COMMON CORERS AND GRAB SAMPLERS

OPERATING MANUAL

AVAILABLE THROUGH

TECHNICAL OPERATIONS

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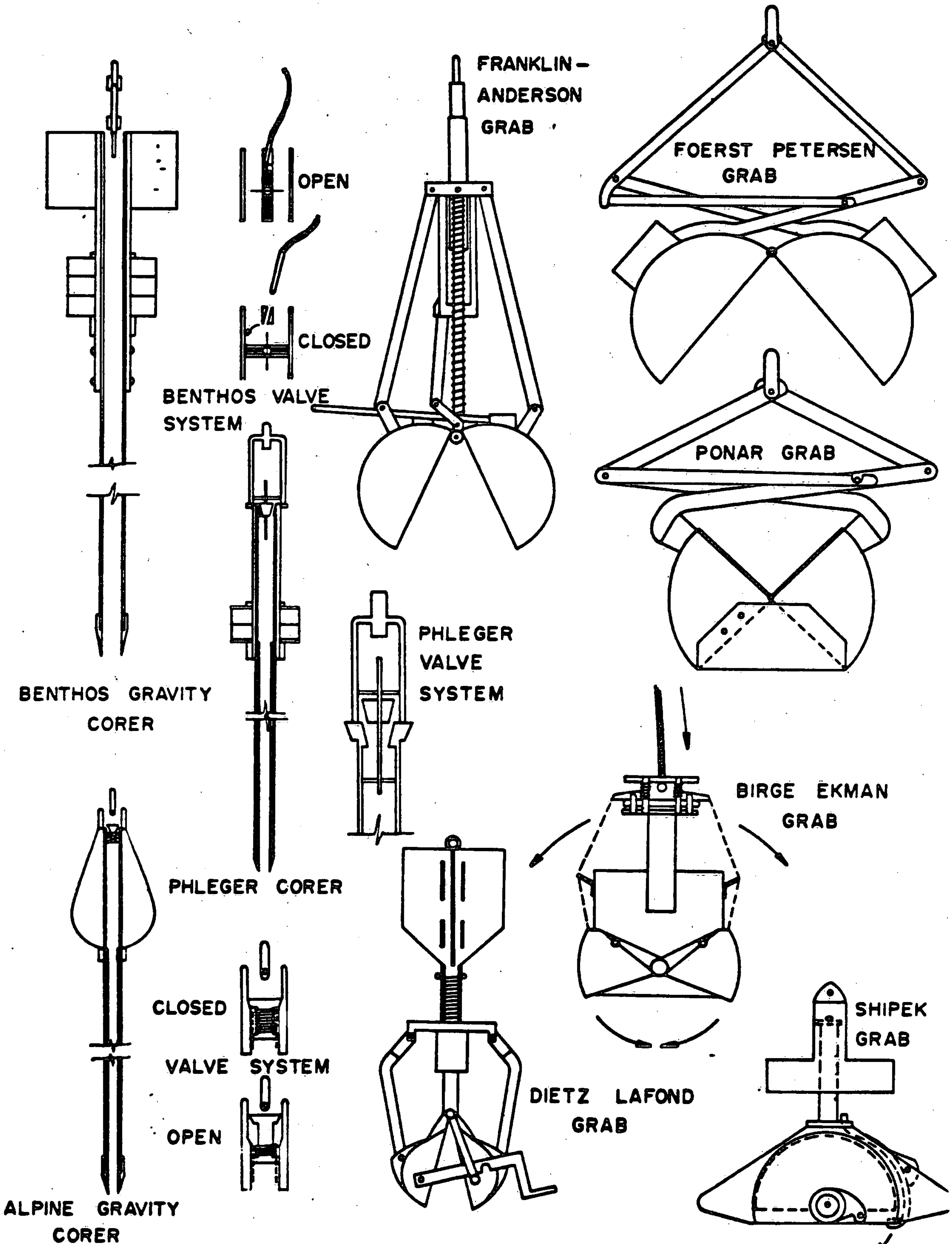
M.R. Mawhinney and C. Bisutti
Technical Operations
National Water Research Institute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INTRODUCTION

A very important aspect of any limnological study of any lake is the geology of the lake. In order to determine the past history, the modern baseline as to the condition of the lake, knowledge of the activities within the sediment must be known for future studies. In order to obtain this knowledge, proper and undisturbed bottom sediment samples must be collected, analyzed and sometimes even stored for future reference and comparison.

As a support service, Technical Operations keep a well-stocked supply of numerous types of coring and bottom grab samplers. The scientific sampling equipment ranges from the very light samplers used from small boats to the very large, requiring heavy cranes and ships. In the following report, numerous most commonly used samplers and their uses are described. Application and types of sediment each sampler will collect accompanies the samplers' descriptions.

BASIC CORERS USED AT CCIW AND OPERATIONAL PROCEDURES

1.1 ALPINE GRAVITY CORER (Model 211)

This tool is finless and has interchangeable steel barrel lengths of 0.6, 1.2 and 1.8 m. The steel barrels have a 4.1 cm I.D. 4.8 cm O.D. and the plastic liners have a 3.5 cm I.D. 3.8 cm O.D. A streamlined lead weight of about 45 Kg is mounted externally on the corer above the barrel. Attached to the top of this is a combination attachment point/valve assembly. The valve system uses a light compression spring to retain a plastic and rubber leg and cap assembly against a bevelled circular seat. During penetration, the increased pressure in the barrel causes the cap assembly to lift clear of its seat and allows the necessary displacement of water from the barrel. As soon as penetration ceases, the pressurized displacement also ceases. The compression spring then forces the cap valve to re-seat and seal prior to withdrawal. The corer is also held in the core tube by the additional use of an eggshell retainer. The retainer should not be used except in extreme cases where the sediments are very firm since sediment disturbance will occur.

1.2 PHLEGER CORER

This instrument has been designed specifically for taking short samples in soft sediments. The core barrel has a chrome alloy, bayonet fitting nose cutter. The barrel and core liner have the same dimensions as the Alpine Corer (I.D. and O.D.). The upper part of the core barrel screws into a further section of tubing on which ring weights are mounted. The weight of the corer (less weights) is 7.7 Kg with each weight adding an additional 6.8 Kg. The upper tubing provides a support for the weight rings and also gives balance to the corer, there being no stabilizing fins. The upper tube is capped by a simple valve assembly consisting of a neoprene bung mounted on a metal pin which slides freely in two locators (one within the tube and one mounted externally above it). The bung is slightly tapered and fits into a similarly shaped metal seating. The pressure of water within the tube on lowering and penetration forces the bung up and clear of its seat. On withdrawal, the pressure within the tube is maintained, assuming a perfect seal, by the bung as it slides back into its seat. The core is also retained by the use of an eggshell retainer. This is not recommended since the core is badly disturbed when the retainer is employed.

1.3 LIGHTWEIGHT CORER

The CCIW lightweight corer is a piece of scientific apparatus and must be treated with care if it is to be operated successfully. The corer, because of its lightweight construction, delicate parts and electronics package, should not be treated as a standard corer. Do not allow it to slam against the side of the ship or launch. When not in use, store it in its box or lash it down and unplug the triggering plug.

Preparation of the Corer

Ensure that all the parts listed in the Operating Parts List are in the storage box and are in clean and working order.

Test the battery at least one day before it is needed. If it is not charged 100%, charge it. (See following section.)

Assembly of the Corer

Remove the corer head and the electronic package from the storage box. Attach the package to the head opposite the solenoid case. Line up the notch in the electronics package with the bar in the cage and fasten the package with the screw clamps.

Put a thin film of silicone grease on the pins of the electrical cables. Connect the solenoid cable to the electronics package and to the solenoid case. Connect the sensor cable to the electronics package*. Using tape or cable ties, fasten the cables to the cage so that there is no strain on the connectors and so that the cables are out of the way of the corer mechanism.

*NEVER connect the sensor cable to the battery plug.

Tape the core tube and the small tube section together using the wide cloth tape (one layer only).

Attach the piston operating wire to the piston by first freeing the slotted pivot arm. This is done by depressing the lever at the top of the piston. Put the aluminum block which is fastened to the operating wire under the pivot block with the wire in the slot. Depress the pivot block so that it latches underneath the lever. Ensure that it has snapped fully into place and that the aluminum block is sitting squarely under the pivot arm. Two sets of piston operating wire for .5 m and 1 m.

Lightly lubricate the seal of the piston. Push the piston down the core tube one metre using the metre stick provided.

Uncoil the closing wire from around the cutting edge. Open the sphincter by inserting the sphincter valve resetter into the slot in the moving ring on the inside of the cutting edge. Rotate this ring 180° clockwise so that the sphincter opens. Smooth the cloth sphincter in its open position so that it points away from the cutting edge.

Lightly lubricate the "O" ring in the cutting edge. Now place the cutting edge over the core barrel end, making sure that the open sphincter lays up against the inside of the core barrel.

Insert the core barrel into the corer head aligning the sockets of the sphincter valve to the slots on the corer head.

Open the latches on the ends of the tie rods. Insert these ends in the sockets on the side of the corer head. Put the lower ends in the slots on the cutting edge. Make sure the tie rods are straight. Close the latches at the top.

Insert the sensor head into the holder on the side of the cutting edge. Straighten out the closing wire from the sphincter and lead it up to the top of the corer head. Latch the snap hook below the small aluminum block on the piston operating wire. For 1 m coring unit, a wire extension is added to sphincter cable.

Lower the slotted lever on top of the corer head around the wire. Turn the tee bar of the solenoid and snap the slotted lever over the tee. Turn the tee bar back to trap the slotted lever.

In cold weather (0 to -40°C), grease the tee bar and the slotted lever with silicone grease G322L.

Attach the loop of the piston operating wire to the wire of the lowering winch, using a proper shackle.

Attach the <u>SAFETY WIRE LINE</u>, using proper shackles on the upper cage to eye of lowering cable.

Grease the pins of the selected operating plug and insert it into the electronics package. Check to ensure that the LED in the interface sensor is flashing.

Recheck the corer to ensure that nothing is loose. The corer is now ready to be lowered.

Wait 90 seconds after plugging in to allow the capacitor for the solenoid to build up a charge.

Lowering and Raising

Carefully put the corer over the side of the vessel. Lower it slowly into the water. Allow it to remain on the surface until the core barrel has filled with water.

Experience and a knowledge of the bottom consistency will help in selecting the right lowering speed. A maximum lowering speed would be about .5 m/sec. Any faster than that is liable to be too great a speed to allow a good core to be taken. The slower the corer touches bottom, the better the core recovered; i.e., interface will be less disturbed.

If the depth of water is very great, a three stage lowering speed is desirable to speed up the coring time. Lower the corer at a rapid rate until it is about 20 m from the bottom. Stop the corer at this point for about 20 seconds to damp any oscillations that might have started during fast lowering. Now lower the corer at a slower rate to within 1 m of bottom, then at .05 m/sec. lower corer to the water sediment interface.

