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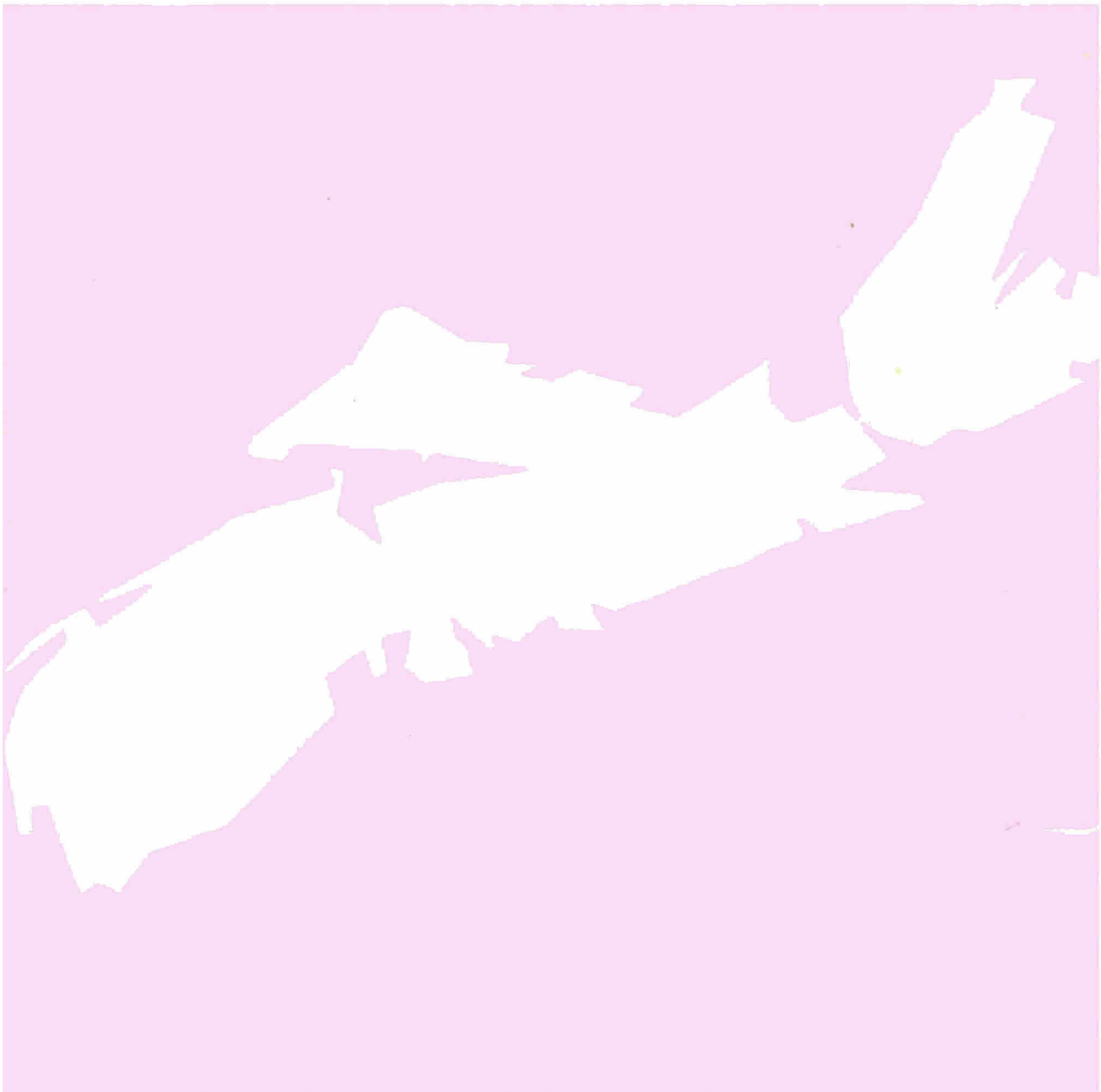

