BRISBANE SOUTH MARINE STUDIES PROJECT

MARINE STUDIES SERIES

UNIT 10

SAMPLING METHODS

written by

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Grad. Dip. Ed. Admin., M.A.C.E.

"TO GREAT DAYS AT THE ALEX"

Australia's coastline forms a special place in our environment because over 90% of us live there. Due to different Ecological, Economic, Social and Recreational interests many conflicts arise over the use of our Estuaries, Beaches and Barrier Reefs. Sand Mining, High Rise development, Longline Fishing, Low water Land sales, Resort Development and Oil Pollution are but a few of the real issues that face us now. There is an urgent need for all Australians to develop an attitude towards sensible resolution of these conflicts. This set of notes is one in a series that hopefully will give students the skills necessary to become involved in these issues and make sensible contributions to coastal environmental decision making. In doing so I hope that the coastline may be managed in such a way that future Australians will derive as much pleasure out of it as I have.

My thanks must go to STAQ for providing the financial backing and support to start this project. Thanks also to my Mother and Father who deciphered and typed my bad writing; and to Len Zell of the Great Barrier Reef Marine Park Authority who read and critised the draft and for making many useful contributions. As this is a first draft any comments would be gratefully acknowledged.

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MARINE SAMPLING METHODS

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FIELD METHODS

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This module is compatable with the Syllabus Topics:

*The Nature of Science *

Students, Teachers and Parents are referred to the Multistrand Science Syllabus (Qld) Board of Secondary School Studies, Spring Hill, Brisbane.

Acknowledgements:

The author is indebted to Engineer Les Ford and the Beach Protection Authority for allowing many original photographs and diagrams to be reproduced. Thanks also to:

Allistair Martin (M.S.C. Tas.); David Kopelke (B.I.F.S.C. Qld); Jim Redfield (C.S.I.R.O.); Roy Jenkins (F.U.S.E.); Dennis Bridger; Ann Kenny; Graham Mitchell; Greg Martin; Steve Hall (G.S.H.S.); Sue Oates; Meran Kilgour (B.S.H.S.); and the Departmsnts of Harbours and Marine, Fisheries, Oceanography, Great Barrier Reef Marine Park Authority, The Beach Protection Authority and The Brisbane Education Centre for all their help.

WHY STUDY THIS UNIT

The Estuary provides an excellent place for students to study the Nature of Science. Firstly it got students into the field to experience the difficulties in research and the time it takes to collect data. They should also come to the conclusion that scientific discoveries do not occur overnight and that hypothesis conferences and scientific generalizations take a long time to become a reality.

NATURE OF SCIENCE

Science is a human activity involving us all as we attempt to understand the world around us. The empirical mode of thought embodied in science provides one way of viewing our world. Students should experience this empirical approach and be encouraged to develop a thoughtful, logical, and thorough approach to everyday life. To do this they should examine various views about the nature of science, its methods and processes.

Many aspects of this topic could be undertaken in conjunction with studies in other core topics or optional areas. An alternative approach could be the development of an introductory unit based on this topic.

MATTER AND MATERIALS

We are surrounded by an immense diversity of natural materials some of which man has adapted for his benefit. In addition he has developed new materials and applied these to the service of man. This interaction between man and his environment is crucial to our way of life.

Students should have an understanding of the structure, properties and uses of a range of materials both natural and synthetic. He should relate the materials, through a knowledge of their properties, to their everyday usage. The student should appreciate the reasons man chooses particular materials for specific usages. He should have a knowledge of some of the technologies involved and the impact of these technologies. As a consequence of the study of this topic the student should acquire a better appreciation of man's adaptation of these materials.

These aims may be achieved by a variety of teaching approaches e.g. by a traditional geological and chemical development or by a thematic study of a particular natural resource being transformed into a finished article. Irrespective of the approach pursued, the laboratory should form a focus for the treatment of the topic and students should acquire hands-on experience with a range of materials being studied.

The materials studied should include examples from each of the following three groups: ores, metals and alloys; non-metallic elements and inorganic compounds; organic compounds and polymers.

Special Note: *Students must be given the opportunity to do Field Work in an estuary for this process, skill and affective objectives to be achieved.*

ESTUARINE CHEMISTRY

PRACTICAL ACTIVITIES

1. Salinity Titration
2. CO_2 and O_2 Titrations
3. Acid/Base Titrations
4. Separation of Dissolved and Undissolved Solids in Sea Water
5. Prepare Chromic Acid Cleaning Solution
6. Observe Abiotic Data

RESEARCH ASSIGNMENTS

1. The Chemical Composition of Sea Water
2. Mining the Sea
3. Materials for Ships and Small Boats

MATTER AND MATERIALS

THE NATURE OF SEA WATER - *(salinity, dissolved particles, characteristics.*

MARINE SAMPLING MATERIALS - *(glass, rope, nylon, plastic, stainless steel, aluminium, fibreglass, perspex.*

FIELD METHODS - *(construction of sampling devices.*

DIRECTED TOPICS

1. The Nature of Sea Water
2. Chemical Tests on Sea Water
3. Materials Resistant to Corrosion
4. Making equipment from Non-Corrosive Materials
5. Visit to a shop selling Marine Equipment

AUDIO VISUAL

STUDENT MATERIALS:

Most materials are described in the Notes but a range of plastics, fibreglass, glass, stainless steel products from a local shipyard or sailing shop could be handy.

PRE EXPOSURE:

Students who had visited a Marina or Shipyard would have an appreciation of the corrosive nature of sea water.

REFERENCE/RESOURCES/NOTES:

Students should be encouraged to make their own sampling equipment. Most Manual Art departments have the tools to work plastics and students should be encouraged to design equipment. For the non-chemistry student who has difficulty working the matter part of this unit, this part should be more rewarding. No attempt has been made to go into atomic structure and this has been deliberate so as to encourage teachers and students to take a wholeistic view of matter. It is hoped that students, while not understanding fully the subtility of titrations, can use the data they collect to make rational judgements about sea water.

EXCURSION:

A ½-day or day trip to a shipyard, sailing ship or boat builders workshop would enlighten students into the topic. Shipwrights would also be able to talk to students about the finer details of materials used.

ESTUARINE CHEMISTRY

PRACTICAL ACTIVITIES

1. Introduction to Glassware
2. Introduction to Apparatus
3. Laboratory Balances
4. Laboratory Burettes
5. Microscopes
6. Making Chromic Acid
7. Environmental Effects of Temperature
8. Making Salt Water
9. Sediments and Turbidity
10. Dissolved Oxygen and Carbon Dioxide
11. Acidity, Alkalinity
12. Biological Oxygen Demand

STUDY ASSIGNMENTS

1. Research into Oceanographic Field Methods
2. Designing Field Study of Local Estuary
3. Building Equipment for Study of Local Estuary
4. Writing Reports on Field Study

NATURE OF SCIENCE

LABORATORY METHODS - (glassware, apparatus, balances, burettes, correct use of glassware, cleaning solutions, oceanographic units and their measurement)

SALTWATER CHEMISTRY - (limits of tollerance, temperature, salinity, sediments, turbidity, oxygen, carbon dioxide, trace elements)

FIELD STUDY TECHNIQUES - (sampling, working, living in the field)

DIRECTED TOPICS

1. Laboratory Methods
2. Marine Environmental Limits
3. Laboratory Methods to Study Limits
4. Field Methods to Study the Limits
5. Designing Experiments
6. Formulating Hypothesis about Estuarine Salinity

AUDIO VISUAL

1. Professor Klandlestein Looks at Apparatus, Glassware.

STUDENT MATERIALS:

All materials are described in the Notes, students enjoy making their own equipment and this should be encouraged.

PRE EXPOSURE:

A basic understanding of chemical reagents and safety is important.

REFERENCES/RESOURCES:

A good supply of burettes is required or access to a salinity/ temperature probe however these are expensive and do not afford the hands-on philosophy of the course. Students should come to grips with sound laboratory techniques in this unit and good supplies of standard glassware and chemical sets are required. All experiments are standard but an excellent reference is found in "Water Pollution and its Measurement" a practical guide for use in schools by John C. Happs. The Jacaranda Press

TIME REQUIRED:

Depending on the type of student and his/her background 10-15 hours could be minimal.

EXCURSION:

An essential component of the course. Jacobs Well Field Study Centre (Brisbane area) and Boyne Island Field Study Centre (Gladstone area) are two excellent sites. However a temporary field station could be set up using boats and camping gear. It is important not to be too ambitious and to concentrate on things capable of students. Much can be achieved with good depth, salinity, temperature readings in the form of experimental design data collection and hypothesis formation, testing and generalization.