After coring action has taken place, extract the corer from the bottom at a very slow rate (.01 m/sec.). This allows the piston to leak water to prevent collapsing the core barrel, in the event that an incomplete core has been taken. This allows water to pass slowly through the large valve in the piston so that the incomplete core is not degraded. Once the piston is at the top of the core tube, the sphincter is closed and is then raised up out of the sediment and to surface at a reasonable rate.

When the corer reaches the surface, do not allow it to smash into the side of the vessel.

Bring the corer aboard in a vertical position and keep it that way until the core barrel and its core are removed and stored. Remove the operating plug.

Disassembly and Core Removal

Release the pressure relief screw on the piston, then with the corer vertical and the cutting edge on a piece of wood, open the two tie rod latches at the top on the corer head. Disconnect the sphincter closing wire snap hook from the piston operating wire. On the cutting edge, unsnap the interface sensor by pulling out on the tee bar just below the sensor protective cage and at the same time, pull the sensor up. Unhook the bottom of the tie rods. Now remove the corer head and put it in a secure place.

When removing the corer head, be careful not to drop the piston, which comes away with the head.

Put a "Caplug" on the top of the core barrel.

Insert the floating piston into the core barrel by means of the cutting edge tool. Slide the cutting tool through the cloth tape where the core tube is attached to the small tube section until it comes to rest on the stops, then push the floating piston into the core tube from its position in the cutting edge tool.

Store the core vertically and securely.

Post-Coring Care

Cleanliness is very important to the successful operation of the corer. Wash all parts with clean water. Do this in a bucket. Do not wash the parts over the side. The risk of losing parts that are difficult to replace quickly is too great. After they are washed, put them in the storage box. The two critical areas are the interface sensor and the sphincter. Ensure that they are clean and free of mud.

While cleaning the parts, also visually inspect them for broken or bent parts, loose screws or frayed wires on cables.

1.4 BENTHOS GRAVITY CORER

This sampler can be used as a pilot corer for large piston cores or as a principal sampler for many scientists. The corer itself takes a very good repeatable, relatively undisturbed sample.

It uses a 6.6 cm I.D. and 7.1 cm O.D. cellulose acetate butyrate tubing approximately 2 metres in length. The corer is designed in such a way that it has incorporated heavy stabilizer fins on the upper portion of the sampler. These fins allow straight penetration into the bottom sediments despite ship's motion caused by severe weather, currents, etc. The corer has interchangeable weights adjustable to 60 kilograms mounted externally on the upper part of the metal barrel immediately below the fins. There are two types of valves used by Technical Operations. The original valve is a very tight-fitting sealing valve which during descent and penetration, this disc, mounted transversely on a metal spindle, is held open against a spring (in a vertical position) by a small locking pin. When triggered, the pin is disengaged and the valve closes with the disc rotating into a position at right angle to the core barrel. An "O" ring, mounted on the outer circumference of the disc, makes an excellent seal against leakage upon retrieval.

Another style of valve used at CCIW is the auto valve. This valve is fitted to the top of the plastic core barrel which is then inserted into the Benthos corer. The valve is a spring-loaded plunger which, as the water passes through the core tube, is held open by the water flow during descent and penetration. Upon retrieval, the suction of the sediment as it attempts to slide back out of the core tube, plus the force of the spring, seals the plunger into a machined seat creating a partial vacuum, thus holding the core in the tube. The auto valve is a much more reliable method of sampling as compared to the older, fitted sealing valve since there is less tendency for the core to slide out of the tube on retrieval.

1.5 TRIPLE BENTHOS CORER

This coring device, built at the Canada Centre for Inland Waters, is a take-off on the Benthos gravity corer. The operational principles of the corer are an exact replica of the Benthos gravity corer.

The triple gravity corer has an outer ring which houses four barrels--three evenly spaced core barrels welded to a fourth non-functional barrel. The valves used are the Benthos gravity corer valves. The trigger mechanism also has the same operational principles as the Benthos gravity corer except it has been modified for convenience. The core tubes are 50 cm in length and have an outside diameter of 7.1 cm. The outer ring of the core barrels and the core barrels themselves make up the total weight of the corer which is vital for penetration of the sediment.

The operational procedures for the triple gravity corer are the same as those for the Benthos gravity corer.

1.6 PISTON CORER

1200 lb. Alpine Piston Corer

Piston coring has come about by the development of corers to obtain a truer representation of the bottom sediment structures. The piston corer not only collects a longer core but also a relatively undisturbed and uncompacted one. Cores of lengths up to 21 metres have been collected.

The 550 kg piston corer is formed by three main parts:

1. A weighted stabilized head

2. Coring pipe including core liners, a piston, a retainer and a cutting head

3. Trigger mechanism

In similarity to the gravity corer, the piston corer depends on the weight of the instrument itself for penetration of the sediment.

The piston which is attached to the winch wire, is placed inside the core liner at the end of the core barrel. On triggering, the piston does not move relative to the bottom, while the barrel penetrates the sediment. The suction caused by the corer moving down on the piston overcomes the frictional forces acting between the sediment sample and the walls of the coring tube. The piston is designed with stops for retrieving the coring apparatus. The sediment sample is prevented from sliding out of the liners by a multifingered steel core retainer.

The trigger mechanism consists of a come-along with an initial grip, a trigger arm and a release. The tripping mechanism is an off-centered balance arm with its fulcrum very close to one end. The piston corer unit is attached to the release on the short arm and a trigger weight is connected to the trigger arm by means of a line causing the arm to sit horizontally. If the trigger weight is removed, the off-centered balance arm will move upward a preset distance causing the release of the coring unit. The initial grip will hold the complete trigger mechanism on the wire after the corer has been triggered. The function of the come-along is to hold the corer and free fall wire in place before triggering of the instrument.

Since the piston corer is time-consuming to assemble, the corer is always made ready before reaching a coring site.

The steps followed in preparing the corer are:

1. Place the coring head on the riggers with the lifting plate in an accessible position

2. Attach the feige fitting to the end of the winch cable. If this has been previously done, then check the fitting

3. Move the pipe to be used onto the riggers and couple a length of coring pipe to the weighted head. Coupling is done by placing a pair of coupling plates around the end of the coring head and the coring pipes, then banding the plates together with stainless steel Bandit tape

4. Place a core liner in the coring pipe

5. Feed the winch cable with the feige fitting on its end through the head and coupled length of pipe, until it dangles from the head of the pipe

6. If another section of pipe is needed to make up the required length for the core, then:

   (a) Insert liner into another pipe leaving an overlap of approximately 2 inches

   (b) Feed the winch cable through this length of pipe until the cable dangles out the end of the pipe

   (c) Tape the plastic liners together so that they are firmly sealed and slide the pipe up flush to the other length

   (d) Couple the two lengths of pipe together

7. Saw the plastic liner flush with the end of the last pipe

8. Attach the piston to the feige fitting

9. Bevel the end of the plastic liner so that the piston leathers will fit easily into the pipe

10. Tie a length of strong twine around the end of the piston and then position the piston in the end of the coring pipe. Positioning of the piston should be done by one person pulling the cable at the core head while another person positions it

11. Insert the core retainer in the end of the coring pipe immediately below the piston. The end of the twine should be passed through the centre of the retainer

12. Place the cutting head in position on the end of the coring pipe and bad it there. The twine which is hanging through the end of the pipe should be tied snugly above the cutting head

13. Attached the release mechanism to the bail link and insert the safety pin

14. Measure the amount of scope required for the desired penetration. The scope is determined by the amount of free fall required for penetration and a recoil factor due to the sudden reduction of tension on the cable when the corer is released. The scope is measured from the bail to the bottom of the come-along and marked with tape to avoid confusion

15. Place the cable at the lower end of the come-along and firmly secure the initial grip. Bolt the removable piece of the come-along into position and check to see if the scope is the correct calculated length

16. Measure the length of the trigger line and secure it to the trigger arm and weight. The trigger line is determined by the length of pipes used, the amount of free fall, the distance the trigger arm travels before release, the length of the core head, minus the trigger weight length

17. Depending on the length of core to be obtained, wire straps are placed in critical positions to aide in the successful inboard hoisting of the core assembly

Because of the tremendous weight and the clumsy shape of the coring apparatus, extreme caution should be taken at all times when handling this instrument. Aboard the ships, piston cores are generally obtained by the following procedure:

1. Place slip ropes on the core barrel in the positions which restrict excessive binding of the pipes when lowering the corer in a vertical position
2. Hoist the entire assembly above the gunwale and swing it outboard so that the core head will be a working distance from the hull

3. Lower the core barrel by means of the slip ropes until the corer hangs nearly vertical

4. Take up the slack on the coring wire until it has the full weight of the corer. The corer now hangs vertically

5. Lower the trigger weight over the side; this action allows the weight to come on the trigger arm

6. Remove the hoisting cable from the lifting plate and check the scope for any possibilities of kinking or fouling during lowering

7. After everything has been checked, remove the safety pin and swing the boom away from the ship's hull. At all times, care should be taken to keep the trigger arm away from the ship's hull to prevent the corer from tripping above the water. If, for some unexpected reason, the corer has to be brought back to the surface, the safety pin should immediately be reinserted

8. Lower the corer at a slow rate of speed to avoid water friction on the trigger arm, which could cause a premature tripping

9. Stop lowering the corer immediately after the apparatus trips. Give the corer ample time to reach maximum penetration and then begin to hoist it slowly out of the sediment. Watch the potentiometer carefully during the pull out period to ensure that the tension does not exceed the safety limits of the cable. Once the core is broken out of the sediment, resume retrieval at a standard hoisting speed

10. The trigger mechanism is now a considerable distance above the coring head on the wire. When it reaches working level, hoist the trigger weight aboard, dismantle the trigger mechanism and remove it completely from the wire

11. Continue hoisting the corer until the head reaches working level. Shackle the hoisting cable to the lifting plate and connect the wire straps to the capstan and winch

12. Hoist the complete assembly onboard and store horizontally on the riggers

13. After the corer has been secured on the riggers, measure and record the apparent penetration of the core barrel; this is noted by the mud marks on the barrel

14. Uncouple the core pipes only at the joins required to extrude the liners from it. Cap the liners immediately after the tape seals have been broken--a red plastic cap for the bottom of the liner and a yellow plastic cap for the top

15. Label the core lengths in order and cut them into the prescribed lengths, then store the corers in the cooler

16. Wash the core pipes, cutting head and retainer thoroughly before inserting new liners in preparation for another core

Note of Caution:

Once the corer is lifted over the side, a minimum number of personnel should be in the work area and persons working in that area should be as close to sheltered positions as possible.

