certain times are the State reefs open to dredging, although at other times tonging is freely permitted.

One type of oyster harvester which has been tried thoroughly on these types of ground and has been found to be extremely effective is the Brown oyster harvesting machine invented at Bayou LaBatre, Alabama. In this machine, the ordinary dredge idea was put into reverse by having the harvesting equipment at the front end of the boat or barge on which it is carried. Although it seems very logical, it necessarily requires mechanism whereby the dredging portion will not run into obstructions on the bottom and either destroy itself or stop harvesting oysters. However, this difficulty was overcome.

In the first place, the entire harvesting mechanism is pivoted on the front end of a self-propelled barge and counterbalanced with water tanks which may be drained or filled to maintain the correct balance. It consists of a rather simple metal framework, and a metal conveyor belt which is provided with cross-bars bearing a series of curved tines. This conveyor belt takes the oysters from the bottom, and at the same time conveys them continuously up to the deck. Very important are the crawler wheels, as they are called, which are wide flanged toothed wheels, one on each side of the actual dredging end of the harvester. Those wheels move in

the direction in which the barge is moving so as actually to drag the barge along, while the dredging tines move in the opposite direction. On fairly solid bottom, it is actually not necessary to have the engine at the stern providing propulsion unless there is a wind, in which case it is convenient to use this engine to maintain constant direction.

The tines on the cross-bars of the conveyor belt have rather a large curvature so that they can scrape the oysters from the surface of the bottom without digging more deeply than necessary. This harvester naturally can be changed to suit particular needs, but as it is at present each row of tines can carry a minimum of one-half bushel of oysters to the deck, and those rows of tines reach the deck at the rate of 16 or more times per minute. On a well populated ground, one may expect to bring aboard the barge at least seven or eight bushels of oysters per minute. In fact, this is one of the difficulties encountered in perfecting this mechanism for it is not easy to dispose of this quantity of oysters by culling, etc., and loading onto boats which will carry them to market.

For this reason, it has been necessary to install conveyor belts. One of them takes the oysters as they are brought on deck, and then loads them onto a cross adjustable conveyor belt which carries them to a boat alongside for culling and transportation.

An additional feature of the Brown Harvester is the fact that the conveyor is provided with a series of jets of water under high pressure so that the oysters reach the deck completely free of mud and debris. On some hard grounds, this would not be significant, but on rather muddy bottom the oysters need to be thoroughly washed.

BROWN OYSTER HARVESTER (COURTESY OF LOUISIANA DEPARTMENT OF WILDLIFE AND FISHERIES)

The first of these harvesters was very defective in one respect; namely, that it was made to harvest oysters from soft bottoms and not from hard rocks and reefs. The dredging tines were made of stainless steel and worked perfectly on soft bottom; however, on a hard reef in Louisiana the steel of the tines proved inadequate and the tines rather quickly bent out of shape. This deficiency has been corrected by installing tines of hard steel which defy anything on the bottom to bend them. In order to avoid damage to the tines or to the entire mechanism, the cross-bars which

bear the tines are individually sprung so that if an obstruction is encountered, the tines spring back and slide over without stopping harvesting. This is one of the most important parts of this type of mechanism for it means that it can continue working day after day without having to go up on the ways for frequent repairs.

Use for Harvesting Clams

This piece of equipment should actually not be called an oyster harvester, but rather a shellfish harvester, because it is at least as well adapted to digging clams as to taking up oysters. The crawler wheels are adjustable from the deck by turning a wheel so that the depth of penetration into the sand bottom by the tines can be adapted momentarily to the particular type of bottom and to the distance under the surface that the clams are living. Ordinarily, clams live in rather hard sand, but they are usually within four or five inches of the surface. The Brown Harvester is able to take out these clams at a rapid rate and constitutes a real improvement over the old method of digging by hand.

Use in Shallow Water

Especially in southern waters one encounters large areas of so-called "coon oysters" in shallow bayous and bays and near the shore even of larger bodies of water. The Brown Harvester has the advantage of being carried on a flat bottomed barge which draws so little water that harvesting can be carried on in water one foot deep. Even tongers in skiffs have difficulty taking up those oysters; however, the usefulness of this type of equipment is not limited to very shallow water. The machine can be made to harvest from almost any depth, although the ones so far put into use have been planned to work effectively in a depth of only eight feet. There appears to be no difference whatever in efficiency within the range for which any particular piece of equipment is intended to operate.

Production of Oysters in the United States, 1945
(Expressed in thousands of lbs. of meats and thousands of dollars; that is, 000 omitted)

Item	New England		Middle Atlantic		Chesapeake		South Atlantic and Gulf		Pacific Coast	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Oysters:										
Eastern, public	45	17	418	189	16,388	5,737	11,889	3,305	-	-
Eastern, private	2,434	1,046	13,134	5,162	16,182	5,884	4,903	1,940	9	8
Pacific	-	-	-	-	-	-	-	-	10,074	1,706
Western	-	-	-	-	-	-	-	-	151	150
Total	2,479	1,063	13,552	5,351	32,570	11,621	16,792	5,245	10,234	1,864
Percent of total	3.3	4.2	17.9	21.3	43.1	46.2	22.2	20.9	13.5	7.4