SECTION 1

FIELD METHODS

1.1 *Areas of Study and Work Boats*

Oceanography is a Science. As other sciences, the most important method of learning is by observation. Observation means careful watching. Observation uses all senses, not only sight. For example, an oceanographer listens to echoes in the ocean. He may smell a sample of water. He feels the rocks, the seaweed, and the sea animals with his fingers.

As the oceanographer makes his observations or collects *DATA*, he keeps careful notes. From his observations he develops a "Guess that can be Tested", or *HYPOTHESIS*. As he gathers more facts, his hypothesis may become a *THEORY*, which is a stronger explanation. Like other scientists, the oceanographer performs investigations or experiments to test the truth, or error, of his hypothesis. On this basis his theories are accepted or thrown out.

Estuaries are very safe places to study oceanography. In the estuary the oceanographer collects his data at the surface, or from the bottom, or in the middle, at any time of the day, month, or year. From his field work he usually takes data back to the laboratory for analysis. After analysis, the oceanographer may take the results of his work to Conference in order to discuss his theories with other scientists.

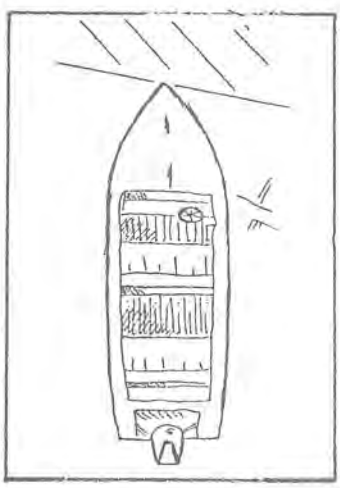


Fig. 1-1: Working Boat

Before any study can be undertaken a research vessel must be found. A power boat of some description is a really attractive proposition unless a good jetty or anchored boat are available.

A 12 foot aluminium unit with a 75 hp on board can be operated in Queensland waters under 10 knots quite safely in sheltered estuaries by students. *No attempt should be made to operate anything yourself in open waters.* Only well equipped professionally operated craft will do. If a power boat is not available, a good sized row boat, or a small sail boat can be used. The vessel must be able to be anchored. Needless to say all safety regulations need to be followed and basic safety gear stowed.

Hire boats or parents' boats are the best way to organise yourself. The tide book sets out quite clearly what safety procedures must be followed. Make sure you go with someone with local knowledge in a sheltered part of the estuary. Even open water in Moreton Bay can be very dangerous in 15-20 knot winds. Also, sampling is difficult in these conditions. *IF IN DOUBT - DON'T GO OUT.*

1.2 Small Ships Forecasting and Boat Safety

Each day the weather bureau produces a weather chart and issues a forecast.

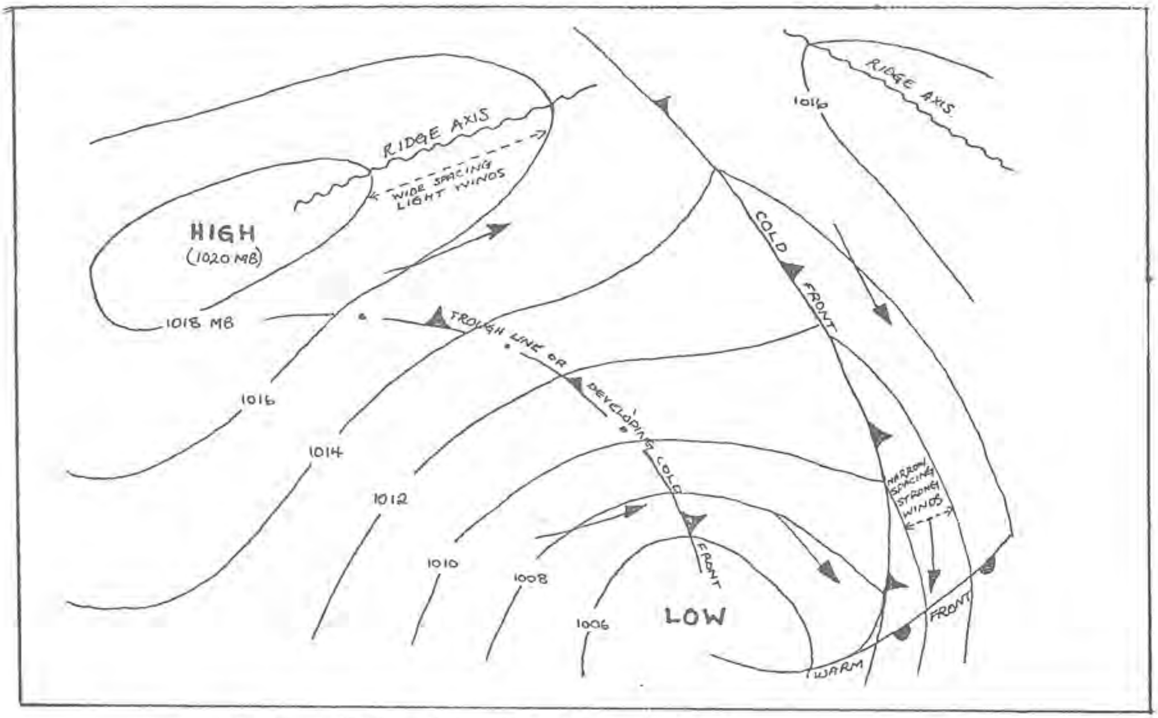


Fig. 1-2: A Typical Weather Map

Winds also play a vital role in small ships forecasting as can be seen by the table below:

Wind Speed (Knots)	*Sea Condition*	*Av Wave Hgt.*	*General Effect Observed*
0	calm	0	No waves break on beach
0-5	calm	0.5M	No waves break on beach
5-10	slight	1 M	Slight breaking on beach
10-15	moderate	1.5M	Waves break on beach
15-20	moderate - rough	2 M	Seas furrowed
20-25	rough	2.5M	Seas deeply furrowed
25-30	rough - very rough	3 M	Strong wind warning
30-35	very rough	4 M	Gale warning
735	extreme	4 M	Cyclone warning

Table 1-1: Forecast Table (modified after Beaufort)

Sample Forecast: "Double Island Point to Coolangatta" seas slight, 5-10 knot SE winds freshing to late afternoon waves to 1m in exposed waters."

Boating in a large group demands special rules. Here are some you may consider:

1. Student should stay in contact with the safety boat.
2. Life jackets should be carried and if possible worn.
3. Students should follow these signals: *one hand raised, raft up with signalled boat: OK signal*
4. Students must be instructed on the care of craft and motor. (Starting, flooding motor, throttle, cables, bung, no collisions, no ramming the shore, correct movement in craft, moving off in turn after rafting up)
5. Student instructed in swamping procedure
6. Student instructed in fuel line blockage

1.3 *Knots - How not to lose Equipment*

Field methods and laboratory techniques *DEMAND* a high degree of skill and accuracy. If you have poor field techniques then it is useless attempting to analyse results in the laboratory. In this Chapter you will learn the *HOW, WHEN* and *WHY*, of sampling and analysing water samples.

As a general rule, an amateur estuarine oceanographer can get away with three basic knots:

A Clove Hitch - for anything tied to a boat
A Bowline - for anything tied to a sampling device
A Stopper Knot - for anything to mark length in a rope (eg Metres)

It is not much good making or buying expensive equipment if it is going to be lost overboard. Make sure you can tie each of these three knots.

The following terms are used to describe the parts of a rope.

End - the last few centimetres of the rope
Standing part - the main length of rope
Bight - a curve in the rope made by bringing the end upwards.
Loop - formed by crossing the end over the standing part.
Strands - the individual layers of fibre.
Yarns - each individual fibre
Coil - the circular method of coiling up a rope.