1.7 DIVER-COLLECTED OR ASSISTED SAMPLERS

Interface Sampler

This is a unique sampling device, capable of collecting a large relatively undisturbed sediment/water interface sample. The sampler was built at Canada Centre for Inland Waters and during the field season it was first used on trial check-outs but later was initiated into a regular field program.

The interface sampler is basically a weighted plexiglass box with a removable top and sliding bottom. During descent and penetration, the top is removed to allow water to pass through the sampler, causing practically no disturbance to the sample. In most cases, the weight of the sampler enables it to attain the desired depth of penetration. After maximum penetration, the top of the sampler is very slowly and carefully slid horizontally into place and clamped. Following this procedure, the sliding bottom is then forced shut. With all intact, the sampler is retrieved.

This sampler is used only in soft muddy bottoms. It can be used for sampling only in good to fair weather conditions because a diver must operate it.

The techniques followed in collecting sediment with this sampler are:

1. Connect the interface sampler to the winch wire which is run through a block attached to the extendible boom of the hydraulic crane. This enables the sampler to be manoeuvred aboard ship with the least disturbance possible

2. Lower the sampler to approximately 3 metres above the bottom. The bottom depths are obtained from an echogram prior to sampling

3. The diver now descends the wire to the sampler. Upon his instructions, the sampler is lowered onto the bottom under the direction of the diver

4. After the sampler has settled into the bottom, the diver very slowly and carefully slides the top of the plexiglass box into position and clamps it shut. He, in turn, forces the sliding bottom closed

5. After the diver okay's retrieval, hoist the sampler to just below the surface. Here the diver checks to see if all clamps are in place and the bottom is completely closed

6. After the checking, hoist the sampler above the gunwale of the ship so that it can be brought aboard by the extendible boom to be stored in a water-filled box

During all periods that divers are in the water, communications between surface and divers are kept up.

1.8 BOX CORER

The box corer is the latest addition to the sediment samplers available for use through Technical Operations. The sampler collects a sample up to 0.125 m^3 of undisturbed interface material. The sample collected can be used for any type of analysis since the only metal which comes into contact with the sediment is a high quality stainless steel.

The box corer consists of a number of basic parts: gimballed frame, control stem with box holder, closing mechanism, tripping mechanism and sampling box. The central frame slides through the gimballed top of the frame in such a way that samples are always taken vertically. The closing mechanism consists of a blade at the end of a double arm which pivots about the box holder. A tripping mechanism on top of the central stem makes it possible to use only one wire for lowering, sampling, closing and returning to the surface. Very little free fall is possible which allows penetration into the sediment primarily based on gravity. Weights can also be added to the central stem by removal of a plate on the side in order for the box to have more penetration, if necessary. Very little or no disturbance of the sediment can be noticed along the sides of the box.

The Frame

The frame not only ensures vertical penetration at slopes up to 18°, but also prevents the sampler from falling over. The frame consists of hollow pipe. The frame base is not square but has the shape of a trapezium with three (3) legs extending to the gimbal through which the central stem slips. The frame also has a number of holes drilled for drainage and to avoid collapse of the pipes under hydrostatic pressure.

Central Stem

The central stem is made of galvanized steel, is square in shape and part of one side can be removed to place or take out lead weights used for assisting in the penetration of the box. The stem slides through the inner ring of the gimbal. When the central stem is raised to its highest extreme, two 1-inch holes are drilled through the stem above the gimbal in which two safety pins fit. These pins prevent the central stem from sliding through the gimbal, thus enabling attachment or removal of the sampling box. An adjuster block is secured to the stem to stop the box from penetrating too far. A frame housing for the sample box is welded to the bottom of the stem. In this housing are four (4) flaps which open as the corer is lowered and close as the corer is returned to the surface. The sample box is held in the frame housing by two grooves (one of which is removable) which match machined angles on the sample box.

Closing Mechanism

The closing mechanism turns under the box to ensure closure before the unit is pulled out of the bottom. At the bottom of the closing mechanism is a curved knife. This curved knife is curved identically to the bottom of the sample box. It is lead-lined to ensure a tight seal to prevent leakage.

Sample Box

The sample box is made of 1/8 inch thick stainless steel and consists of two parts. One part forms three sides, the other part fits over it and is secured by 6 counter-sunk screws on each side. The top and bottom of the box are open. The shortest side of the bottom curve is the same as the curve of the closing mechanism. All lower edges of the box are beveled to obtain better penetration.

Sampling Procedure

On deck, the sampler hangs in the frame with the safety pins through the central stem to keep it off the deck. The sampling box is secured in the housing. The closing mechanism is turned to a position parallel to the bottom of the frame. The lowering wire is fed through the trigger mechanism until the slotted block on the end of the wire comes in contact with the top of the trigger mechanism, at which point the trigger block is pushed through the slotted block of the wire. The sampler is ready for use.

The sampler is raised and swung outboard just prior to lowering the safety pins in the central stem for removal and the corer lowered to bottom. As soon as the frame comes to rest on the sediment surface, the sampler turns to a vertical position and then pushes the box into the sediment due to its weight. If the sediment does not stop the penetration, the stop block on the central stem will. Only through trial and error will it be known at what height this stop block should be placed. The tripping mechanism fires automatically when slack comes in the main wire.

Upon retrieval, the main wire is pulled and this causes the closing mechanism to turn underneath the box, forming a seal between the sample box and the bottom knife of the closing mechanism. This occurs before the box is pulled out of the sediment. The sampler is then retrieved and set on deck. The bottom knife of the closing mechanism is disconnected and the sample box freed. The outside frame and the central stem is then lifted clear, exposing the sample box. The water is drained off by syphon hoses and the sample is ready for subdivision or storage.

1.9 TECHNICAL OPERATIONS CORER

This corer, which was modified by Technical Operations at the Canada Centre for Inland Waters, is a combination of a Kajak-Brinkhurst and Benthos gravity corer. The operating pcinciple of the corer is a replica of the Benthos gravity corer. Due to the corer's size and weight, the corer can be employed to collect cores from lakes using small boats where hand-lowered and retrieval of equipment is the only feasible method of operation.

The Technical Operations corer uses a 6.6 cm I.D. and a 7.1 cm O.D. cellulose acetate Butryate tubing approximately 1 metre in length. The corer is designed in such a way that a plastic stabilizer fin is incorporated into the upper portion of the corer. This fin allows for straight penetration into the bottom sediment despite boat drift or current. The corer has interchangeable weights which are clamped externally to the upper part of the corer below the fins.

The valve used in the Technical Operations corer is a modified Benthos auto valve. The Benthos valve has been modified by the removal of all springs from the plunger. This was done to remove the bullet effect of the core tube as the corer is allowed to fall by gravity into the sediment. The valve is fitted to the top of the plastic core tube which is then inserted into the modified Kajak-Brinkhurst/Benthos corer. The valve which, as the water passes through the core tube, is held open by the water flow during descent and penetration. Upon retrieval, the suction of the sediment as it attempts to slide back out the core tube, plus the weight of the plunger, seals the plunger into a machined seat creating a partial vacuum thus holding the core in the tube. The corer is then retrieved and the core tube is capped for subsequent extrusion.

GRAB SAMPLERS AND OPERATIONAL PROCEDURES

Grab samplers are more commonly used than corers for collecting sediment samples since they are by their design, lighter. They also give a reasonably good undisturbed interface sample. Following are the basic grab samplers available from Technical Operations:

2.1 PONAR GRAB SAMPLER

The grab sampler consists of a pair of weighted jaws--the cross-sectional shape of each jaw is nearly that of a quadrant of a circle. When the instrument is cocked, the jaws are held open by a catch bar. On touching the bottom, the tension on the bar is released and one end of it drops free, allowing the hinged jaws to move freely. The jaws close somewhat on their own weight, but are completely closed by the scissor movement of the upper portion of the sampler, caused by tension being put on the retrieval line. The jaws of the sampler overlap to minimize washout of the sample during retrieval. The upper portion of the jaws is covered with a mesh screen, allowing water to pass through the sampler during descent, thus reducing the disturbance of the interface of the sample. Upon recovery, the screen mesh can be removed, making access to the interface of the sample simple.

The operational procedures usually used for this sampler are:

1. With boom of the winch inboard, attach the winch wire to the sampler

2. Trigger the sampler

3. Swing the boom outboard and lower the sampler slowly under the surface of the water. This procedure is followed to avoid premature tripping of the sampler on impact with the surface of the water

4. Lower the sampler at a desired rate of speed until approximately 5 metres from the bottom, then slowly let the sampler down on it

5. When retrieving the sampler, hoist it slowly and steadily from the sediment and maintain a slow, steady winch speed until the sampler is clear of the bottom

6. When the sampler arrives at deck level height, swing the boom inboard. Remove the sample from the sampler by either seiving the sediment through mesh screen for biological samples or bagging and labelling it to be stored

7. Now that the sample is collected, wash the sampler and prepare it for the next cast

2.2 SHIPEK SEDIMENT SAMPLER (HYDRO PRODUCTS MODEL 860)

The Shipek grab sampler consists basically of a steel shank, weight and one spring-loaded bucket. This sampler is designed to collect relatively undisturbed portions of bottom surface sediments. The sampler is unusual in concept yet very simple in design. A steel bucket in the form of a half cylinder with closed ends is lowered in an inverted position (convex upward) until it comes in contact with the sediment surface. An internal weight mounted above it continues to drop and triggers a release mechanism which frees the inverted bucket. The bucket is then forced to rotate on its axis, at high speed, by a pair of exterior mounted helical springs. The bucket cuts in a continuous curve through the sediment and is stopped in a position concave upwards (thereby completing a rotation of 180°). The body of the sampler protects the bucket from washout on ascent. The bucket is released by pulling outwards on its pivot pins and a cleancut, undisturbed bottom sample is obtained.

The Shipek sediment sampler, Model 860 and the mini-Shipek are self-contained, automatically operating devices for sampling a wide variety of ocean and freshwater bottoms. The operation of a double Shipek is identical to that of both the single Shipek and mini-Shipek.

They are ruggedly built and with reasonable care will withstand many years of use. The samplers are designed to take sediment samples in soft ooze, clay, sand, gravel and pebbles on flat or gently sloping bottoms.

In order to obtain optimum usage from the sampler, the following instructions should be thoroughly studied:

<u>Preparation for Use</u>

Preparation for use of the Shipek sediment sampler consists of the following procedures:

1. Connect the winch cable shackle to the top of the messenger

2. Pull out the 2 knurled knobs at the ends of the 2 torsion shafts approximately 1/2 inch and rotate 90° to the "UNLOCK" position

3. Insert the bucket, open side first, into the housing until the bucket is symmetrical and ~~may be inserted either way~~

17.

NOTE:

Be sure that the knurled knobs are pulled all the way out to assure ease of bucket insertion. Slight tapping on the female housing dogs may be necessary on new units.