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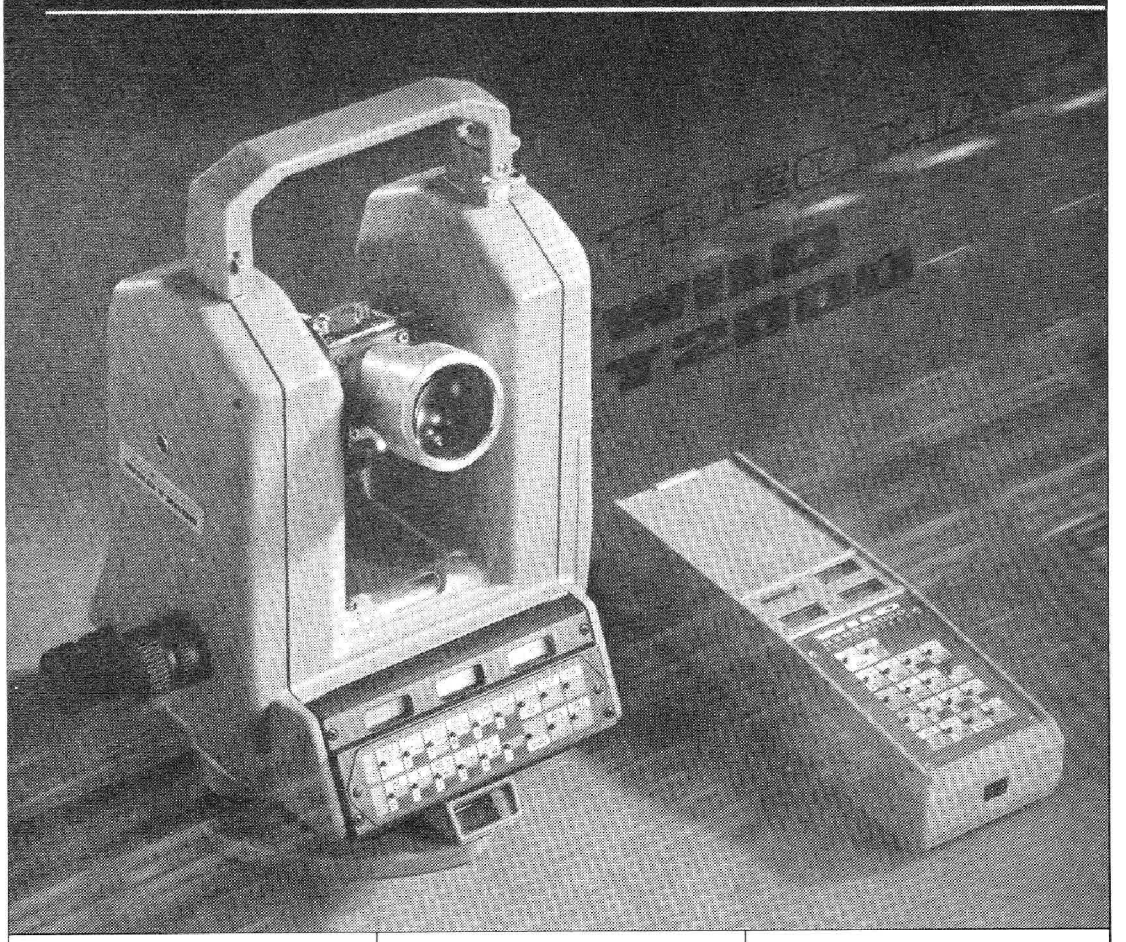

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Views, expressed in articles appearing in this publication, are those of the authors and not necessarily those of the Association.

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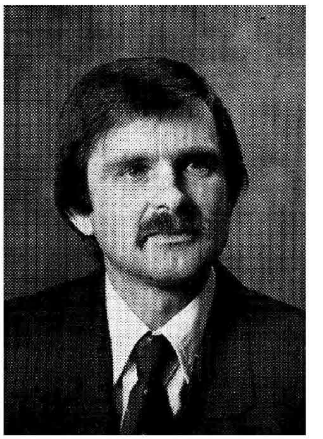
** PRESIDENT'S PAGE **

Fellow Members:



Summer is upon us, and with it a change of life style that, thankfully, does not include snow shovels. My wish for a safe and enjoyable season is extended to all of you and your families. I, for one, plan on soaking up as much sunshine as possible, if time permits.

Together, Jane and I attended the annual meeting of the Alberta Land Surveyors Association in Edmonton from April 24 to April 28. It was a very enjoyable and informative meeting. I had an opportunity to meet both old and new friends. The meeting was well advertized in the Edmonton Journal, and the general public was invited to attend various educational talks that were presented.