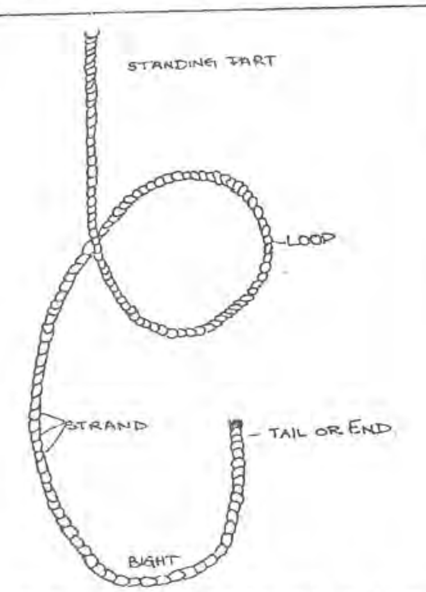
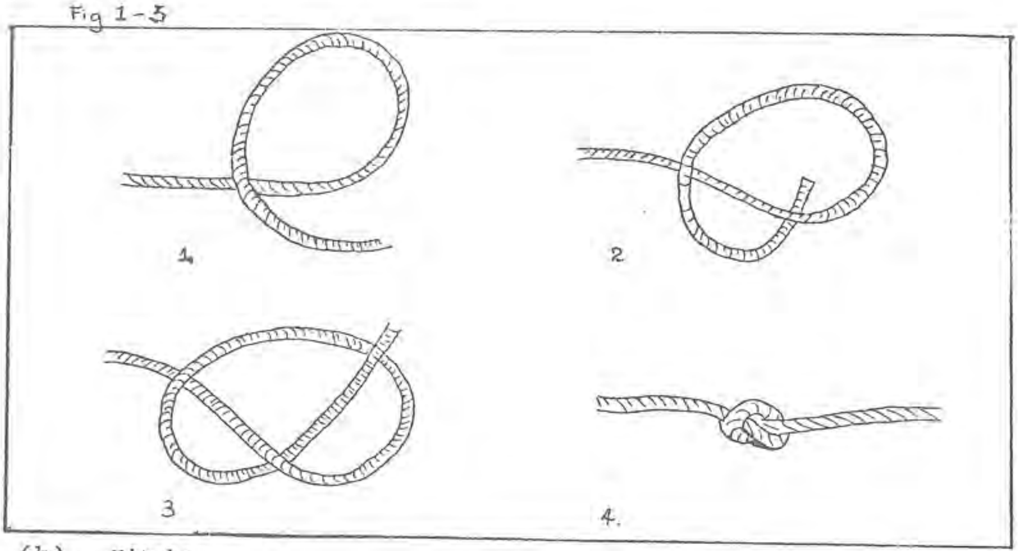


Fig. 1-3: Parts of a Rope

(a) *Stopper Knots*

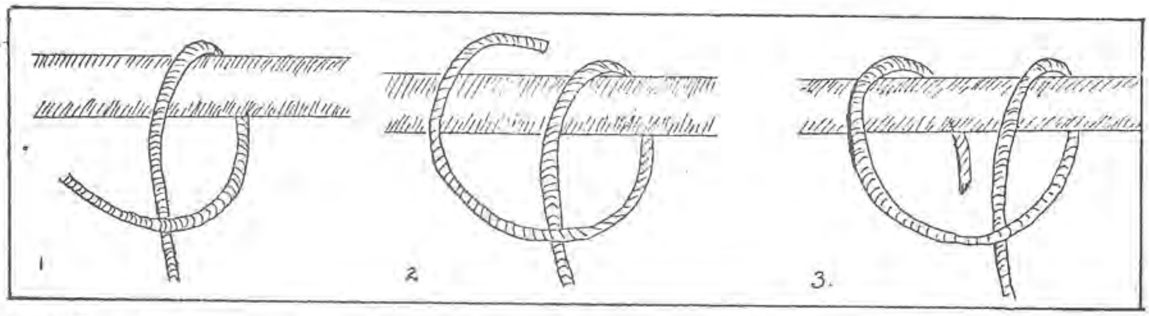
This will be used in the construction of your water sampling bottle. It can be used to mark metre lengths in a rope. Once wet, however the knot will be very hard to undo and should be used as a permanent knot.

Fig 1-3

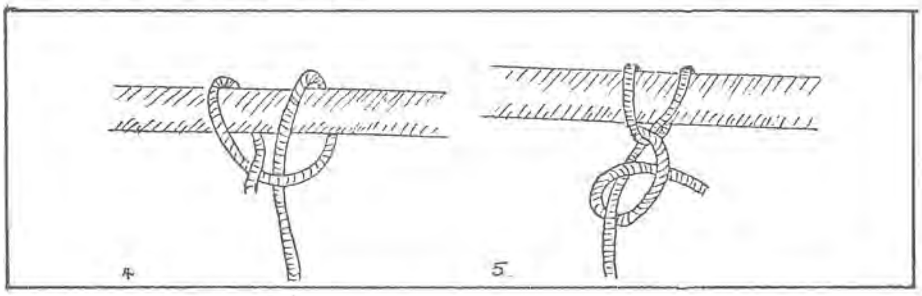


(b) *Hitches*

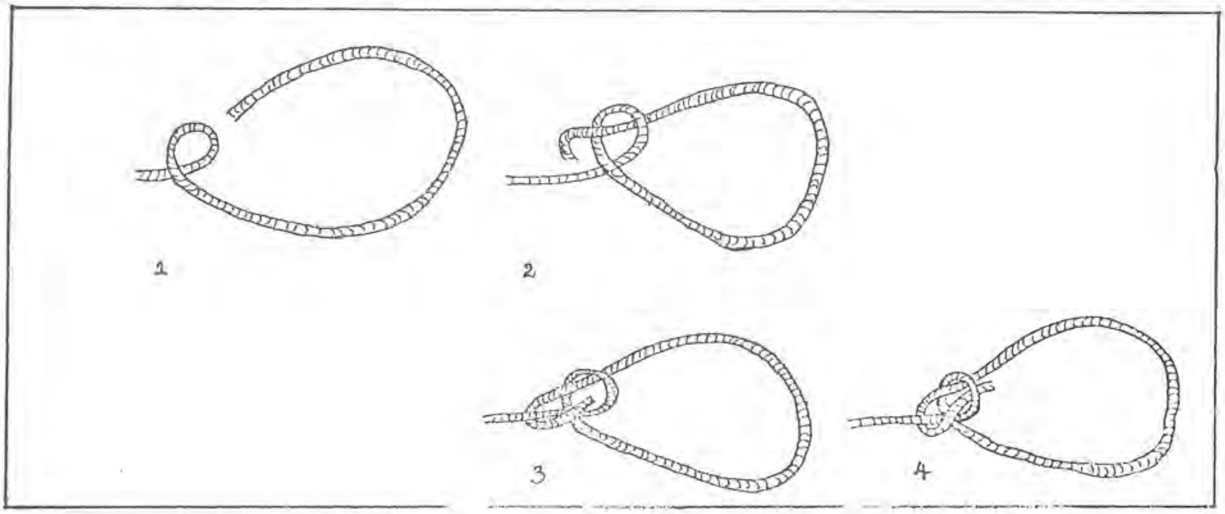
1-4 a The Clove Hitch:



1-5 b The Chinese Hitch:



1-6 The Bowline



1.4 Bathymetric Surveying

The basic requirement for an estuarine study is an adequate chart. In most coastal areas the Department of Harbours and Marine stock charts, and many ship chandlers and harbour masters also stock them. *These charts should be used with care for research purposes*, however, because their quality is usually in direct relation to the importance of local shipping; therefore, if your study area is not in a busy port, the charts will often be *out-of-date*. Also, silting can be quite rapid in estuaries, and this t-o may invalidate the available charts. Thus, it is wise to check the available charts, and it is often necessary to remake or revise them in part. *Assuming that a good base topographic chart* and a small powerboat are available, running a simple bathymetric survey is relatively simple and rapid.

Specialized gear includes *a compass* which can be used to take *bearings*, a *protractor* to *plot positions*, and some sort of *sounding device*. This can be either a small echo sounder (if available) or an adaptation of the traditional sounding line - a weighted, graduated line used to measure water depth directly. *If you are using a compass*, be sure to take your bearings far enough away from the engine or other large metal structure to avoid local magnetic variations. An enlarged working copy of the base topographic map should be carefully mounted on a plywood frame and covered with an acetate film to protect it from spray or rain. *Before starting the survey*, be sure that all the prominent local landmarks are clearly marked on your base map. It may prove necessary to install temporary landmarks to permit adequate triangulation within the estuary; a tall flagpole with a bright banner is usually quite satisfactory.

Location with a hand-bearing compass is less accurate than with sextant angles, but it is much easier to accomplish in a small boat. Any good compass graduated to at least 5° increments can be used, but those designed specifically for yachtsmen are much easier to use on a boat. Simply align the compass with landmarks that appear on your chart, and read the magnetic bearings. *These lines of position are then transferred to your chart* (correcting for declination, if necessary), and your position is defined by their intersection. You must use at least two bearings with this technique; it is much more accurate to use three or more, which will then define a triangle or polygon within which your true position lies. *Again, practice and speed in taking correct bearings are essential.*

The simplest way to operate the survey is to run your boat at a slow constant speed on predetermined lines evenly spaced within the estuary. As a general rule in small-boat surveys, it is wise to run as slowly as possible and still stay on course; remember that at 2 knots you travel about 200 feet every minute. *Your initial survey lines* should be laid out in advance, heading, as much as possible, directly for obvious landmarks so that the helmsman will have a straightforward job. A hypothetical survey is illustrated below. *At regular time intervals (perhaps 30 seconds* if you are using an echo sounder, longer if you are using a sounding lead), the depth should be measured and recorded. If you are sounding with a lead, practice a good bit before you attempt to run your survey lines. *In this technique* a 1 or 2kg weight is tied to the end of a line graduated at appropriate intervals (1-metre spacing is adequate). As the boat proceeds along its track, the leadsman heaves the lead underhand ahead of the boat, pulls the line taut, and reads it as it comes vertical; *he then recovers the line and coils it for the next cast.* In water less than about 5 metres deep, it may be convenient to use a graduated bamboo *sounding pole* instead of a line. *Once a good rhythm is established,* highly precise depths can be obtained very rapidly in shallow water by this technique.

