International Council for
the Exploration of the Sea

C.M. 1970/B:10
Gear and Behaviour Committee

# Some effects of the passage of a trawl over the seabed

by

J. P. Bridger

Fisheries Laboratory, Lowestoft



## INTRODUCTION

It has long been the practice, in trawl fisheries for flatfish, to rig the groundrope of the net with chain and to use one or more "tickler" chains arranged across the mouth of the net so as to travel in advance of the groundrope. With the substantial increase in engine power of North Sea type trawlers and the re-introduction of the beam trawl to high-seas fisheries in recent years, the numbers and weights of tickler chains used on both otter and beam trawls have been considerably increased. In one or two localities around England, mainly inshore, there have been reports of the traditional fishing grounds being altered and becoming rock-strewn, allegedly as a result of the action of chain-rigged trawls. This report describes a first investigation, made in June 1970, aimed at observing and recording the effect on the seabed of a trawl with various modifications of chain rigging.

The investigation was planned and carried out by the Gear Research Unit and the SCUBA diving team of the Fisheries Laboratory, Lowestoft, assisted by Dr. Lythgoe of Sussex University, using R.V. TELLINA (114 hp, 55 ft oa) on regular inshore trawling grounds off the Sussex coast (English Channel). The grounds fished were some on which, according to some local inshore fishermen, trawls with tickler chains had brought boulders out of the seabed to the detriment of other types of trawls. R.V. TELLINA and the trawl used on her were closely similar to the ships and gear employed in that locality.

The key plan of operation was that divers should observe and photograph the seabed both in front of and immediately behind the moving trawl, and should also observe the action of the tickler chains and

trawl groundrope, the rigging of the net being changed from haul to haul so that the effects of the various parts of the trawl could be separated.

In the five days of the investigation, fifteen hauls were made involving eight different rigs. A pair of divers descended to make observations on each tow, their dives each lasting about twenty minutes.

## THE TYPES OF GROUND FISHED

Three grounds were fished in this investigation:

i. About 4 miles south of Brighton, consisting of patches of stones and boulders mainly well buried in sand and shell, depth 10-11 fm (18-20 m).

ii. About 1 mile south of Brighton, consisting of large numbers of stones and small boulders and some sand, depth 6-8 fm (11-14½ m).

iii. 2-3 miles offshore between Peacehaven and Rottingdean, consisting of small patches of flints, some buried and some exposed, set among wider areas of rather viscous muddy sand, depth 8-10 fm (14½-18 m). The inshore edge of this ground was strewn with pieces of chalk broken away from the cliffs by the sea.

Four tows were made on the first ground, only one on the second because the gear was damaged by the boulders, and ten tows on the third ground.

## THE GEAR USED

The net used was a "Fleetwood 8 fathom trawl" (groundrope overall length 48 ft (14.6 m), headline length 41 ft (12.5 m). This net, made of polythene, is similar to those used by the local 100-120 hp vessels of Newhaven, and it was rigged as closely as possible to the Newhaven pattern.

The groundrope consisted of three 16 ft (4.8 m) lengths of 3/16 inch (5 mm) chain on to which rubber discs of 3 inch (76 mm) diameter were threaded. The 51 ft (15.5 m) fishing line was attached to 44 ft (13.4 m) of the groundrope by a rope bolsh leaving two feet (0.6 m) of bare groundrope protruding in front of the lower wings. The groundrope was then wrapped with varying amounts of chain.

The otter boards measured 5 ft x 2 ft 9 inches (1.5 m x 0.8 m) and were of the normal flat rectangular wooden variety, bound with iron. The net was connected to the otter boards by legs, the upper of 26 ft (7.9 m) of synthetic rope and the lower of 24 ft (7.3 m) of chain. Two sizes of chain were employed during the experiments, a heavy one of 11/16 inch (17 mm) and a lighter one of 5/16 inch (7.5 mm).

Various tickler chains ranging from ¼ - 11/16 inch (6-17 mm) in diameter were used, either between the two otter boards or between the wing ends. Some hauls were made without tickler chains, and for two of the hauls all the wrapping chain on the groundrope was removed.

## METHOD

The keynote was accuracy of observations, making very sure that these were precisely positioned in relation to the path of the trawl. Before each tow and dive, all participants were briefed as to features of the gear in use, what to expect and what were the priorities of particular observations. Normal safety precautions were taken.