Following the Alberta meeting, the annual meeting of the Canadian Council of Land Surveyors was held on April 29 and 30. All provinces were represented by directors and representatives. Our Director is Bill Tl . During this meeting, Ken Aldred, A.L.S., was elected as President, Gerard Raymond, Q.L.S. was elected as Vice-President and Don Yates, O.L.S., was elected as Secretary-Treasurer.

Our discussions dealt with a great many items of national and mutual concern to all.

I was very impressed with the caliber of the people present, and I can assure you that a concerned effort is being made to make the survey community in Canada the most united in the world.

While I was in Alberta, Art Abbott represented our Association at the annual meeting of the Association of Professional Engineers for the Province of Nova Scotia on April 25, 1984. Thanks Art!

An executive meeting was held during the afternoon of May 14.

Both Howard Wedlock and myself attended the graduation exercises of the Nova Scotia Land Survey Institute in Lawrencetown on May 18.

Vice-President, Don Parker, represented our Association at the annual meeting of the Canadian Council of Professional Engineers held in Halifax on May 25. Thank you Don!

Our approach to St. John's, Newfoundland, on May 23 was made quite pleasant by the addition of bright sunshine and glistening icebergs. Jane and I had the unique pleasure of being "introduced" to the "Royal Order of Screechers", an unforgettable experience that has something to do with eating Newfoundland steak (bologna), drinking screech, and kissing a cod fish. Yuk is right!

My thanks to Past President Gary Hughes for his hospitality and the opportunity to present him with a certificate of appreciation from his friends across Canada that was prepared by an Honorary Newfoundland Land Surveyor, George Bates.

Their annual meeting saw the end of the "location certificate" as we know it. A full survey, together with a plan, is now required. Mandatory insurance was rejected by the membership, due in part, I believe, to a lack of information.

Liability insurance in Canada is going to cost more this year. It seems that some surveyors are making mistakes, and big ones at that.

One national project that is going to be undertaken is an insurance seminar to be held in Toronto in September of this year. I would like to see such things discussed as variable deductibles, repeated offenders, types of errors, discipline of members and denial of insurance under the C.C.L.S. program. This seminar will be held in conjunction with the C.C.L.S. semi-annual meeting, and I would hope that our Association will have an active participation.

A council meeting was held on June 2, and is further reported on by Ted Webber on Page 36.

Every year our Association presents a scholarship to the best first year student at the Nova Scotia Land Survey Institute. At the June 2 meeting, council named this scholarship the George Bates Scholarship. Congratulations George!

Special thanks is extended to Harry Ashcroft and the members of the Continuing Education Committee for the seminar presented at Halifax on June 16 and Baddeck on June 19. The speaker was Lorraine Petzold, O.L.S., and also executive director of the Association of Ontario Land Surveyors. Very timely and informative indeed.

Our annual meeting is planned for November 8, 9 and 10, 1984, at the Chateau Halifax. Please take note, Dave Roberts, that you have at least one week this year to shoot your deer before the meeting.

It is hoped that our regulations can be put to rest at this meeting, together with any necessary revisions to the Act. Thus the reason for the three day meeting, with no seminar. Advance registration will be made available and attractive. If you like "Country and Western" music, be sure to attend "Nashville Night" on the 8th.

There is a great deal expected of a president in regards to his time, meetings and review of Association affairs. Is everyone doing his share? The following is a list of the most recent zone meetings:

ZONE 1 - September 28, 1983
2 - May 2, 1984
3 - October 13, 1983
4 - September 30, 1983 (special held in April)
5 - January 23, 1984 and May 15, 1984
6 - September 29, 1983

Our Association dues are among the lowest in the country, mainly due to our large membership, which is greater than New Brunswick, Newfoundland and Prince Edward Island put together. Do we know what we want for the future? What should our dues be?

I plan on forming a finance committee to assist in budget making, planning projects and liaison with committees. Council has also decided to draft a five year plan for the Association. Such a plan would require the participation of all committees. All committee chairmen may now take note that you will be asked to have a plan, and financial costs, for your own committee before a total plan can be realized.

Done any condominium surveys lately? Let's have a workshop or seminar on this topic soon, before some of our members end up learning by their mistakes. Let's get over the idea that once we get our licenses we know all there is about surveying.

The 34th annual meeting is approaching fast. Make your plans to attend and watch for a tentative schedule later this summer.