4. Rotate the 2 knurled knobs to the "LOCK" position so the pivot rods slide in and secure the bucket

5. Set the 2 free ends of the 2 ear springs under the first pair of latches

6. Fit the cocking lever over the 2 torsion arms so that the pegs of the lever engage the 2 cocking ears on the torsion arms

7. Rotate the cocking lever (rotating the bucket) approximately 180° until the ear catches under the bucket lip

CAUTION:

The bucket is now armed and will trigger with a light blow on the upper end of the ear. The bucket has sufficient stored energy to cause considerable injury or damage to objects in the path of its closure.

Operation

8. Lower slowly until the messenger is submerged and continue lowering at any convenient rate

9. Note that the terminal velocity of the sampler is approximately 100 metres/minute. Therefore, cable payout rates in excess of this may cause tumbling with resultant cable tangling and failure to collect a sample

10. Actuation of the sampler is accomplished automatically upon contact with the bottom. No stabilization time is necessary

11. In shallow water, activation can be sensed by cable slackening, but in deeper waters, a bottom sensor may be required

Retrieval

12. Retrieval should be initiated gradually to avoid cable tangling

13. Once the sampler is clear of the bottom, retrieval rates of up to 200 metres/minute may be used. At this speed, wash-out or disturbance of the sampler is minimal

14. When sampler has returned to the surface, remove bucket and store sample accordingly. Replace bucket

2.3 MINI-SHIPEK SAMPLER

The CCIW mini-Shipek works exactly as the standard Shipek described previously except as the name implies, takes a considerably smaller sample. This sampler is used basically from small boats by hand.

2.4 FRANKLIN-ANDERSON GRAB SAMPLER

This sampler has a pair of semi-cylindrical jaws whose closure is affected by a pair of tension springs pulling against a pair of rods attached to the outer part of the jaws. The jaws are held open by means of a kneebend joint, fitted vertically above them and under the fin-stock. With the sampler cocked and suspended, the knee bends inward and presses against a stop. On touching the bottom, the knee bend is forced outwards by a descending rod which is depressed by inertial trigger weight. The resulting outward collapse of the joint allows the tension springs and inertial weight to force the jaws to close. The maximum jaw gap is 21 cm, the maximum cutting depths is 18 cm and the maximum sample surface area is about 248 cm^2. The maximum jaw capacity is about 3480 cms^3. The sampler weighs 27 kg.

2.5 DIETZ-LaFOND GRAB SAMPLER

This is a bottom grab which uses a metal bar to separate its small spring jaws. On touching the bottom, a foot contact, attached to this bar, is pressed upwards and the enforced separation of the jaws is terminated. The pressure of a heavy weight and a strong compression spring actuates a pair of rods attached to the outer top surface of the jaws and forces their closure. The sampler weighs about 27 kg. Its jaw gap is 15 cm and the maximum cutting depth is 10 cm. The maximum sample surface is an area of 77 cm^2 and the maximum jaw capacity is about 470 cm^3.

2.6 BIRGE-EKMAN DREDGE

This is available in three models, all basically similar in design. The standard model is described. In addition to this, there is a tall model essentially the same as the standard but with a deeper box and a modification of these two in which weight is added. The standard model consists of a brass or stainless steel box with a pair of free-moving hinged flaps. During descent, these flaps are forced open by the pressure of water passing through the open box. On ascent, the flaps cover the upper surface of the box and prevent disturbance of the material inside it. Pivot points on opposite sides of the box serve as mounting points for a pair of spring-tensioned, scoop-like jaws. The jaws are held open by wires which lead up to an externally -mounted trigger assembly. This is normally triggered by a surface release messenger weight. The jaws are designed to overlap to prevent washout during retrieval. The dredge is in the form of a box with sides 15.2 cm long. With the jaws closed, the maximum depth of their cut is about 10 cm. The standard Birge-Ekman weighs 4.5 kg or less and the maximum sample surface area is approximately 230 cm^2, the maximum sample capacity is about 3900 cm3.

2.7 PETERSEN GRAB SAMPLER

This sampler consists of a pair of weighted semi-cylindrical jaws which are held open by a catch bar. On touching the bottom, the tension on this bar is released, thus allowing one end of it to drop free. This simple action allows the hinged jaws to move freely. They begin to close under their own weight and are assisted by a scissor-like movement of the attached levers which are fitted across the hinge line. Final closure is completed when the scisssor movement which is imparted by pulling on the retrieval line, ceases. The measurements (maximum) are: sample volume, 9450 cm^3; jaw gap, 31.5 cm; sample area, 595 cm^2; cutting depth, 20 cm. The sampler weighs 34 kg.

OPERATIONAL SUITABILITY

OF COMMONLY USED CORERS AND GRAB SAMPLERS

3.1 BENTHOS GRAVITY CORER

Cores of 3 m or less in soft clays, muds or sandy silts. Particularly suitable for studies of the sediment/water interface, for studies on depositional sediment structures.

3.2 ALPINE GRAVITY CORER

Cores of 2 m or less in almost all sediment types. The rugged nature of this corer lends itself to general usage. For studies involving sediment structure or large volumes of material, the corer is unsuitable; for studies of a pilot nature, or to prove the suitability of an area for piston coring, this gravity corer is excellent.

3.3 PHLEGER CORER

Cores of 0.5 m or less, in almost all sediment types. Particularly suited to bottom material containing a high percentage of fibrous organic material. The low cutter angle, the narrow wall thickness and high point loading and the extremely sharp cutter make it very suitable for sampling shallow lacustrine and estaurine deposits, marsh deposits and thin peat beds.

3.4 LIGHTWEIGHT CORER

Cores of 1.5 metres or less of very soft clays, muds, sandy silts or gyttja. Particularly good for collection of cores from small lakes where only a small boat or aircraft can be used for access to these lakes. The corer can be modified and, with diver assistance, can take a core up to 4 m in length. Takes larger diameter cores, giving greater amount of sample for analysis per depth.

3.5 TECHNICAL OPERATIONS CORER

Cores of .75 metres or less in soft clays, mud or sandy silts. Particularly suited for studies of the sediment/water interface. The corer is especially useful to collect cores from lakes where only small boats or aircraft can be used for access. This sampler is used basically from small boats by hand.

3.6 FRANKLIN-ANDERSON GRAB SAMPLER

Suitable for obtaining material for bulk sample analysis. Works best in soft clays, muds, silts and sands. Will occasionally obtain a good gravel sample. Material of no use for structural or other specific analyses.

3.7 DIETZ-LaFOND GRAB SAMPLER

Can be used for general sampling but not recommended for any particular use. Of all the samplers tested, this pattern proved to be the least suitable.

3.8 BIRGE-EKMAN DREDGE

Suitable for soft clays, muds, silts and silty sands. This sampler should be used under calm water conditions, typically in small lakes or restricted areas. The lack of sample disturbance, square cross-section and moderate penetration make this sampler suitable for detailed studies (i.e.: biological and geo-chemical) of the top 2 - 3 cms of bottom sediment. Because of its light weight and easy handling, it is well suited to small boat operations.

3.9 PETERSEN GRAB SAMPLER

Poor. Comments as for Franklin-Anderson, except that instead of the reduction in closure pressure being produced by slackening of tensional springs, the same result is affected by reduced leverage on the scissor arms mounted across the hinge line.

3.10 PONAR GRAB SAMPLER

Excellent. Jaw shape exactly follows arc of cut and almost no sample displacement occurs. Sample is disturbed upon removal.

3.11 SHIPEK SEDIMENT SAMPLER

Excellent. As for Ponar. In addition, the rotation of the bucket is extremely rapid. In most cases, the rotational shear is far greater than the sediment shear strength, thus the cutting action is very clean (producing minimal disturbance), particularly in soft clays, muds, silts and sands.

PRESERVATION AND PROTECTION

FROM WASHOUTS OF GRAB SAMPLERS

4.1 FRANKLIN-ANDERSON GRAB SAMPLER

Fair, but the tightness of closure is largely dependent upon the lack of grains trapped between the edges of the jaws. Providing a tight fit between the two jaws is obtained, the sample is well shielded against washout. If the jaws are kept open by material trapped between the jaws, washout can be severe or total.

4.2 DIETZ-LaFOND GRAB SAMPLER

Fair. Comments as for Franklin-Anderson.

4.3 BIRGE-EKMAN DREDGE

Good, except when the sampler is used in very coarse or shelly sediment. Under these conditions, material may be trapped between the jaws, preventing their closure. In this case, washout may be severe. The jaws are so designed that they slightly overlap one another, thus a slight imperfection of closure can be tolerated.

4.4 PETERSEN GRAB SAMPLER

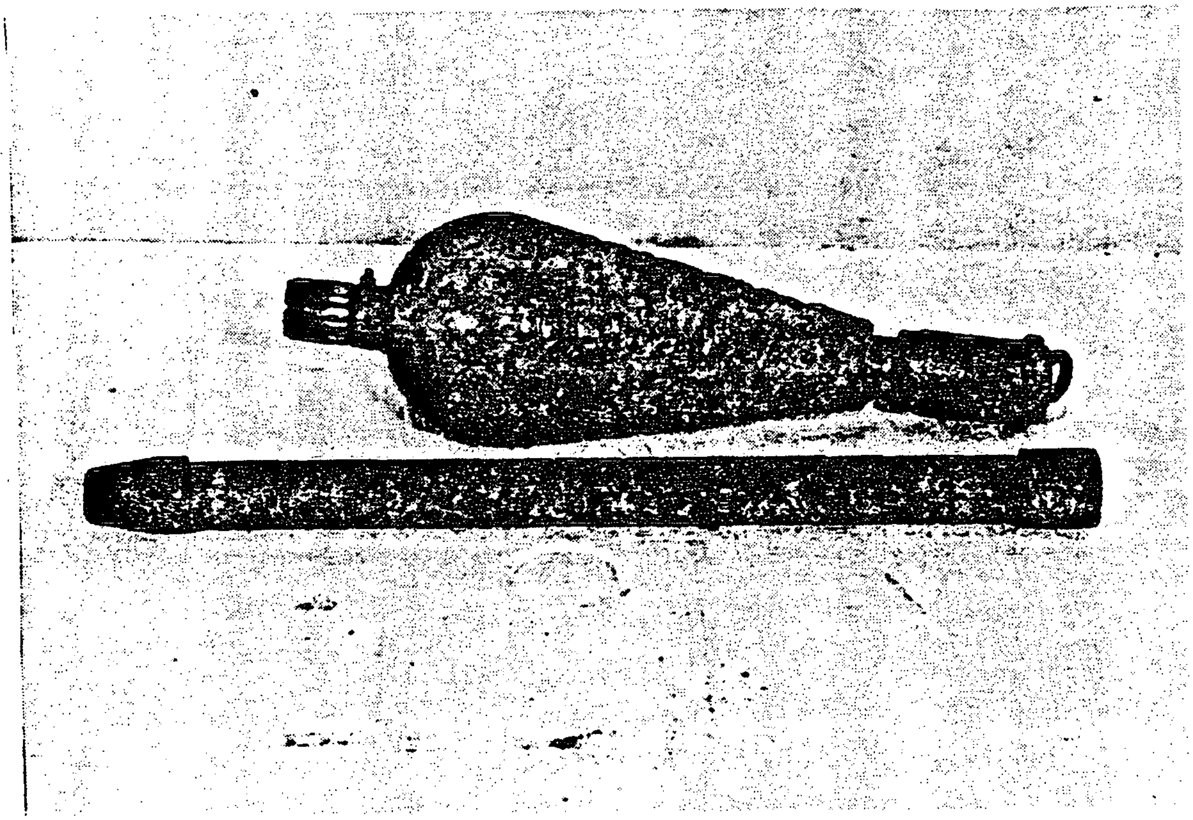
Good. Comments as for Birge-Ekman.