After the gear had been shot and the warps blocked up, two of the three divers descended from their rubber boat to the gear, either by hauling themselves down a light line attached to the headline of the net, or by following the warps down to the gear. Until it was ascertained that both divers were safely on the headline the towing speed was kept to a minimum; thereafter it was increased somewhat, depending on the amount of equipment carried by the divers and the tasks they had been briefed to carry out. The direction of tow was normally with the tide or slightly across it. The mean speed through the water was 1.4 knots (~~1.0~~ 0.7 mps) and the mean speed over the ground was 1.9 knots (~~1.5~~ 0.95 mps) since at speeds greater than this the divers were unable to work efficiently.

For the first seven hauls the two divers rode on the headline of the net, taking photographs or filming the action of the gear on the seabed and the reaction of fish to the gear, and making only occasional excursions forward along the wings and upper legs as far as the otter boards. Later a technique was developed to study the detailed effect of the passage of the trawl over the seabed. This involved the use of a length of twine with a lead weight fastened to each end, a spike, a 30 ft (10 m) tape measure and an underwater note pad as well as the

underwater cameras. The method was as follows: having ridden on the headline for a while, both divers moved back to the cod-end and from there, while holding on to the cod-end, released the first weight and paid out the length of twine. When the twine became taut they dropped the second weight and immediately loosed their hold on the net. The weighted twine thus marked the centre line of the track of the gear and the divers stayed by it until the cloud of detritus stirred up by the trawl had been swept away by the tide. They then drove a spike into the ground on this centre line, fixed the tape measure to it and swam at right angles to the line, paying out the tape measure as they went. The distance from the centre line of each sign of disturbance or feature on the seabed was recorded and often photographed. In this way not only was the horizontal spread of the gear measured but the cause of each type of disturbance determined.

After about 20 minutes the two divers surfaced, were picked up in the rubber boat and brought back to TELLINA to report. The gear was then hauled, the appropriate changes to the rig were carried out, and the divers were briefed for the next haul. While the divers reloaded their cameras and changed their air bottles the catch was sorted and counted.

## RESULTS

Although no part of this comparatively light gear ploughed deeply into the seabed, it was found that on the softer stretches of ground every part of the gear which was in contact with the seabed left its individual mark. Clearly the nature and extent of these marks depends not only on the gear used but also on the exact composition of the seabed. The following observations, based on reports given by the divers immediately after the dives and subsequent scrutiny of the films and photographs taken, therefore apply particularly to those grounds on which they were made.

The tickler chains disturbed only a thin layer of the top sand even when a 44 ft (13.4 m) length of $^{11}/_{16}$ inch (17 mm) chain was used between the wing ends (see Figure 1). The chains soon collected a number of starfish (Asterias sp) wrapped around them and at times the heavier ones were coated with them. These chains rode over stones which were reasonably well buried in the sand, especially if these had smooth upper surfaces. However, if a stone protruded much above the surface of the sand

or had an irregular shape on which the chain could catch, it was pulled out of the seabed by the tickler. Stones dislodged in this way were carried along by the tickler for a few feet but finally the chain either passed underneath them or more commonly rode over the top (see Figure 2). In the process many of the stones so dislodged were overturned, leaving the original upper surface, with its incrustation of marine life, underneath and its bare lower surface uppermost. These reversed stones and the empty sockets from which they had been dislodged made the track of the trawl very easy to find, and when occasionally the divers went outside the area of the gear these signs helped them to re-locate it. The empty sockets left by the stones were not normally filled in by the passage of the groundrope or netting of the trawl (see Figure 3). The heavier ticklers also left parallel ridges in the sand where alternate links in the chain had gouged out a groove, but these marks were largely erased by the passage of the net.

The heavy chain lower legs also dislodged stones from the seabed, but since the eddy trail from the otter boards normally hid the legs in a cloud of sand it was usually impossible to see or to photograph exactly what happened. These legs also left very distinctive parallel ridges in the sand (see Figure 4) and the area in which these ridges occurred was strewn with dislodged stones.

When light lower chain legs ($^5/16$ inch or 7.5 mm) were substituted, the ridges and dislodged stones were not in evidence and when both the tickler chain and the wrapping chain on the groundrope were removed it became extremely difficult to determine exactly where the trawl had been. With all the wrapping chain removed and the groundrope lifted almost entirely clear of the seabed by means of trawl floats, a $\frac{1}{2}$ inch (12 mm) tickler chain fastened between the wing ends dislodged many stones and left clear signs of its passage over the seabed.