F. C. Hutchinson, N.S.L.S., C.L.S.,
President

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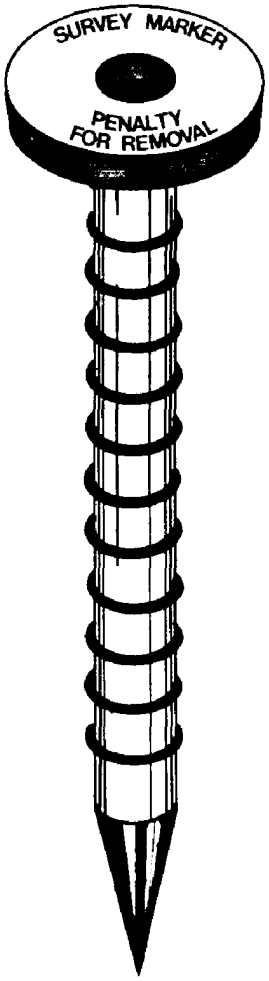

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** BOOK REVIEW **

Tidal Boundary Delimitation by Susan Nichols. Technical Report No. 103, Department of Surveying Engineering, University of New Brunswick, Fredericton, N. B., E3B 5A3. 202 pages; 37 figures; price $10.50.

By the time this review appears a judgement will have been given by the World Court on the matter of the Canada-USA boundary seaward of Machias Seal Island in the Gulf of Maine. This decision, of great consequence to the fishery of southwestern Nova Scotia, will set our country's (and in a sense) our province's outer limits. Ms. Nichols' report concerns itself with the inner limits of our maritime domain.

The report addresses three aspects of our tidal boundaries - the definition of legal boundaries, the current practice of surveying them, and the availability of tidal information. Study of her work should enable the land surveyor better to deal with tidal boundaries while showing him where more work must be done to produce a higher level of clarity and consistency. Her report also may encourage land surveyors to give more of their attention to matters beyond the line of Mean High Water - the limit beyond which they have traditionally had no reason to go or to think.

Supporting the narrative are some 37 figures which are of considerable assistance to the reader. In fact, it is difficult to imagine how one could get along lacking them. After all, '"What good is a book without pictures", said Alice'. It might be noted that the figures were produced by Ms. Nichols herself. They are well executed and give considerable attention to detail.

The report embraces five chapters and two appendices:

Introduction
Tides and Tidal Datums
Coastal Land Tenure and Tidal Boundaries
Tidal Boundary Surveys
Conclusions and Recommendations
Appendix I - Current Practice in the Maritimes
Appendix II - Two Maritime Case Reviews

The introduction sets the scene by noting that tidal boundary determination requires an interdisciplinary approach. The delimitation of tidal boundaries, for example, is seen as an exercise which draws upon "such diverse topics as oceanography, geography, biology, geomorphology, and history, as well as the various fields of law and surveying". It is of interest too that Ms. Nichols subdivides the general problem of tidal boundaries into three subcategories: legal, survey and scientific concerns.

The chapter on Tides and Tidal Datum is most interesting. It gives a very helpful account of tidal component forces without going into exhaustive detail. The central point is that sea level is very much affected by variation in time. While recognizing that tides are essentially daily and monthly variables, most of us tend to think of sea level as a fixed elevation. But in fact there is much more to things than that. "Tidal datums are often misunderstood to be fixed level planes rather than time dependent undulating surfaces."

One finds in this chapter, as well, a figure showing the ranges of tides which border the Maritime Provinces. The Bay of Fundy is subject to very large semi-diurnal tides while those of the Northumberland Strait (not that far by land from Fundy) are rather small in comparison and diurnal. Canadian and American definitions of various tidal datums are given for comparison. Of considerable interest is a figure showing the differences between predicted and actual elevations above datum at Rustico Bay and at Brackley Beach, P.E.I. These two places are very close together but the difference in tidal heights varies by as much as 0.6 m.

Ms. Nichols raises a point with respect to the Maritime Cadastral Accuracy Study of 1977. If standards of boundary determination are to be conformable to these standards, then much work remains to be done by way of getting a precise tidal datum established and maintained.

Her third chapter, Coastal Land Tenure, highlights land ownership within the context of maritime boundaries from early times to the present day. She observes that some contemporary undertakings such as the intensive port development in Saint John, draw attention to the confusion between provincial and federal rights, and this in turn fuels litigation. Coastal Zone Management is discussed and developing concepts are noted.