In deeper water, lead-line sounding becomes slow and very tedious. Periodically, perhaps every 5 minutes during a run, you should take a series of sights with the compass bearings to determine your true position. If enough hands and space are available during the survey, plot your *locations immediately;* this will provide a good check on your speed and general accuracy.

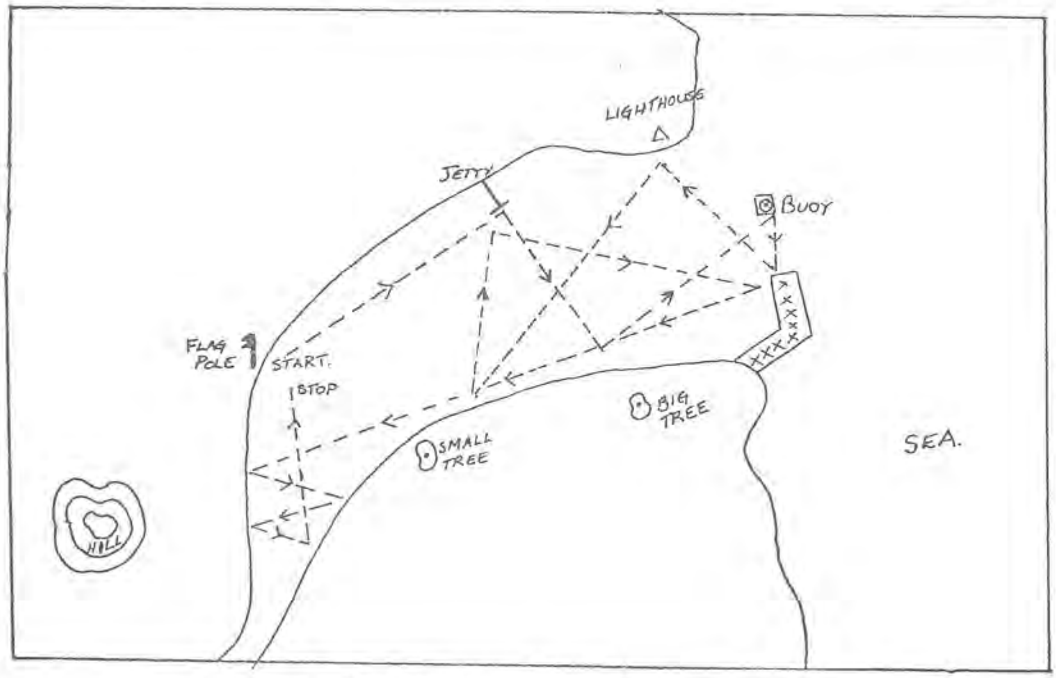
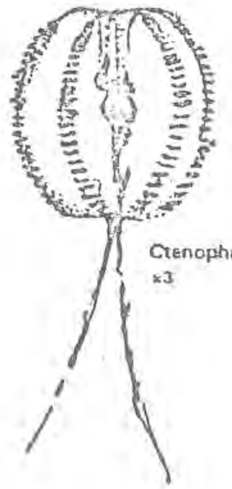


Fig. 1-7: A Sample Bathymetric Trac.

If a survey could be run entirely at low or high tide slack water, charting would be considerably simplified. Since this is never possible, the soundings obtained must be corrected for the stage of the tide. To do this, a tide-height curve should be drawn and the correction necessary to bring the observed soundings to the reference point must be applied. *Normally, survey lines are short enough and boat speed high* enough so that tidal-current corrections can be ignored. With currents greater than 1 or 2 knots, it is wise to suspend operations during peak flood and ebb periods.

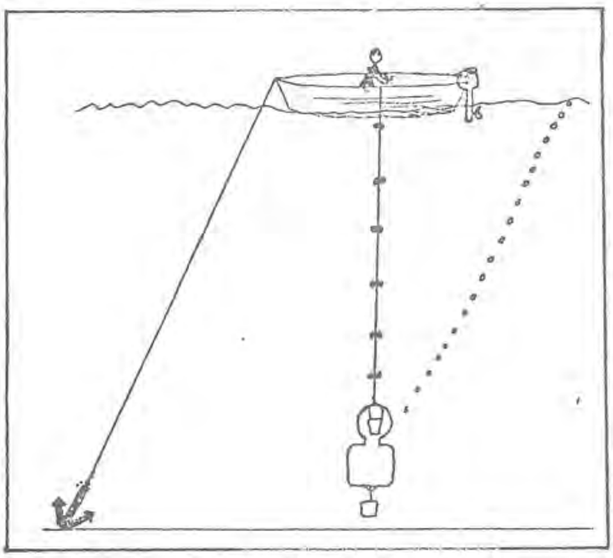
Back at the laboratory, the sounding tracks should be transferred to an enlarged version of your base map. 1 centimeter to 50 metres is a good scale. When all the tracks have been marked, transfer in your soundings (corrected for tidal height as necessary). Normally, coastal charts will use Mean Low Water as the datum plane. Once all soundings have been recorded, the map should be contoured at an appropriate interval and then reduced to a convenient size for field use. *A 2-metre interval is excellent,* but often a larger contour interval will prove more convenient and realistic.



Ctenophora
x3

1.5 Water Sampling

Expensive Nansen bottles can be purchased, but these usually work out at between $600-$800. The principle of the water collecting device is that you should be able to collect a water sample from any depth.



At your sampling site, water samples are taken from a number of depths by setting the water collecting bottle and lowering it carefully over the side of the boat. The Stopper Knots are let through your hands, and when you are at your depth, the cork is pulled and the observer watches for bubbles to rise. When no more bubbles can be seen, the bottle is pulled on board and the sample taken.

Fig. 1-8: Water Sampling

Making a Water Collecting Bottle

You will need

* 1 x 2 l. empty wine flagon
* 1 cork to fit, with a hole.
* Washer to fit small diameter of cork.
* 2 lead weights or house bricks (enough to take bottle to bottom)
* 2 lengths of cord. (curtain cord is good and cheap - enough to make a harness for the bottle and enough to attach from the cork to the boat)
* Ring to stop cork when popped.
* Bucket (to put the whole thing in).

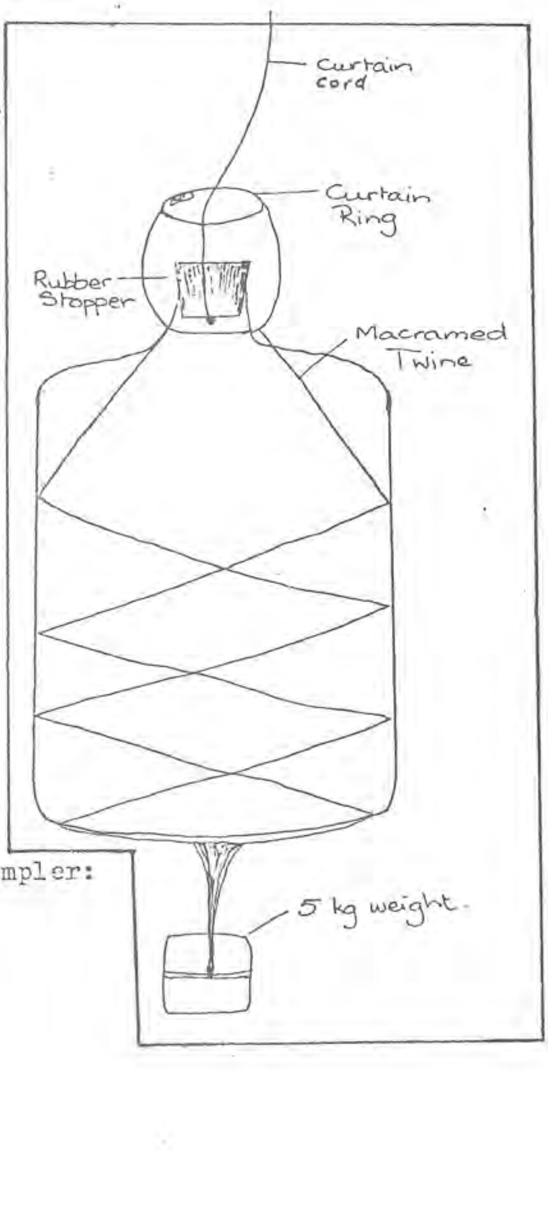


Fig. 1-9: A Home Made Water Sampler:

A simple water sampler that is cheap to build and perfectly adequate for shallow-water operations is shown below.