The 5 ft long otter boards completely obliterated the natural sand ripples over a track width of about 3 ft (1 m) and on stony ground left scars on some of the boulders where the iron sole plates struck them.

The central bosom section of the groundrope itself left little or no sign of its passage, and such ridges as may have been made by the wrapping chain were obliterated by the subsequent passage of the netting. The extreme ends of the groundrope, however, left distinct grooves in muddy sand. These grooves were normally from $\frac{1}{4}$ - $\frac{1}{2}$ inch (6 - 12 mm) deep and

rounded off by the rubber discs, making them quite distinctive, so that it was possible to measure the wing end spread of the net.

It was clear therefore that the tickler chains were not alone responsible for the trawl's effect on the seabed, but that other chained parts, and especially the lower legs such as are used on almost all flatfish trawls, contributed to the dislodgement of stones on the grounds fished in these experiments.

For all but five of the fifteen hauls the groundrope was wrapped with 66 ft (20 m) of $\frac{1}{4}$ inch (6 mm) chain spread evenly from wing tip to wing tip, and the 16 ft (4.8 m) bosom section was additionally wrapped with 42 ft (13 m) of $\frac{3}{8}$ inch (8 mm) chain. Despite this moderately heavy wrapping the groundrope exerted little weight on the seabed and rode over practically all the obstacles in its path. Although many hundreds of stones and small boulders of up to the size of grapefruit lying completely exposed on the seabed were encountered by the groundrope, only two were caught in the net.

The catches taken in these experiments at slow speeds in daylight were small and consisted mainly of plaice and dabs, with a smaller number of soles. The numbers of marketable fish of these species were counted, as were the numbers of all undersized flatfish. The quantity of benthos brought up in the net, consisting mainly of Asterias spp, with some Ophuroids and Echinocardium spp, were measured into 25 kg baskets before being dumped overboard.

The catches, adjusted as per 60 minute tow by the main gear configurations tested, are given below.

| Gear rig | Numbers per 60 minute tow | | | | | Catch of benthos (baskets) |
|---|---|---|---|---|---|---|
| | Marketable fish | | | | Undersized flatfish | |
| | Sole | Plaice | Dab | Total | | |
| No tickler chain | 2 | 27 | 30 | 70 | 51 | 0.9 |
| $\frac{1}{4}$ inch chain | 5 | 22 | 18 | 47 | 25 | 2.1 |
| $\frac{3}{4}$ inch chain | 8 | 23 | 7 | 39 | 75 | 6.7 |
| $\frac{11}{16}$ inch chain | 15 | 30 | 38 | 87 | 90 | 9.0 |

Because this was not a controlled comparative fish-catching experiment, inter-haul catch comparisons could be misleading. However, the figures above suggest that, while the catch of soles and unwanted benthos is greatly increased by the use of heavy tickler chains, the catches of marketable plaice and dabs on these particular grounds are not substantially altered. The numbers of undersized flatfish caught were also somewhat higher when heavy chains were used, but the number of hauls was small and this result is not significant.

## SUMMARY AND CONCLUSIONS

Despite the fact that the otter boards, chains and net used in these experiments were of relatively small size and light weight, being typical of much English inshore trawling gear, the degree of disturbance they caused to the particular seabed fished over was considerable. The divers had no difficulty in discerning exactly where the gear had been, since it left clearly defined ridges and grooves in the sand and partially or completely obliterated the natural sand ripples. When tickler chains and/or heavy chain legs were used, the track of the gear was strewn with dislodged or overturned stones and numerous depressions in the sand from whence these stones had been removed. Since the net brought up only two stones and suffered damage only once, the impression gained on board of little seabed disturbance by the trawl was different from that obtained from divers' reports and pictures.

Although the contention that tickler chains dislodged boulders on these grounds was found to be substantially correct, these experiments indicated that this, in itself, did not render the grounds untrawlable by causing excessive gear damage. However, since it appears that in order to become caught in the net a boulder must be of such a size and must lie at such an angle that the groundrope strikes it below its centre of gravity, the smaller the diameter of the groundrope the more likely it is that it will undercut boulders. The smallest size of inshore trawlers in that particular region, using a 2 inch (51 mm) groundrope, might therefore suffer more gear damage from displaced stones than would a larger vessel using a 3 inch (76 mm) diameter groundrope.