General inconsistencies are illustrated by reference to recent cases. In one instance she records that "The Court used every term associated with high water boundaries interchangeably". A particularly comprehensive table of reference is provided in this chapter. There are 180 footnotes (not all to different sources, of course). These not only demonstrate how wide a net Ms. Nichols has cast in her research, they also provide the reader and the student with a wealth of useful references.

The material grouped as Tidal Boundary Surveys reviews conventional survey methods. No attempt is made to choose a best method. Illustrations are drawn from reported experiences both within the Maritime provinces and the United States. A more extensive examination of the whole problem by the survey profession is hoped for.

Conclusions and Recommendations offers numerous suggestions as to how we may improve our current situation. The common base to all of them is the need for further investigation and analysis, with continuing cooperation between the legal, surveying and scientific communities.

The first appendix to the report contains summaries of interviews with nine surveyors who have had considerable experience with tidal boundaries within New Brunswick and Nova Scotia. The second appendix reviews two very useful cases: the one involved expropriation of a part of Courtney Bay at Saint John, N. B. for industrial purposes; the other was for the ultimate development of a national park in P.E.I.

The former case, while subsequently of interest for a number of reasons, has always struck this reviewer as a good example of using a sledge hammer to crack a nut. What began as a consequence of a major development project degenerated into the pursuit of a tidal boundary in exquisite detail. After everything was over, its precise location wasn't that important.

The survey in P.E.I. will evoke many memories for those who have used Cautley's little red book on descriptions. They will recognize him as the R. W. Cautley DLS who did the initial survey at Brackley Beach in 1936. At the time he reported to the then Surveyor General that it was

> an emergency survey being made at the wrong time of year in order to enable the local government to pass title to the Dominion so that the Parks Branch may give authority to expend the current appropriation for this park. It is a case of working against time to get the very considerable amount of survey work required finished before the country is completely frozen up.

Has anything really changed?

Ms. Nichols has given us a very useful addition to the literature on tidal boundaries - particularly so because nothing of an organized kind and set within the Maritime Provinces has been available. For $10.50 surveyors and others may have the results of her initiative, intelligence, skill and determination in tackling a difficult, complex topic and bringing it into a state of good order and understanding.

Having been told of the situation, having had pointed out the existing problems, and having been offered some approaches to solving them, it is surely up to the several professional bodies to press collectively and individually toward improving things.

There is no good reason why surveyors should not take the lead.

- J. F. Doig, BSc, CLS

* * * * *

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** N.S.L.S.I. SHORT COURSES **

Over the next few months, staff at the Nova Scotia Land Survey Institute will be presenting the following courses at Nova Scotia Institute of Technology (NSIT), Leeds Street, Halifax. Courses are open to all who are interested and are subject to cancellation if not enough interest is shown by 10 days prior to the scheduled course start up. Course costs include supply of materials where applicable but do not include meals. Minimum and maximum numbers are 8 and 15 respectively:

MONDAY, SEPTEMBER 24, 1984 - 1 DAY

Introduction to Electronic Positioning - G. McBurney

The theory of offshore position determination and discussion of the technical aspects of measuring systems currently in use.

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MONDAY, NOVEMBER 5, 1984 - 1 DAY

Photointerpretation for Surveyors and Land Managers - L. Telfer

An introduction to those aspects of photointerpretation which are of interest to surveyors and land managers. Emphasis will be on practical interpretation of photographs which will remain with the student.

- Cost $100.00 per person

MONDAY, JANUARY 14, 1985 - 1 DAY

Matrix Algebra for Surveyors - D. Woolnough

An introduction to matrix algebra for surveyors with emphasis on the practical uses of the subject.

- Cost $25.00 per person

MONDAY, FEBRUARY 11, 1985 - 1 DAY

Curves by Coordinates - D. Wedlock

The use of coordinates in the computation of simple horizontal and vertical curves complete with worked examples.

- Cost $25.00 per person

MONDAY & TUESDAY, MARCH 4, 5, 1985 - 2 DAYS

Simple Least Squares Adjustment - D. Woolnough

An introduction to lease squares adjustments with simple worked examples. Emphasis will be on the applications of these techniques, and an understanding of matrix algebra is assumed.

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Practical Field Astronomy - P. Milo

A review of the theory and techniques behind the astronomic observations required to determine position and azimuth.

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MONDAY & TUESDAY, APRIL 1, 2, 1985 - 2 DAYS

Working with Map Projection Coordinates - D. Woolnough

The applications of the provincial coordinate system from elementary theory to practical example.