4.5 PONAR GRAB SAMPLER

Good. Comments as for Birge-Ekman. In addition to the overlapped jaws, this sampler has a pair of metal side plates, mounted close to the moving side faces of the jaws. These plates further reduce the possibility of washout.

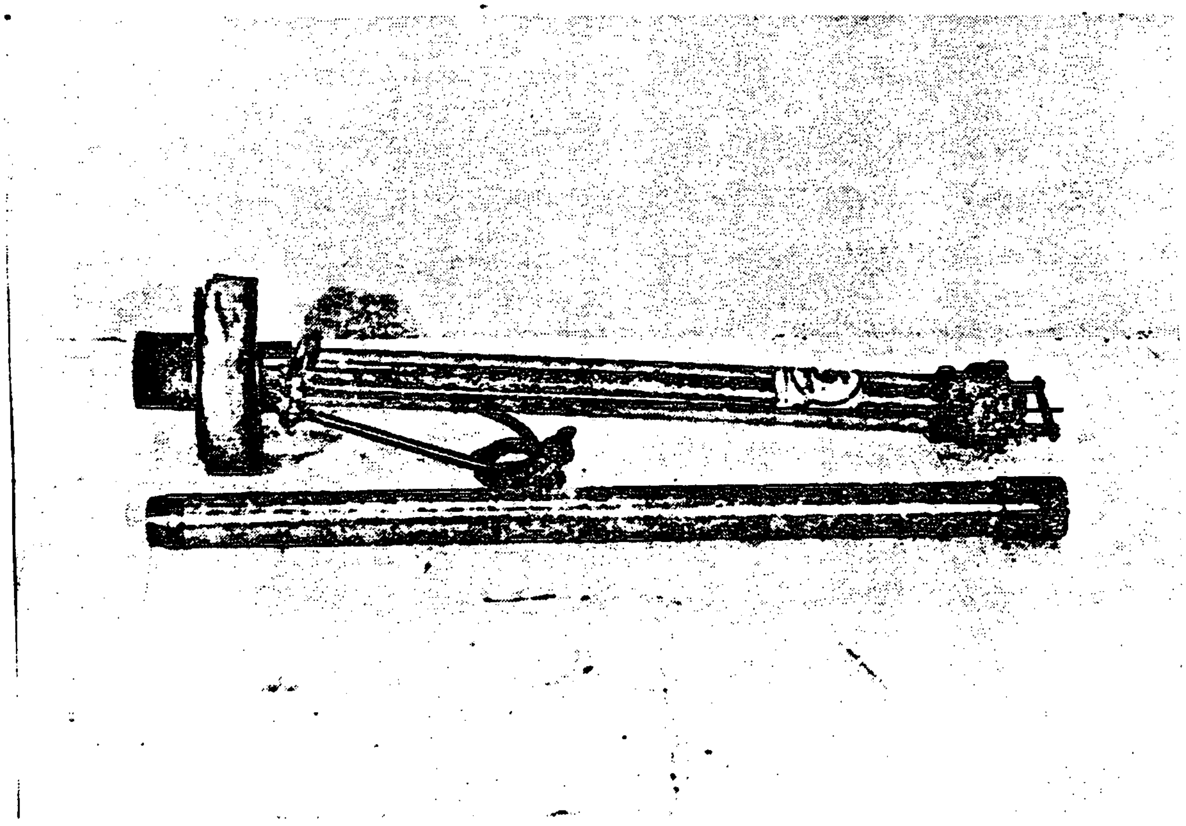
4.6 SHIPEK SEDIMENT SAMPLER

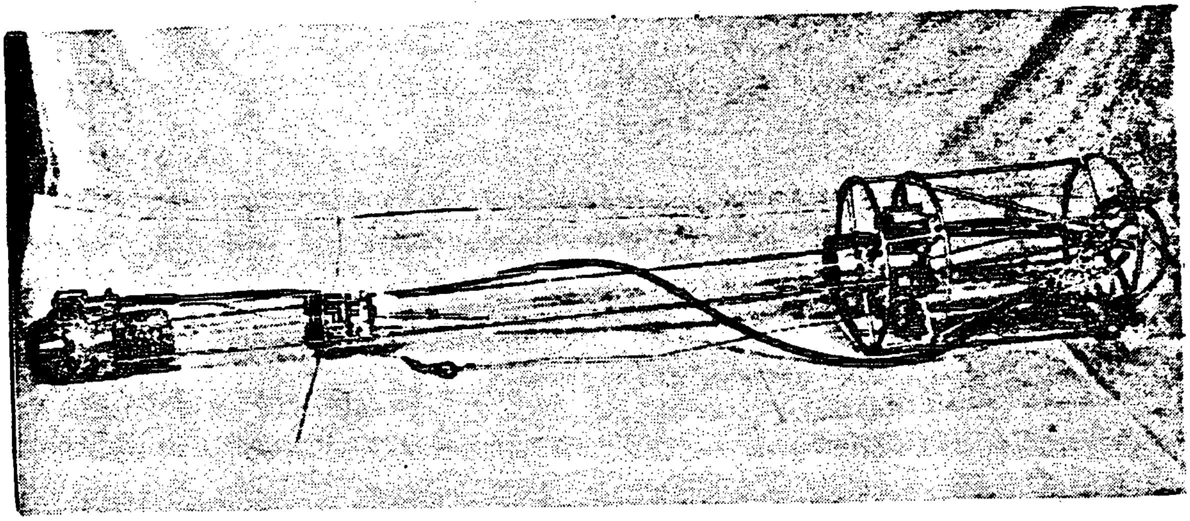
Excellent. The great advantage of the Shipek over all of the other samplers described, is that the bucket closes with its separation plane aligned in the horizontal rather than in the vertical. Good samples can be retrieved even when bucket closure is prevented by pebbles or similar material, even 2 to 5 cm across. With the bucket properly rotated, washout is completely avoided.