The quantity of benthic marine life brought up in the net was ten times greater when a heavy tickler was used than when the same net was used without a tickler; the disturbance to the benthic animals torn off stones or buried when stones were turned over must have been considerable.

The effect on the seabed of any trawl will depend upon the trawl itself, on the nature of the ground and on the animal life upon it. Even after making allowance for the fact that the results of these first limited trials apply particularly to the type of fishing ground where they were made, it is not unreasonable to suppose that the much heavier and multi-chained trawl gear such as is currently in use in several European fisheries will, especially on some grounds, have considerable effects on the surface structure and ecology of the seabed. The subject requires further study.

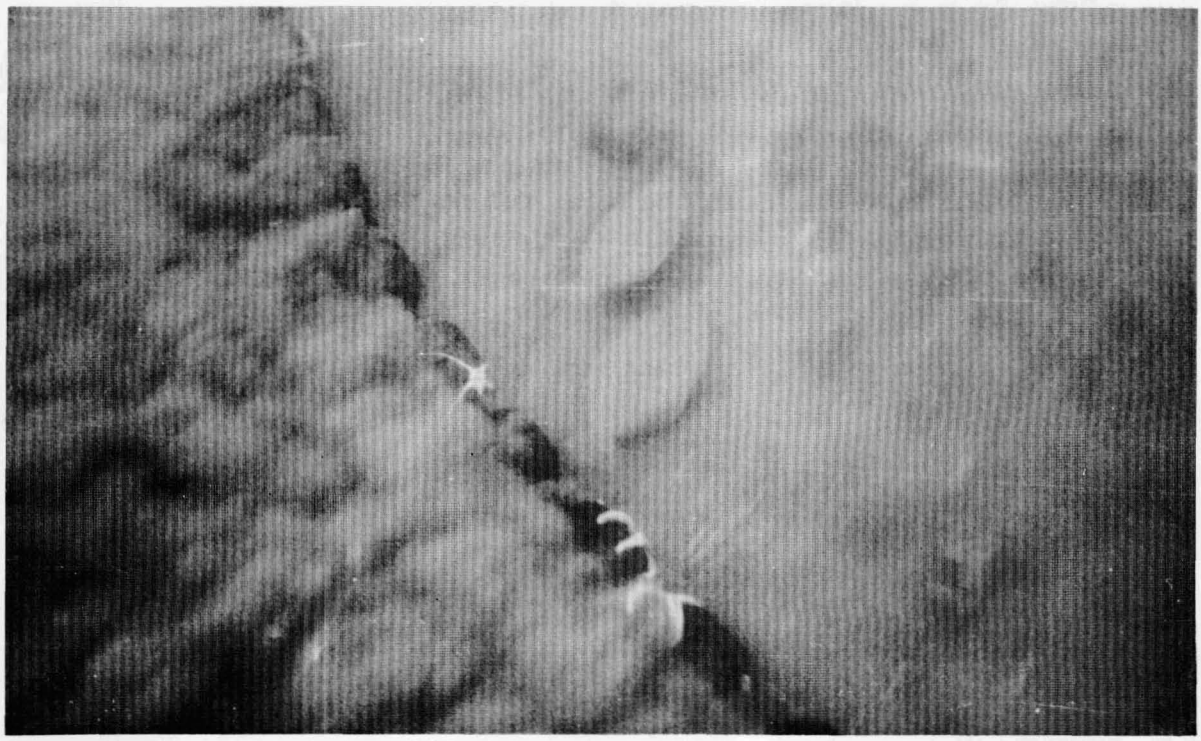

Figure 1 A tickler of 11/16 inch (17 mm) diameter chain riding over sand.