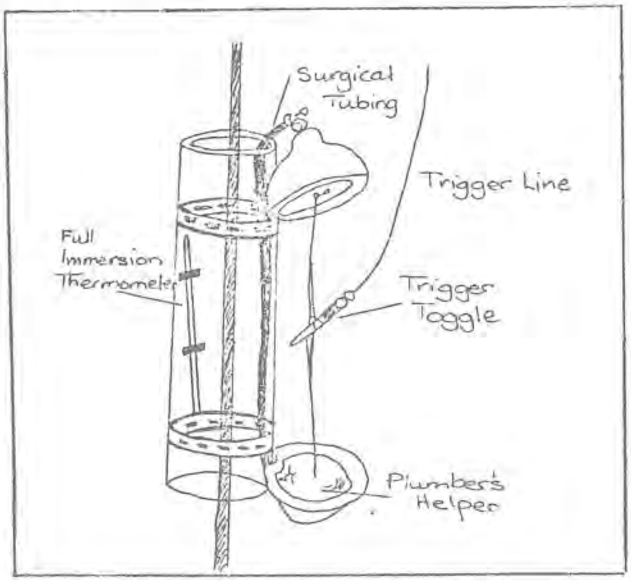


Fig. 1-11: A More Elaborate Water Sampler Bottle.

This water bottle is made from a section of a 3-inch internal-diameter tubing (preferably clear, as shown, but opaque PVC can be used) and two rubber balls or the ends of plumber's helpers that are large enough to serve as plugs. In the example figured, the cups from plumber's helpers have small steel eyes screwed into their tops and bottoms, and they are rigged as shown. *A piece of rubber surgical tubing,* obtainable from any pharmacy, or shock cord is attached to the handle side of the plugs, and loops of light, sturdy line are attached to the eyes on the cup side. The length of surgical tubing, which is run through the plastic tube, is adjusted so that the plugs are firmly seated in each end of the cylinder. *Then the lengths of the loops are arranged to hold the bottle open* - held, as shown in the figure, by a light toggle. When sampling, the bottle is attached to a piece of line (nylon parachute cord is convenient) above a weight. *The cocked bottle* is lowered to the predetermined depth, and the trigger line is jerked sharply to withdraw the toggle and collect the sample. A certain amount of experimentation is necessary to develop a reliable toggle; we use a smoothly sanded wooden peg. Usually, you can feel a bump on the line when the bottle samples successfully. *The bottle is attached to the sampling* line with several turns of black plastic electrical tape - one of the true necessities of modern oceanography.

With the water sampler, you can collect reliably to depths as great as 100 feet, but with increased depth, there is more opportunity for malfunction. *Fortunately,* in most estuarine work you are concerned largely with the shallow waters. Ideally, one should take a number of samples simultaneously, but this has not proved convenient with this apparatus. *A number of bottles can be lowered serially,* but triggering these is very awkward if you use individual trigger lines and almost impossible if you try to use one trigger line. *Instead, it is usually easier and quicker to anchor and take a number of samples successively at the station,* using a single bottle and set of line.

1.6 Current Measurement

Currents are certainly the most important physical processes at work in estuaries. They exist in three dimensions throughout the entire system and are produced by several factors. The flood and ebb of the tides usually produce the greatest currents, but there is often a residual gravity-driven flow of river or stream water, and wave or wind-driven currents may have considerable local influence. Currents often change both velocity and direction with depth, and it is by no means uncommon to find surface river water flowing out of the estuary while deep-sea water flows in underneath.

Of the two basic approaches to *current measurement*, one is passive (measuring the current flowing past your point of observation), while the other is active (putting something into the water and following its movement). Often, *both approaches must be used to gain a comprehensive view of estuarine circulation.*

Estuarine Current

A trajectory study of water circulation is mechanically very simple to conduct. All that is necessary is something distinctive that will travel with the current and can be observed along its route or at its *final destination*. A familiar example of this approach is the traditional note in a bottle produced by shipwrecked (or bored) sailors. For an integrated record of average surface currents away from a given location, the drift-bottle or drift-card technique is quite useful. This is fundamentally the technique suggested earlier for observing currents in the alongshore drift area of beaches. *The greatest problem with the technique is the uncertainty of recovery.* To get any information you must use many bottles and must trust to casual fishermen or beachcombers for their return. Since the technique depends on recovery at the shore, it can only be used for surface currents.

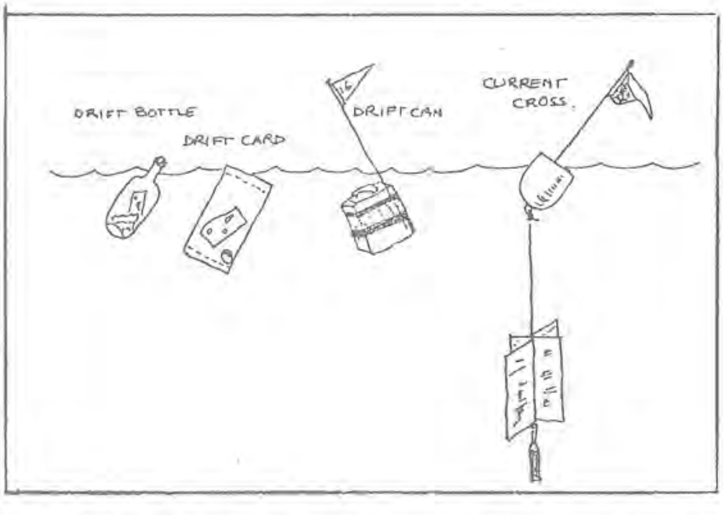


Fig. 1-12: Types of Free Trajectory Current Measuring devices.

In practice a considerable number of bottles must be obtained and should be rather distinctive - perhaps painted brightly so that people will notice them. Inside the bottle, place a return questionnaire postcard and enough sand or other weight so that the bottle floats with only its top above water. *Cork or seal the bottle securely.* A modern variation of this technique employs plastic bags or envelopes instead of bottles. These have the advantages of light weight and portability, and they eliminate broken glass on the shore. Experiment with freezer bags to develop a good weighting and sealing technique. *The heavier polyethylene bags* used for freezer storage usually prove most satisfactory. The cards should float at the surface but should expose as little area as possible to catch the wind. A few small washers usually provide enough weight, and sealing with a moderately hot household iron is usually satisfactory. *Each card in such a drift survey* should be numbered, and the numbers and locality recorded when you release them. On recovery, map time and place of release and recovery to show an average surface drift pattern and rate. *Check Local Authorities for local litter regulations.*

A somewhat different approach may be used in the trajectory system. Instead of leaving recovery entirely to chance, you may choose to follow directly the movements of a float of some sort. *Such a float is called a drogue* and may be used to study either surface circulation or currents at depth. For surface-water movements, you can use any sort of convenient float weighted like the drift bottles to float at the surface.

To mark the drogue, attach a mast and an easily spotted flag. Since you want to minimize wind effects, one of the most practical marking systems is a wire mast, made from a straightened coat hanger or wire of similar gauge, with a flag of light-weight material painted with *a Bright UV fluorescent* paint. To measure currents at depth by this technique, build a simple current cross of plywood, weight it with an old sash weight or a similar object, and suspend it from a small float at the depth you wish to monitor. A typical current cross might be a half metre square. The float and suspending line should be as small and streamlined as possible to reduce drag. *Since the surface area is much greater than that of the suspension system,* this sort of drogue will move with the deep currents. Normally, drogues are released at slack water at critical points within the estuary and their movements checked periodically by sextant angles or compass bearings. Routinely, several floats will be set from one site to tract currents at various depths simultaneously. The drogues should be numbered so that you can identify individual paths.