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For further information, or to pre-register, please contact:

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Head, Survey Department
Nova Scotia Land Survey Institute
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B0S 1M0

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* * * * *

** *LAND SURVEYOR OF THE YEAR AWARD" - NOMINATIONS* **

The Public Relations Committee would like to invite the general membership to submit nominations for the "Land Surveyor of the Year Award". The award was first presented at our annual meeting in 1981 and again in 1982. There was no presentation made in 1983.

To be eligible for this award the nominee must be a member in good standing who has made significant contributions to the advancement of the land surveying profession in such areas as: dedication to the affairs of the Association, education, and general practice.

The nominee must also be active in service to his community by participating, especially in a leadership role, in community activities for the betterment of his fellow citizens and quality of life.

The nominee being one who is able to combine a professional career along with outstanding volunteer service to both the Association and community.

If you feel a fellow member is deserving of this recognition, please forward to the Public Relations Committee his name and listing of his Association and community activities along with other pertinent information and remarks.

In order that the Committee can make its selection prior to the upcoming annual meeting please forward this information to the following address by September 30, 1984: - WAYNE D. HARDY, CHAIRMAN, 28 COMMON STREET, SYDNEY, N. S., B1P 3L1.

** HYDROGRAPHIC SOUNDING **

Presented to

The Board of Examiners

Association of Nova Scotia Land Surveyors

by George Podetz

Submitted in partial fulfillment of
the requirements for registration as a
Nova Scotia Land Surveyor

April 1984

ABSTRACT

Sounding is one of the most important parts of the Hydrographic Surveyor's work because it exposes dangerous irregularities under water. Lines of sounding are run in a set and methodical manner. It is often necessary to run interlines, crosslines and test lines when additional information other than that obtained by just running lines of soundings is required. The sounding ship must be handled in an efficient and professional manner in order for the survey to be carried out economically and accurately. The two principal methods of sounding are the Echo Sounder method and the Lead Line method, each of which has its own application.

1. INTRODUCTION

"Hydrographic surveys proper can be defined as surveys executed to measure the position of the bottom of bodies of water. These surveys, or soundings, are chiefly used to make nautical charts for navigation, but they are often essential for planning and controlling engineering projects like bridges, tunnels, dams, reservoirs, docks and other river and harbour improvements.(1) Sounding is perhaps the most important part of the Hydrographic Surveyor's work.

Safe navigation demands an accurate knowledge of the depth of the sea, particularly in harbours and their approaches where vessels may often be forced to use channels where the depths may allow little margin for error. As the sea bed is hidden from view, its form can only be determined by systematic soundings at regular intervals over the whole water area of a survey. Unless there are other indications, it is assumed that the slope of the bottom is uniform in spaces between adjacent sounding lines.

This cannot be said to be a truly accurate method of determining the configuration of the ocean bottom. The possible existence of irregularities, dangerous to navigation, between adjacent soundings, cannot be overlooked. Thus it is often necessary to supplement sounding by sweeping parts of the survey area at some predetermined depth. This will ensure that no dangers remain undetected but unless bottom sweeping is done, the exact nature of the irregularities will remain unknown.

The operation of sounding is usually the most arduous and sometimes least interesting part of hydrographic surveying. Safety and economy demand that much of it should be done in small boats in which the surveyor is somewhat exposed to the elements. However, devices such as the Echo Sounder have done much to increase the output and the accuracy of the work.

2. HISTORY OF SOUNDING

During his voyage around the world (1519 - 1522) Ferdinand Magellan may have been the first to attempt a deep sea sounding. Magellan used a sounding line only 100 or 200 fathoms (1 fathom = 6 feet) in length in the Pacific and did not reach bottom. Although several attempts at sounding the ocean deeps were made before him, the first real success was by Sir John Ross in 1818. He obtained a sounding and a mud sample from a depth of 1050 fathoms in Baffin Bay.

The art of sounding was advanced by a device built by a U. S. Navy Officer in 1854; to the end of the sounding line he attached a detachable weight which dropped off when the line hit the bottom. The dropping off of the weight made it much easier to detect when the sounding line had reached the bottom. The introduction of steel cable in 1870 was another important advancement since it replaced the rope and hemp lines which were subject to shrinking and stretching due to water content, etc.