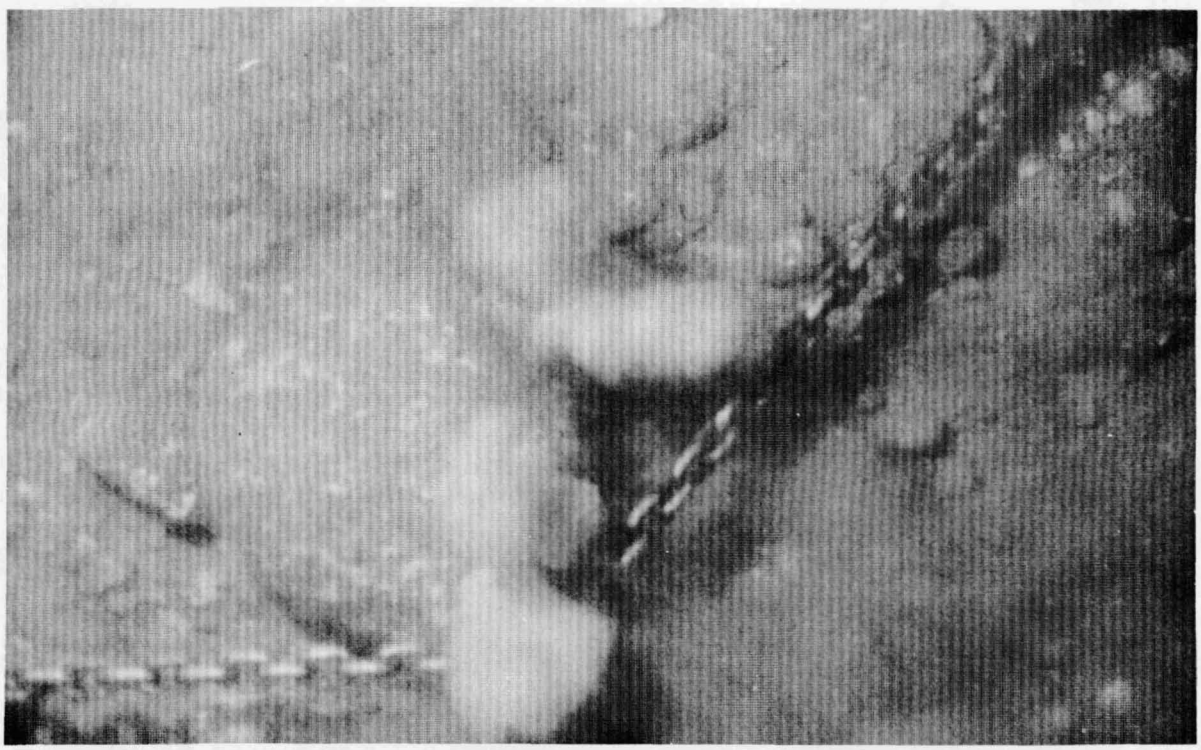

Figure 2 A tickler of $\frac{1}{4}$ inch (6 mm) diameter chain in contact with a small boulder.