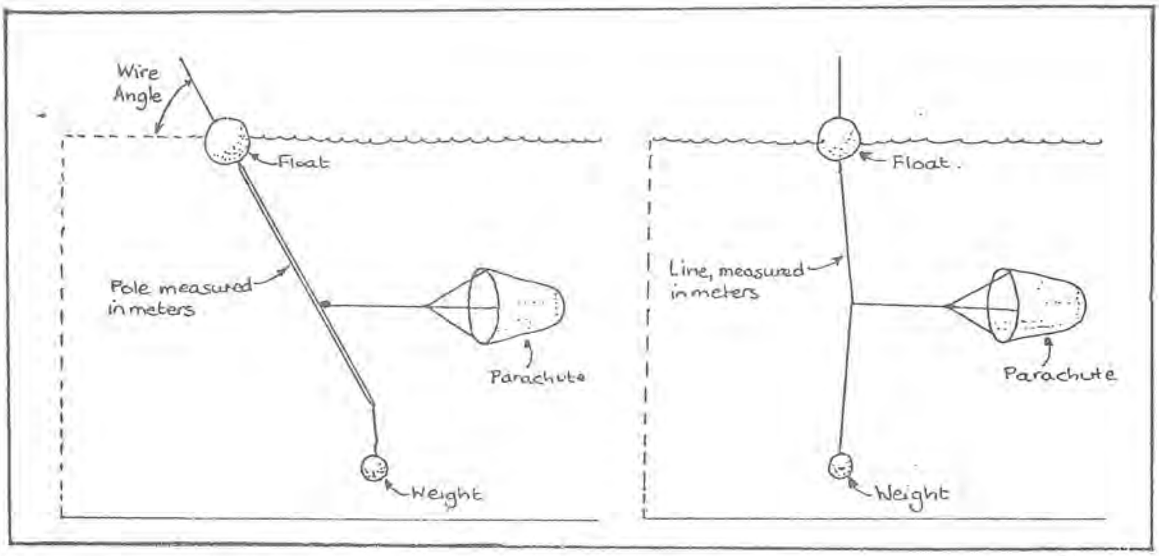
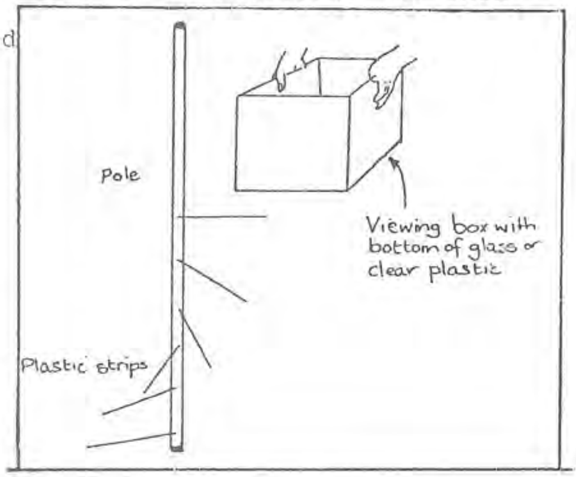


Fig. 1-13: Current Measuring Devices.

If you are going to be working in very shallow water, a simple current-measuring device can be made by attaching plastic strips to a pole at intervals of about 10 centimeters. Of each strip is a different colour, they will be easily distinguished under water. *A viewing box, with a glass or plastic bottom (such as a small aquarium)* can be useful for these and other underwater observations. Not only can you get a rough idea of current direction but also you can get a rough idea of current velocity; the greater the angle of the strip from the pole the faster the current. *Or you can get a fairly accurate calibration of velocity by walking the* current pole in a swimming pool and calculating your walking or current velocity. You may have to weight the strips with small fishing weights or something similar.



1-14 Viewing Box

Making a Drogue

You will need

- 4 sheets of ½ x ½ mm Masonite
- 4 strips of 1 x 1 Meranti
- * Wood glue, nails and hammer
- 1 sheet of 80 x 40 Masonite
- 1 x 1m of 60 x 40 Pine
- Curtain cord
- Brick or lead weight
- Paint (optional)
- Felt pen
- Protractor

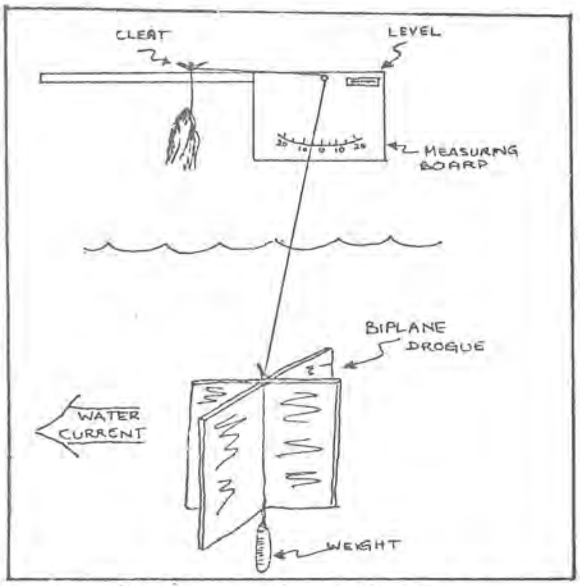
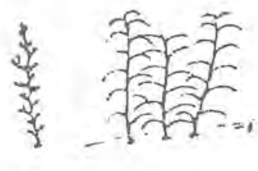


Fig. 1-15: Bi Plane Drogue.

The angle gives the current speed. The compass direction gives the current direction.

* *For prolonged use use Marine Ply but if the equipment is only used once or twice a year Masonite will do.*



1.7 *The Sediment Corers*

This item is one of the most difficult pieces of equipment to make and use properly. *It is designed to collect a cylinder of sediment from the water-sediment interface down into the sediment.* The difficulties in using the corer are (1) to collect the sediment surface without badly disturbing it, (2) to penetrate a reasonable distance into the bottom (say, a foot or two), and (3) to recover the sediment without losing it as you extract the cylinder from the bottom and pull it up to the vessel. *Two kinds of corers will be described* - a hand corer and a gravity corer.

The hand corer should be used in preference to the gravity corer if necessary. It can be used only in shallow water, say, water as deep as ten feet or so. The best hand corer for this exercise is shown in Figure 1-16. *It consists of a clear plastic tube,* 1 or 2 inches in diameter and about 20 feet long, with a core catcher inserted into the end that will penetrate the sediment. A core catcher can be made from a tennis ball (one that is old and smooth is best) or a thin rubber ball. *It should be cut in half,* and slits be cut from the apex to about two centimetres from the equator. *It must fit snugly into the end of the core tube,* and should be attached by bolts through holes cut in the end of the core and in the equator of the core catcher. *The core catcher is important* because it insures that the sample is not lost as the core is retrieved, and it should work as illustrated in Figure 1-16.

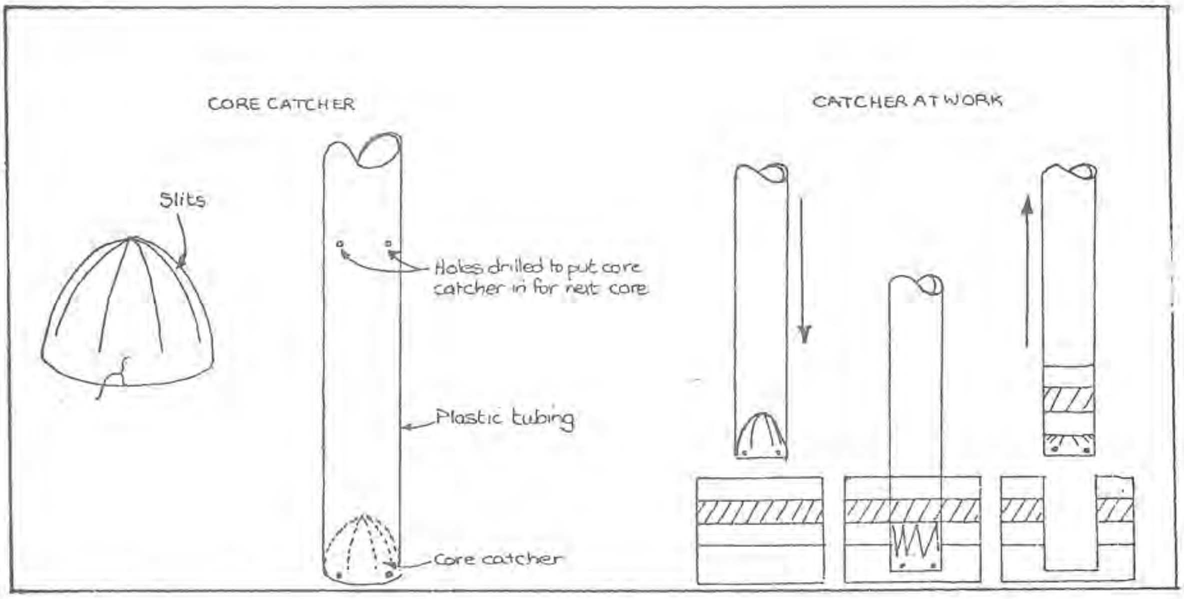
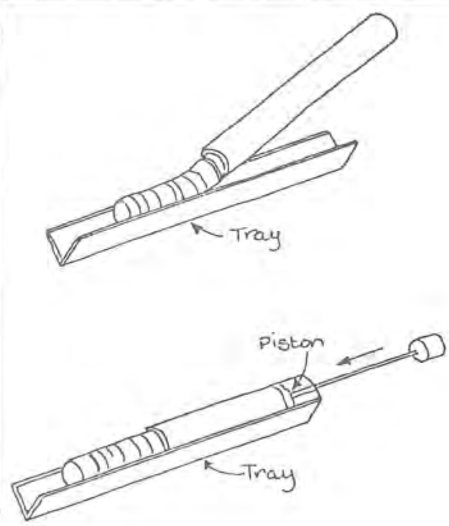


Fig. 1-16: The Hand Corer.