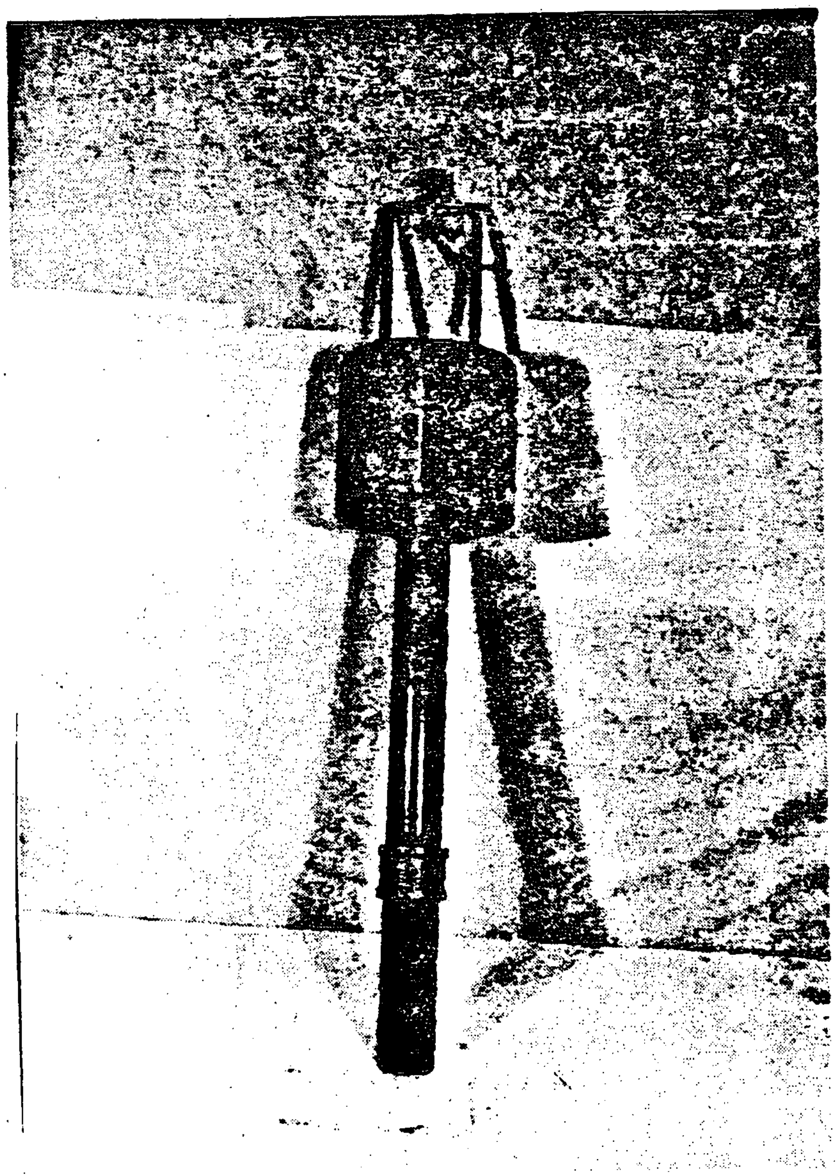
ALPINE GRAVITY CORER

PHLEGER CORER

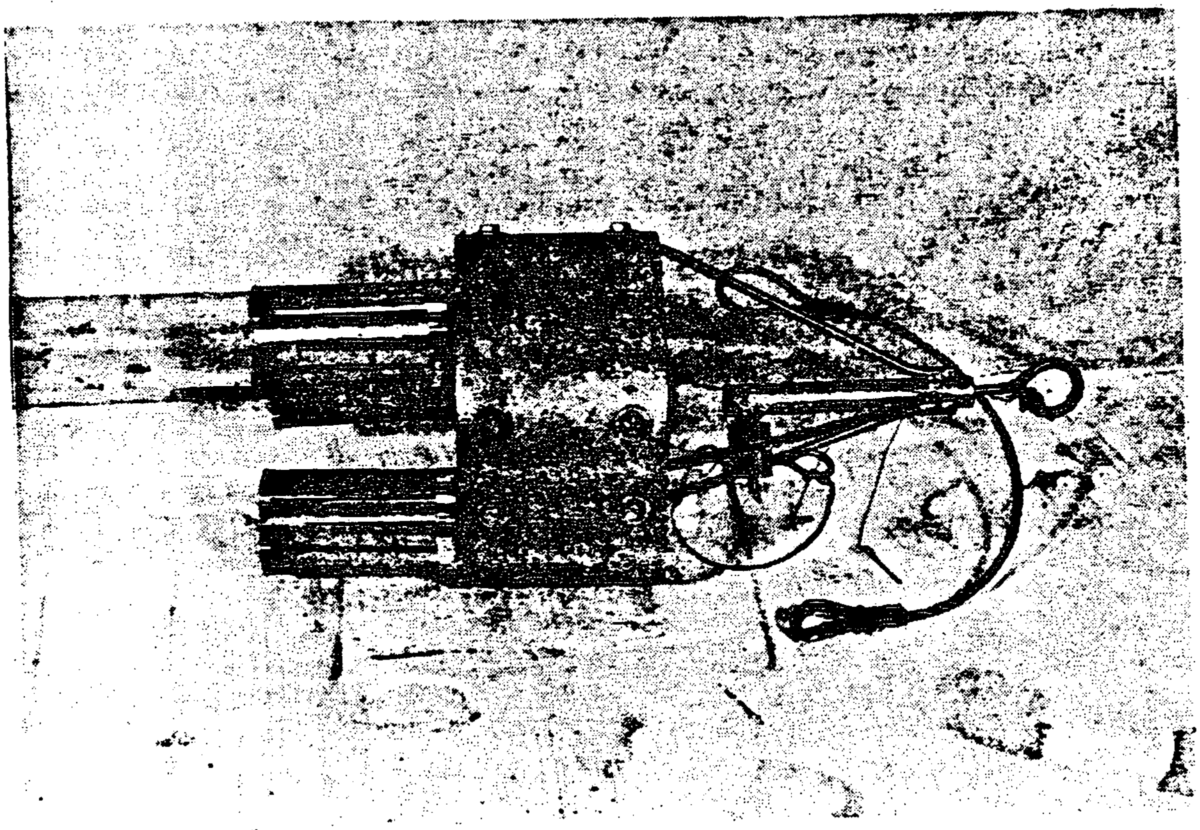




LIGHTWEIGHT CORER

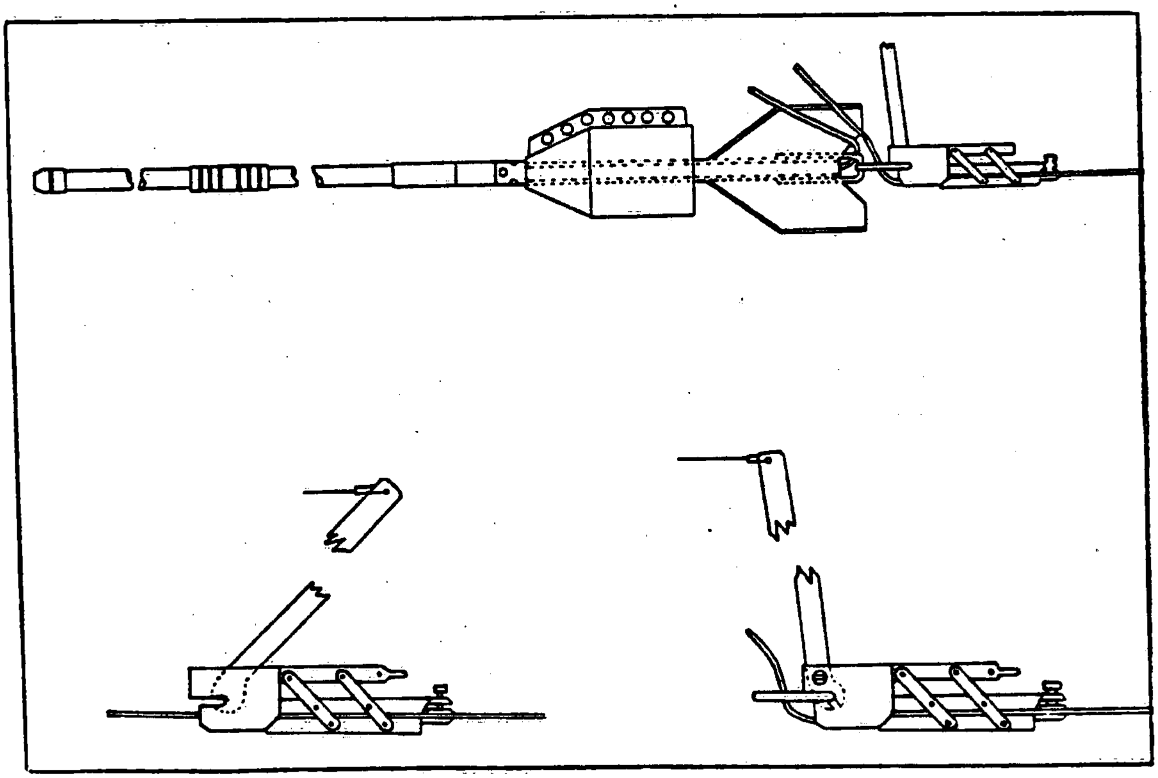


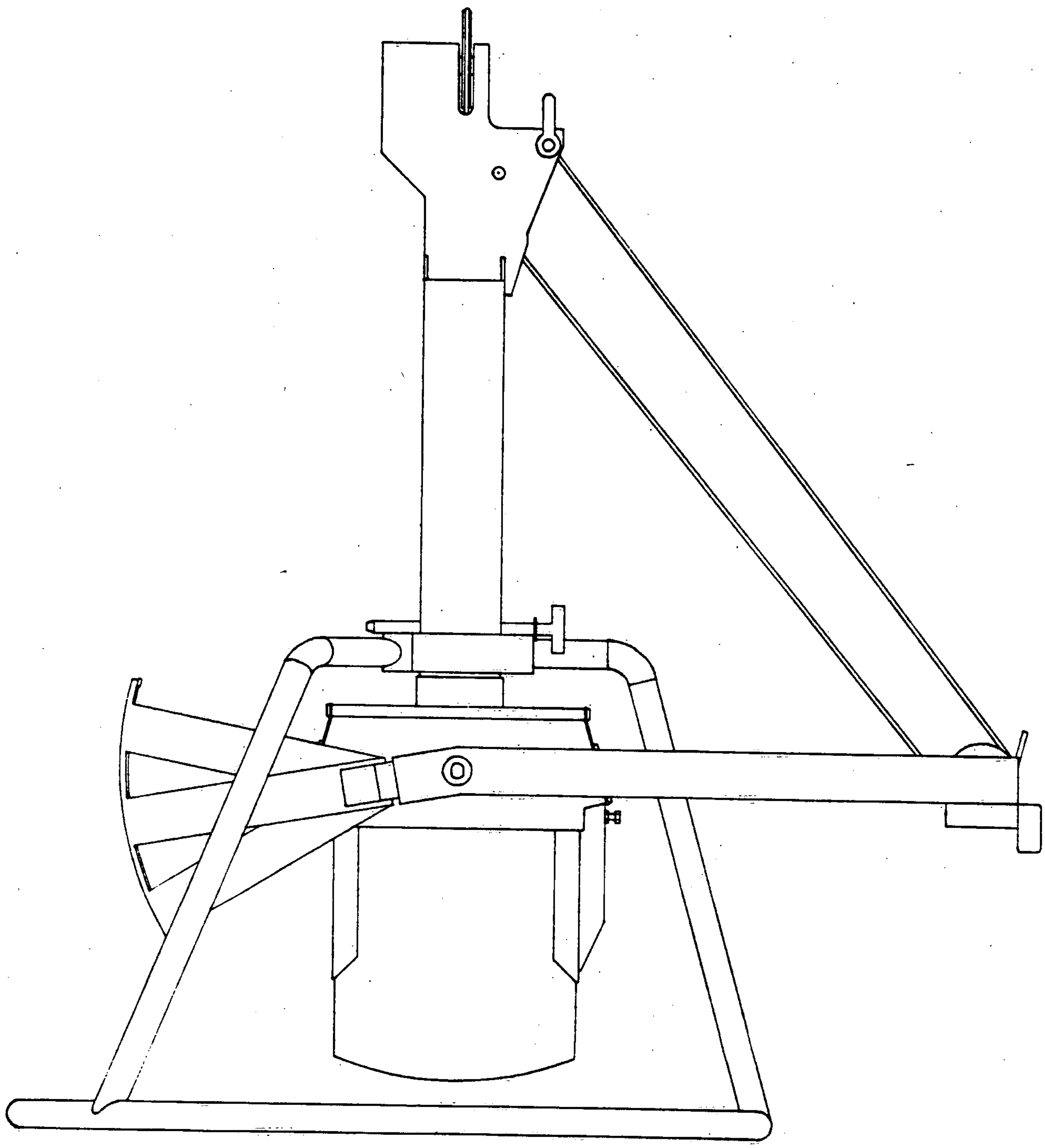
BENTHOS GRAVITY CORER



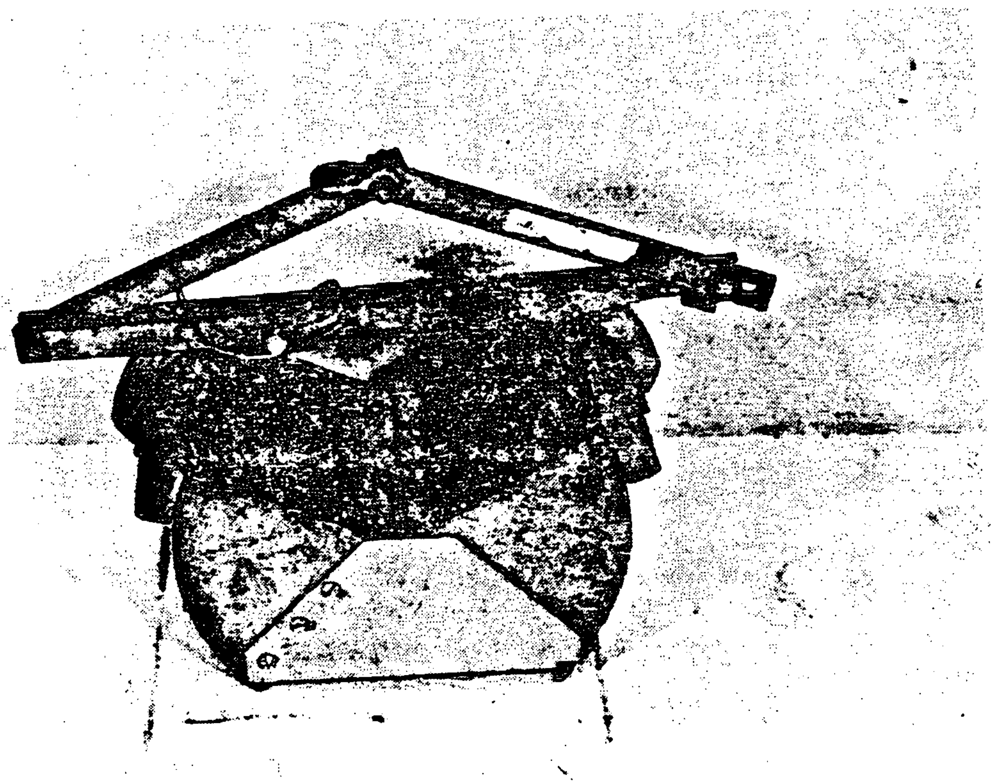