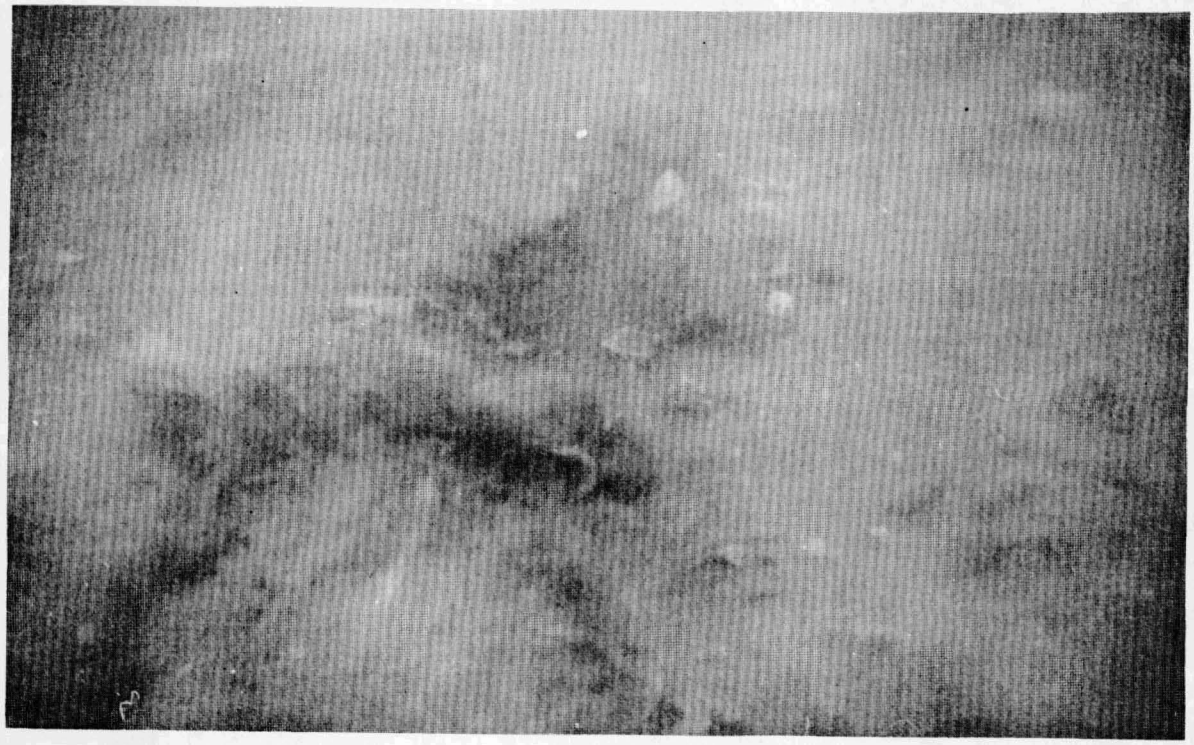

Figure 3 A boulder pulled out of the seabed by a tickler chain.

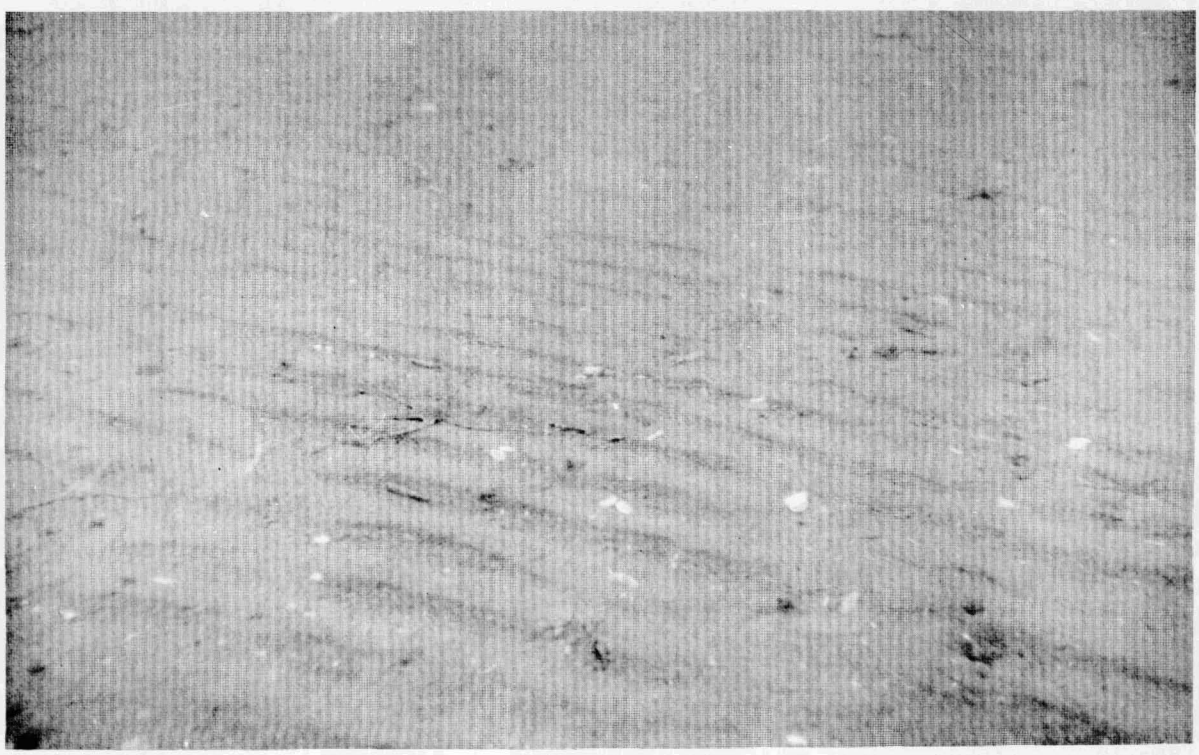

Figure 4 Ridges left in the sand by 11/16 inch (17 mm) diameter chain lower legs.