After a core is taken, cut the core tube with a saw just above the sample, remove the catcher, seal the sediment core in the sawedoff part of the tube on top and bottom with plastic electrical tape and bottle caps and store vertically (in a cold place if possible). *The core catcher is then inserted into the remaining part of the empty tube* (now about four feet shorter) for reuse. For ready reuse of the core catcher, you can drill holes at about four-foot intervals along the tubing before you go into the field, or you can take a hand drill with you into the field. *In this way, you will be able to take three cores* or more with each core tube. If you do not have a long plastic tube, you can make the corer from a metal pipe.

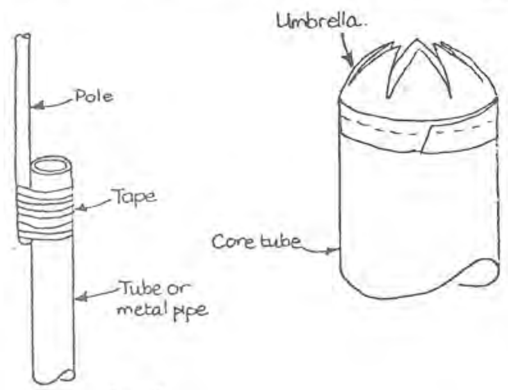
Upon retrieval, slide the core out into a tray, or push it out into a tray gently with piston plunger, as shown in Figure 1-17

If you are taking a core in water deeper than the length of the tube or corer barrel, attach a thin pole to the side of the barrel with electric tape, being sure that you wind the tape around the pole and barrel several times to secure them firmly together. (Figure 1-18). *After you have taken your sample,* you will have to retrieve the corer very slowly so that you do not disturb the water sediment interface collected. You may want to design *an umbrella* to cover the top, so that water can get out during penetration but not enough of a current will be developed on retrieval to disturb the water-sediment interface. *To make the umbrella,* use the other half of the rubber ball but, instead of slits, cut out wedge-shaped slices as illustrated in Figure 1-18 and bolt to the top of the corer tube as you did for the *core catcher.*



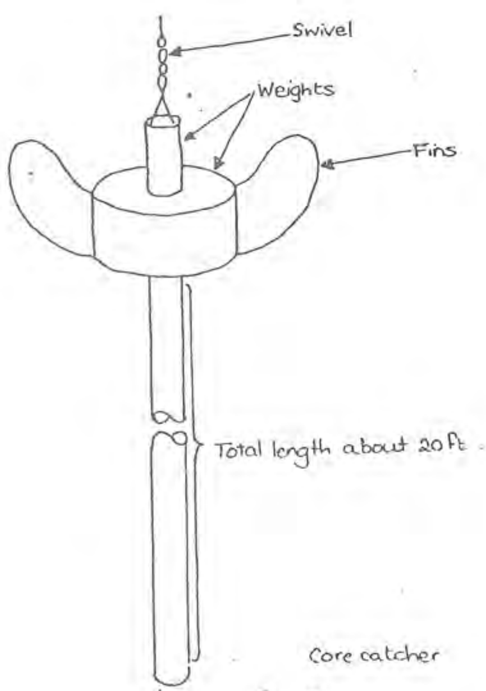
1-17.

If you are going to be in water deeper than about ten feet (so that the hand corer alone will not be sufficient), you will have to make a gravity corer. It is much the same as the hand corer except that it penetrates by the force of free fall (dropped with a slack line) instead of being pushed into the bottom.



1-18

The best type of gravity corer consists of *a plastic liner* that *fits snugly* into a metal corer and that can be removed and stored as from a hand. Alternatively, the plastic tube can be used as the corer itself or only the metal pipe can be used and the sample extruded as shown in Figure 1-19. *Weights will have to be bolted to the corer* so that it will penetrate, or you can place them on racks so that you can alter the weight as needed. If the corer is to be hauled by hand, weights should not exceed 50 pounds. Also, fins will have to be *welded or bolted to the weights or the tubing so that the corer will fall true.* (Figure 1-13). Finally, you will need an umbrella device as described for the hand corer (see figure 1-16) *which will prevent the water from washing away the sediment* - water interface upon retrieval, and you will need the core catcher.



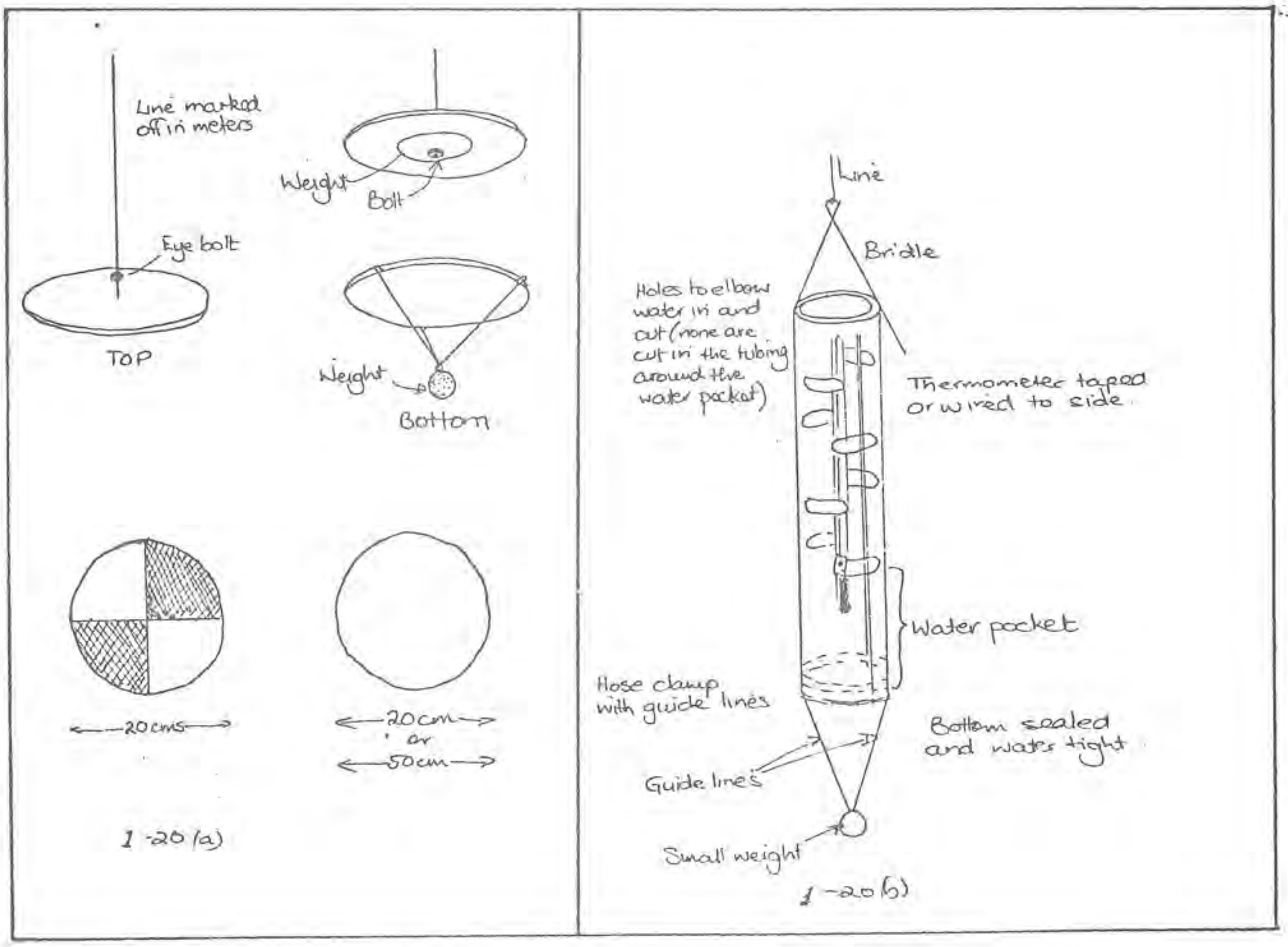
1-19

1.8 The Secchi Disc and Bucket Thermometer

A Secchi, or visibility, disk is used to measure the transparency of the water column. The usual procedure is to lower the disk over the sunny side of a vessel that is motionless in the water, and then to note the depth when it reaches the point at which you can barely see it. This measurement is especially important for your collection of biological samples, and it may also give you some information on currents and sediment transport.