TRIPLE BENTHOS CORER

PISTON CORER



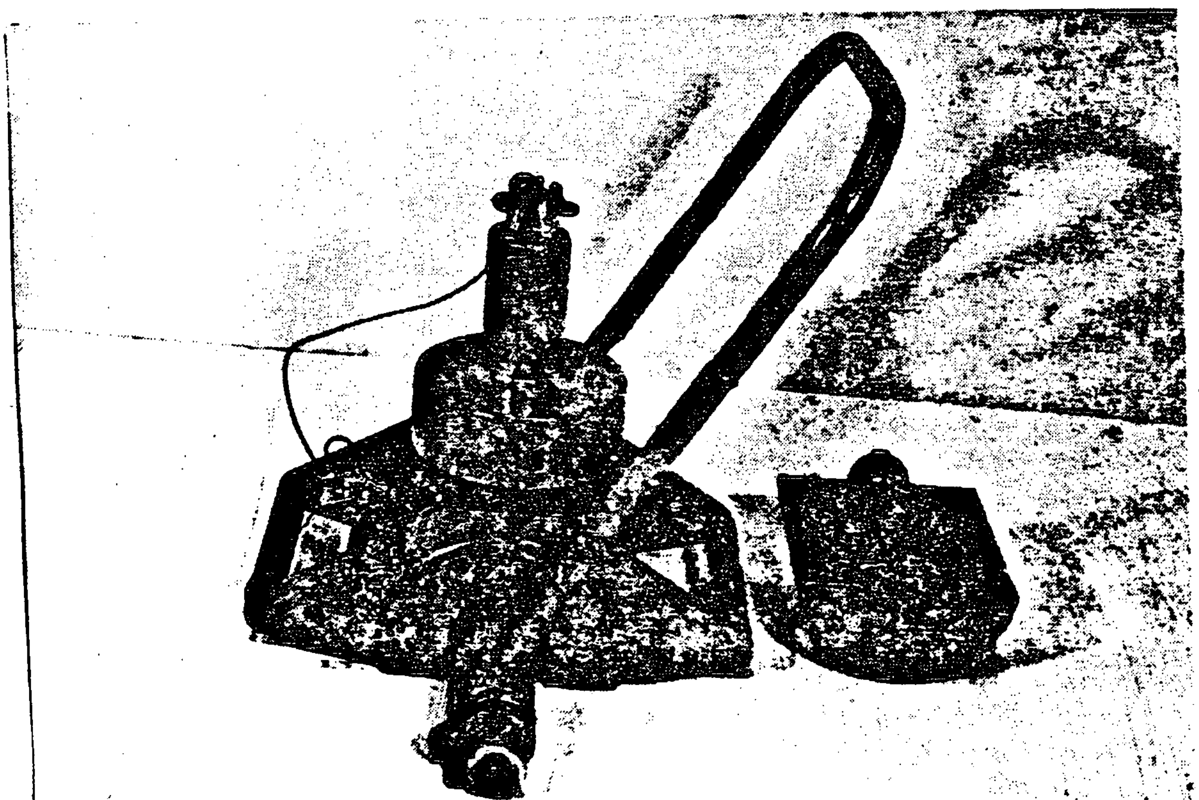


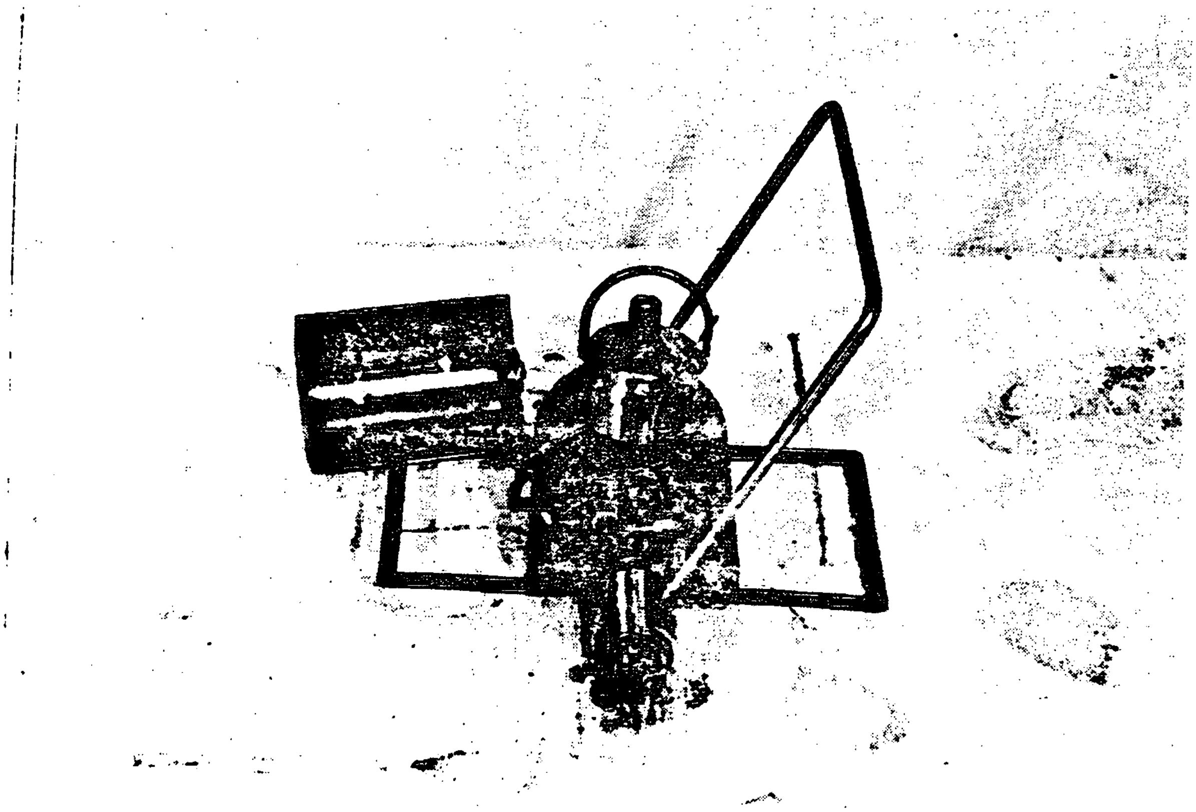
BOX CORER



PONAR GRAB SAMPLER

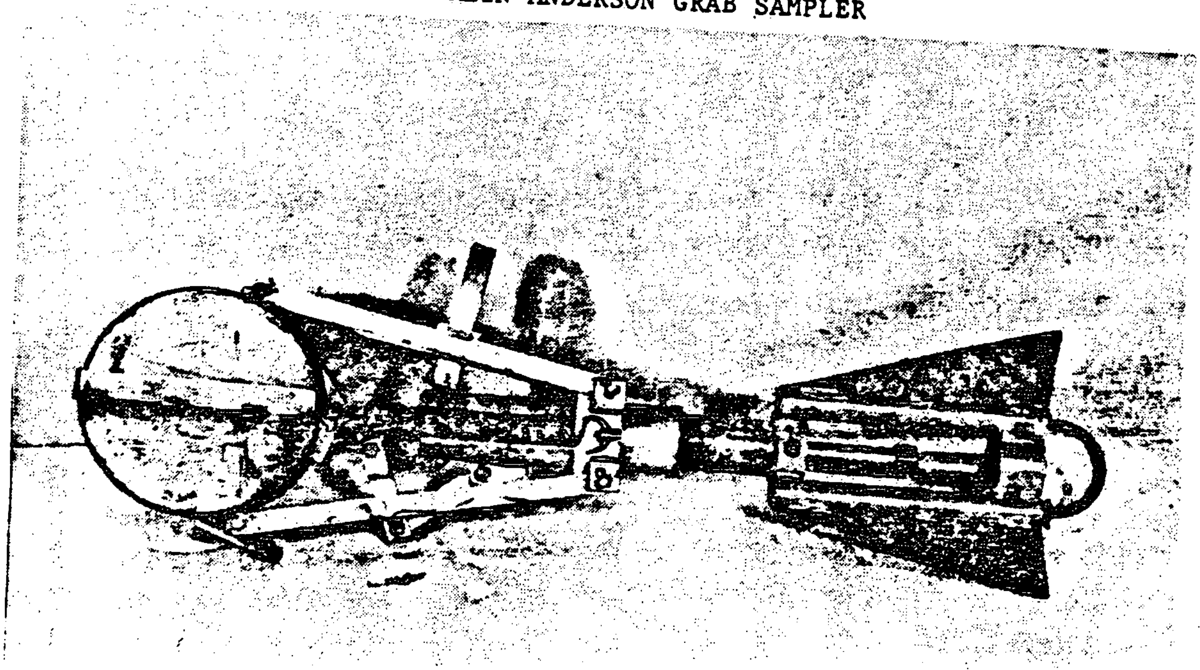
SHIPEK SEDIMENT SAMPLER

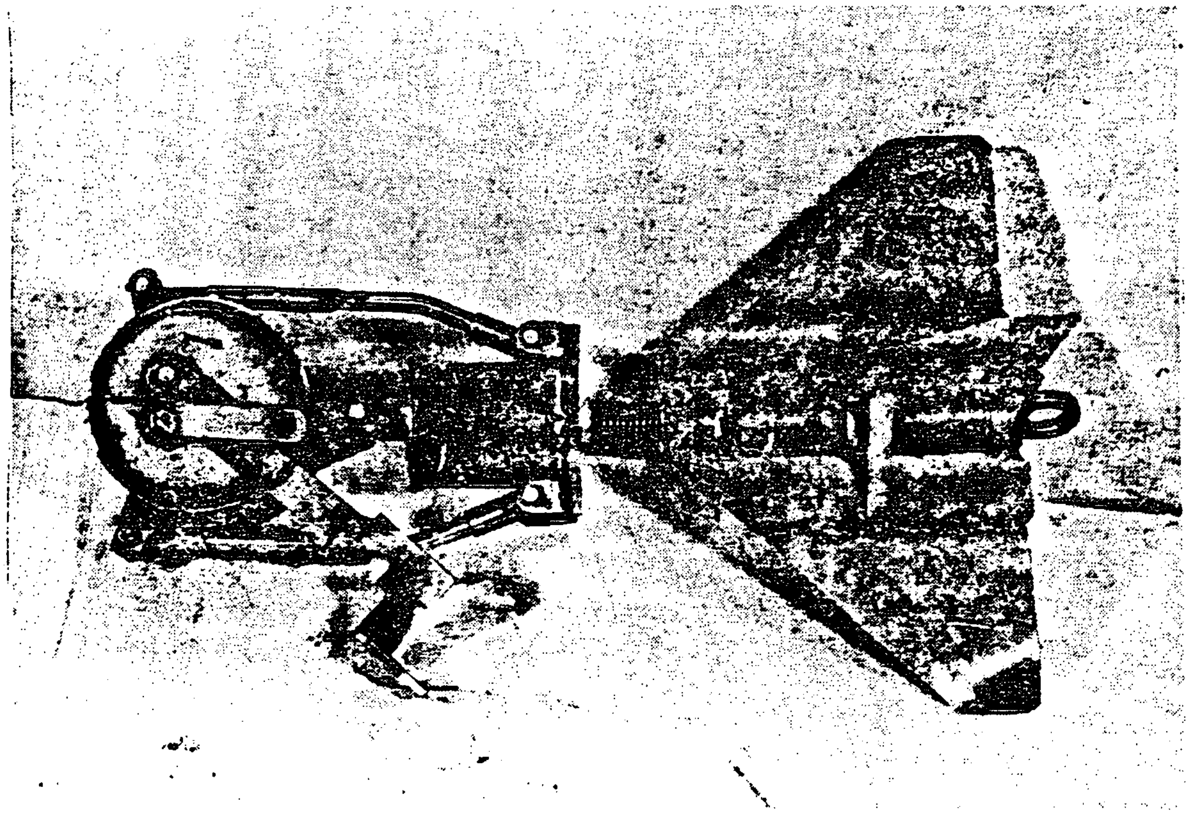




MINI-SHIPEK SAMPLER