Most of the Secchi disks have a diameter of either 50 centimetres (for marine disks) or 20 centimetres (for fresh-water disks). *Most marine disks are all white* and most fresh-water disks are black and white. Construct the disk from plywood painted with a number of coats of durable (marine type) white paint; the black sectors of the fresh-water disk can be covered with black tape (plastic electric tape works well) or black paint (Figure 1-20). *Drill a hole in the centre and insert an eyebolt* so that the line can be attached to the top. Now attach a weight (of about two pounds) to the bottom, either by the same eyebolt in the centre, or by lines from three different eye bolts spaced around the periphery, so that the disk will not float or drift. *Because you will want to measure the depth,* mark the line at one-metre intervals to a length of 50 metres so that you can count them when the disk is retrieved.

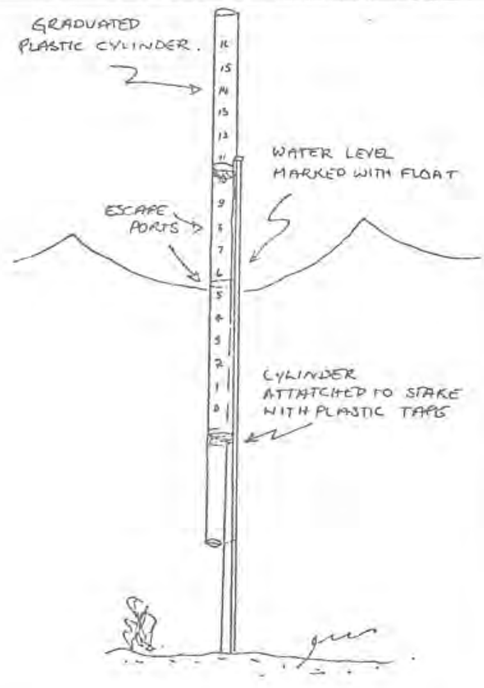
A bucket thermometer is used to measure surface and shallow subsurface temperatures. It is best to use a clear plastic tube about 30 centimetres long, with holes (of about one centimetre in diameter) drilled or cut into it so that



water can enter and leave the upper two-thirds of the cylinder. Be sure that a water pocket (with no holes) is left at the bottom so that some water will be retained, and that the bottom is sealed. *You can seal the bottom by gluing a flat piece of plastic to the tube* (a plastic solvent glue is best). For this item, too, you will need a line marked at one-metre intervals, or the same line that you use for the Secchi disk. The thermometer will be taped or wired to one side of the interior of the tube. *Ideally it should have a temperature range of about* $2^{\circ}C + 35^{\circ}C$ but it must have at least a minimum range that will not be exceeded in the field. A weight of about a pound should be attached to the bottom by rope or wire lines held to the bucket by a hose clamp. *A similar arrangement can be used* to attach the top of the bucket to the line, or the line can be attached to the bucket by a metal rod that has been bent around two holes drilled in the bucket.

1.9 Wave Determination and Analysis

Wave effects within sheltered estuaries are usually of minor importance. To develop waves of any real size, the wind must have the opportunity to work on the water surface for a considerable time and over a considerable distance. The only estuarine areas, then, where waves are likely to be significant are places exposed to waves coming in from the open sea. *In these areas, there are likely to be considerable mixing of surface waters and longshore currents* developing in the shallow water. Also, the energy of breaking waves is such that finer sediments are carried away and sand or gravel is left behind to form a beach.



1-21 WAVE POLE FOR ESTUARINE WAVE ANALYSIS.

TABLE 2: SAMPLE WORKSHEETS (Copyright Release)

GLADSTONE OCEANOGRAPHIC STUDIES PROGRAMME

FIELD DATA SHEET: OF

GROUP:

OBSERVERS:

DATE:

VESSEL:

LOCALITY:

STATION NO.	TIME:	TIDE: EBB/ FLOOD	AIR TEMP ^{o}C	DEPTH M	WATER TEMP ^{o}C	WATER ANALYSIS					CURRENT ANALYSIS		
						EXTINCTION COEFFICIENT SECCHI DISC x 2 (CM)	SALINITY		OXYGEN	250Ml FOR TDS TSS	DIRECTION HOR^{o}	DEFLECTION VERTIC^{o}	VELOCITY
							BY DENSITY SALINOMETER READING IN CYLINDER	BY TITRATION TITRATE SILVER NITRATE TO 1ML SEAWATER 1 DROP POT.CHROM. RED BROWN PT.	BY TITRATION TITRATE FRESH $Na_2S_2O_4$ in 250Ml SEAWATER WITH 3 DROPS METHYLENE BLUE TO COLOURLESS				
A	0955	EBB	24.2^{o}C	0	20.4^{o}C	150 x 2 300 CM	10	230 ppm	10.2 MLS		330^{o}	5^{o}	

GLADSTONE OCEANOGRAPHIC STUDIES PROGRAMME

OBSERVER: ____________ *CLASS DATA SHEET:* ____________ *OF:* ________ *DATE:* ________

STATION NO	TIME	TIDE	DEPTH	WATER TEMP.	EXT. COEFF.	SALINITY PPM	O_2 PPM	TDS	CURRENT	
									TSS	VELOCITY

STRIVING
BENOWA HIGH SCHOOL
CARING

BENOWA HIGH SCHOOL PARENTS & CITIZENS ASSOCIATION

PRESIDENT: Roger Brewster
Ph. 381 755 Bus.
501 660 A.H.

SECRETARY: Leslie Ponti
Ph. 323 782

17th July, 1986

Mr. R. Moffatt,
Benowa State High School,
Mediterranean Drive,
BENOWA. QLD. 4217

Dear Bob,

On behalf of the P & C Association and the students of the school, I would like to express our deep appreciation for your personal commitment and untiring efforts in relation to the Marine Studies program.

The P & C Association has benefitted financially from your generous loan of the copyright over the Marine Studies classroom notes. The sale of notes to other schools has defrayed the costs of establishing the Marine Studies program here at Benowa as well as assisting many other schools in Queensland to begin their school programs.

This letter acknowledges the return of the copyright over the following classroom notes to yourself as owner:

Navigation, snorkelling, coastal physics, fisheries biology, estuarine chemistry, oceanography, science of diving, field methods, boating and marine radio.

The P & C Association will continue to be able to sell copies of the sea notes which will continue to operate under the Marine Studies Sub Committee. The Association acknowledges that these notes were produced in school time and therefore remain the property of the Education Department.

Finally, we are very pleased that the inaugural Castrol Sea Safety Award was made to you. It is a fitting tribute and worthy honour to your entrepeneurial achievement.

Yours faithfully,

Roger J Brewster

ROGER J. BREWSTER
PRESIDENT

MARINE STUDIES SERIES

OTHER UNITS :

There are two types of Classroom Note : **Practical & Applied**

(a) Practical Notes

Unit 1 : Navigation	: Features of the Coastline, Navigation Methods, Practical, Weather, Pilotage, Tides, Exam.
Unit 2 : Snorkelling	: Physiology, Techniques, First Aid, Dangerous Marine Animals, Safety, Certificate.
Unit 3 : Radio	: Components, Features, Discipline, Types, Practice Excercises, Certificate.
Unit 4 : Boating	: Buying a Boat, Safety, Seamanship skills, Handling, Maintenance, Licence.
Unit 5 : Camping	: Types of, Equipment for Camping with a boat, Campsites, Practical Conservation, Safety, Leadership Skills.

(b) Applied Notes

Unit 6 : Fisheries Biology	: Plankton, Nekton, Benthos, Fishing Methods, Protected Species, Fisheries Management
Unit 7 : Estuarine Chemistry	: Laboratory Methods, Pollution, Salinity, Temperature, Ph, and other parameters.
Unit 8 : Coastal Physics	: Waves, Tides, Beach Erosion, Beach Protection, Coastal Management, Local Coast Management
Unit 9 : Diving Science	: Boyles Law, Charles Law, Effects of Pressure on Diver, Marine Medicine.
Unit 10 : Sampling Methods	: Marine Technology in Scientific sampling apparatus, student project, collection methods.

SAFE BOATING = KNOWLEDGE + COMMON SENSE + COURTESY