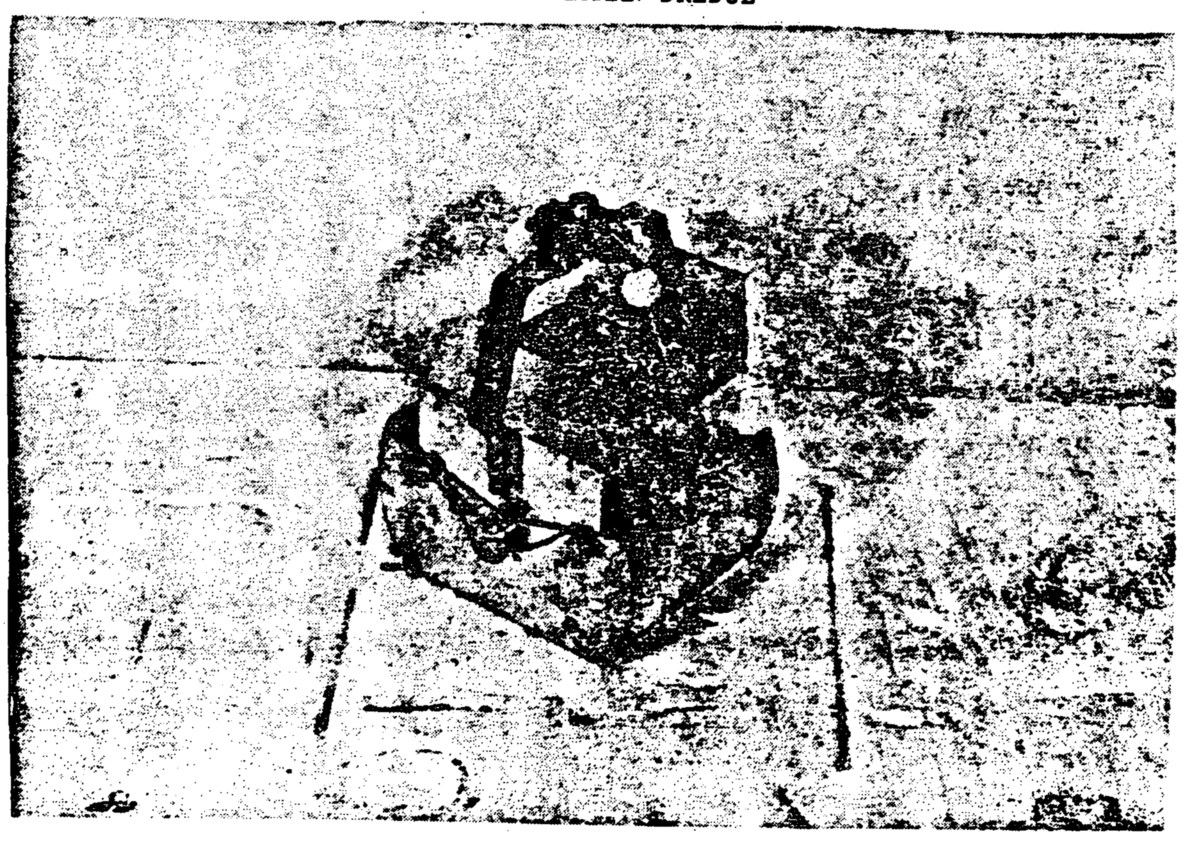
FRANKLIN-ANDERSON GRAB SAMPLER

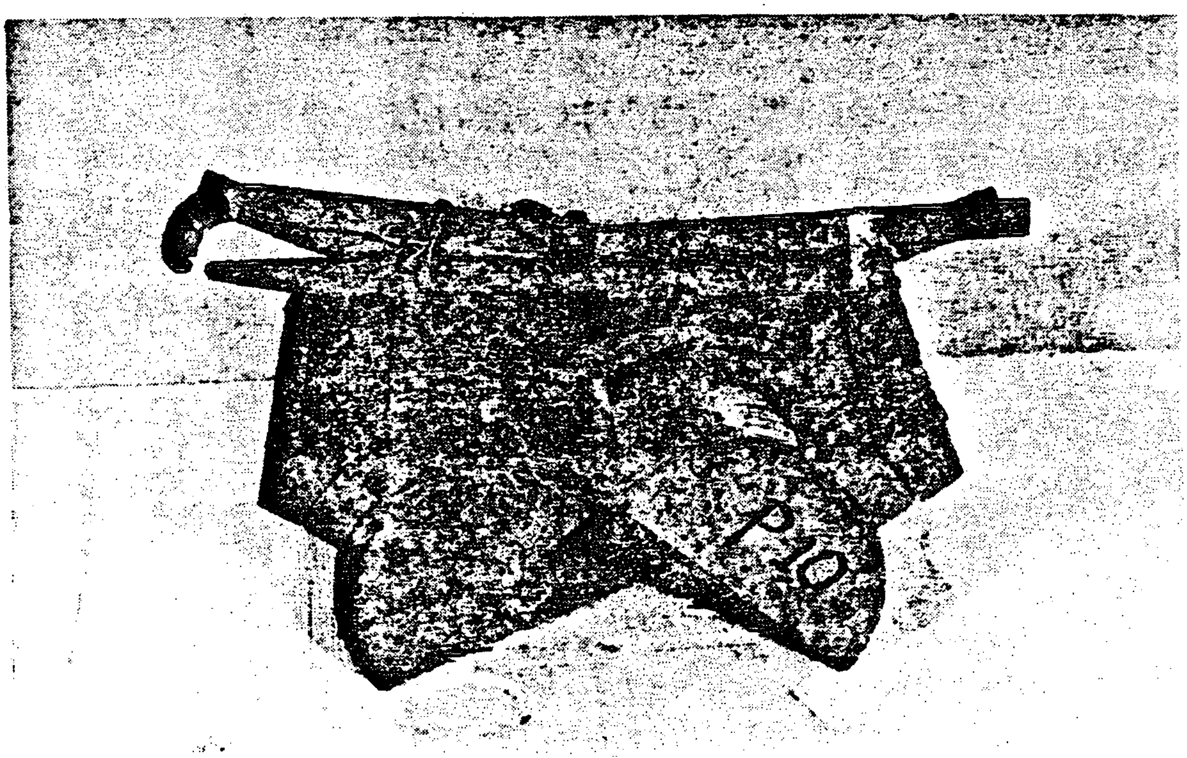




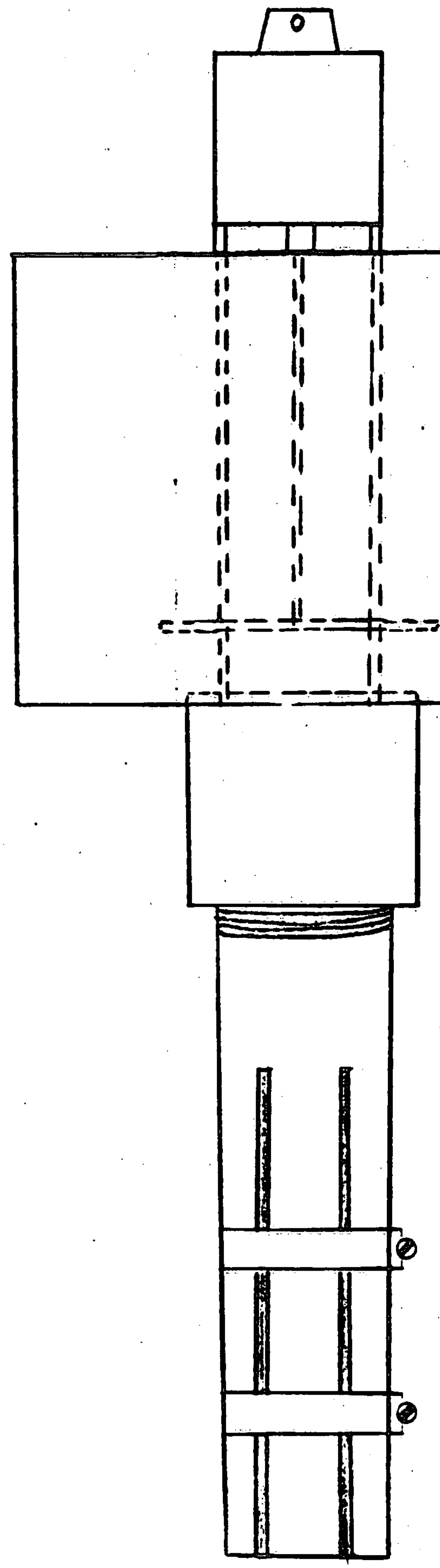
DIETZ LaFOND GRAB SAMPLER

BIRGE-EKMAN DREDGE





PETERSEN GRAB SAMPLER



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