The Meteor Expedition of 1925 was the first time that soundings were routinely and continuously made across the ocean. It made one of the first detailed studies of a particular part of the ocean. The expedition was the first to use an electronic echo sounder to measure ocean depths, gathering more than 70,000 soundings in 14 crossings of the South Atlantic. These soundings clearly revealed the ruggedness of the ocean floor and the Meteor Expedition created great interest in and spurred on more thorough research in the configuration of the ocean bottom.

With the invention of the echo sounder came rapid and precise mapping of the world under water. Great areas could be sounded and mapped more quickly and economically than ever before. Modern technology's contribution towards this field is the Lidar Bathymeter, which is scheduled to make its debut in the fall of 1984.

(1) *Philip Kissam, C. E., Surveying for Civil Engineers, Second Edition, McGraw-Hill Book Company, Toronto, Ontario, 1981, Pg. 480.*

3. PROCEDURES OF SOUNDING

3.1 Lead Line Method

Handheld lines are usually a length of sash cord, hemp or braided flax with a sounding lead attached to one end. The line is usually 50 fathoms long and is marked at each one-half fathom from zero depth to twenty fathoms; from twenty fathoms to fifty fathoms, it's marked in even fathoms. Color-coded bunting cloth and leather are used to mark the various graduations along the line (see figure 1). This type of line is extremely time consuming to use and requires a great deal of manual labour. Also, rope lines must be stretched before being used, kept dry when not in use, and must be soaked in water for at least an hour before being used in order to allow the rope to assume its tested length, since it is graduated while wet.

Although this line works well in coastal waters, it becomes time consuming to use in deep water. Here the handheld line is replaced by a motor driven reel of wire, which requires no extensive preparation before being used, is much faster to use and doesn't require a great deal of physical labour. However, this method also has its drawbacks. As the wire is let out further and further, it eventually becomes much heavier than the lead weight at its end, therefore, making it difficult to tell when the weight has reached bottom.

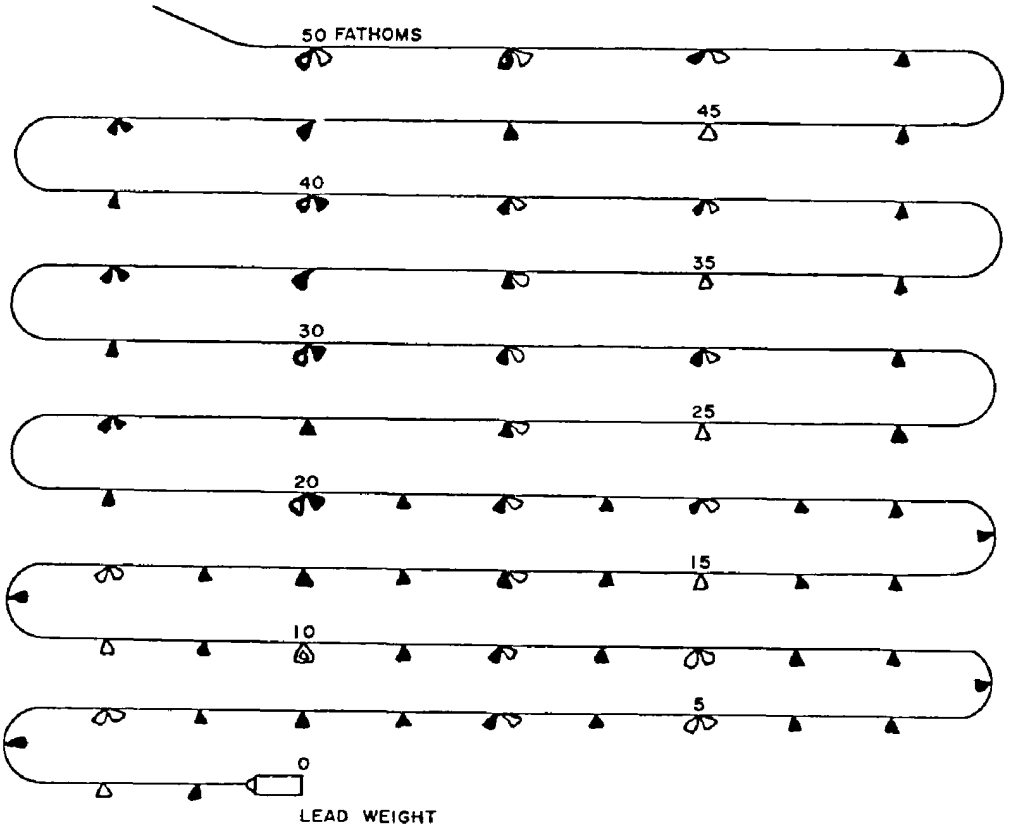

Figure 1 — MARKING of LEAD LINES

Procedure for Use:

When a lead line is used for sounding, the procedure usually depends on the depth of water and velocity of currents. If the depth is less than 75 feet, the sounding is made without stopping the boat when using a handheld line. "The leadsman casts the lead forward far enough so it will reach bottom as the line comes into a vertical position. Where the current is too fast for this, a line of soundings is taken by letting the boat drift with the current while the leadsman lifts the lead between soundings only enough to clear obstructions on the bottom. The boat is then propelled upstream and a second line of soundings is taken paralleling the first, and so on. Soundings in deep, still water are taken by stopping the boat for each sounding, as is the case when using a wire sounding machine."(2)

If water depth is less than 75 feet and there are no currents, the line is lowered into the water and by noting how much of the line is out when the lead weight hits the bottom of the body of water being sounded, one can determine the depth of water at that point. However, this technique is very tedious and does not always result in correct depth values. One reason for this is that when a wire or rope is lowered to the sea floor, it does not necessarily go straight down, but can be deflected either by surface currents or by movements of the surface vessel. Another disadvantage is that this method gives only one depth with each lowering rather than a continuous picture of the bottom. For these reasons, the lead line method is used mainly in special areas such as narrow channels and harbours that are extremely busy as far as water traffic is concerned.

3.2 Sounding by use of the Echo Sounder

(a) Principles and use of the Echo Sounder

As mentioned previously, mapping the ocean bottom by the lead line method is very time consuming. "Every 100 metres, or so, a line is lowered thus obtaining elevations of points that are far apart. The sampling is random, for mountain tops and valleys cannot be seen from a vessel on the surface of the water. Although one can obtain a good idea of the underwater topography of broad plains, mountain ranges are very poorly mapped by this method. Because sea water absorbs light, visual methods cannot be used to explore the depth of the ocean from the surface. Since sea water is a fairly good conductor of electricity, it absorbs radio and other electromagnetic radiation, so that radar cannot be used either. Sound waves, however, are readily transmitted by sea water. These waves are utilized by the echo sounder."(3)

Echo sounding is a technique whereby an outgoing signal or pulse (from an echo sounder on a ship) travels through the water to the ocean bottom, is reflected off the bottom, and travels back to the ship (see figure 2). The time that it takes the signal to make this trip is accurately measured. After necessary corrections, with knowledge of the speed of sound in water, the depth can be calculated and plotted by the instrument itself.

(b) Problems associated with the use of the Echo Sounder

A modern echo sounding device will produce a permanent graphic record of the returning sound. Some problems arise, however, in the interpretation of the echo sounder record, one is the exaggeration in scale. The surface vessel is travelling at a speed of 10 - 12 knots, this being the horizontal scale of the graph. The

(2) *Raymond E. Davis, Francis S. Foote, Joe W. Kelly; Surveying Theory and Practice, Fifth Edition, McGraw-Hill Book Company, Toronto, Ontario, 1966, Pg. 777.*

(3) *Peter K. Weyl - Oceanography - An Introduction to the Marine Environment, John Wiley & Sons Inc., Toronto, Ontario, 1980, Pg. 203.*

vertical scale of the graph shows the depth (usually in hundreds of fathoms) and is usually smaller and exaggerated as compared with the horizontal scale. If, however, both scales were made with the same dimensions (see figure 3) it would be very difficult to observe any details of the bottom features.

Another problem is the shape of the outgoing sound beam; it is a wide cone and covers a large area when it hits the ocean bottom. Therefore, the first echo to return will come from the point closest to the ship, which - in the case of underwater canyons or mountains - doesn't have to be directly below the ship. Thus, the following echoes will be obscured by the first one. This makes it difficult to accurately define small features on the ocean floor and to be sure that the feature is directly below the ship.

A third problem is determining the actual speed of sound in water. The speed of sound increases with increasing temperature, salinity and depth of the water. Also, soundings must be corrected for the tide. These factors must be known and corrected if a very accurate survey is needed.

Oceanographic vessels routinely use their echo-sounding equipment at sea. Many crossings over an area can be used to produce a model (see figure 4) or bathymetric chart (figure 5) of the ocean floor.

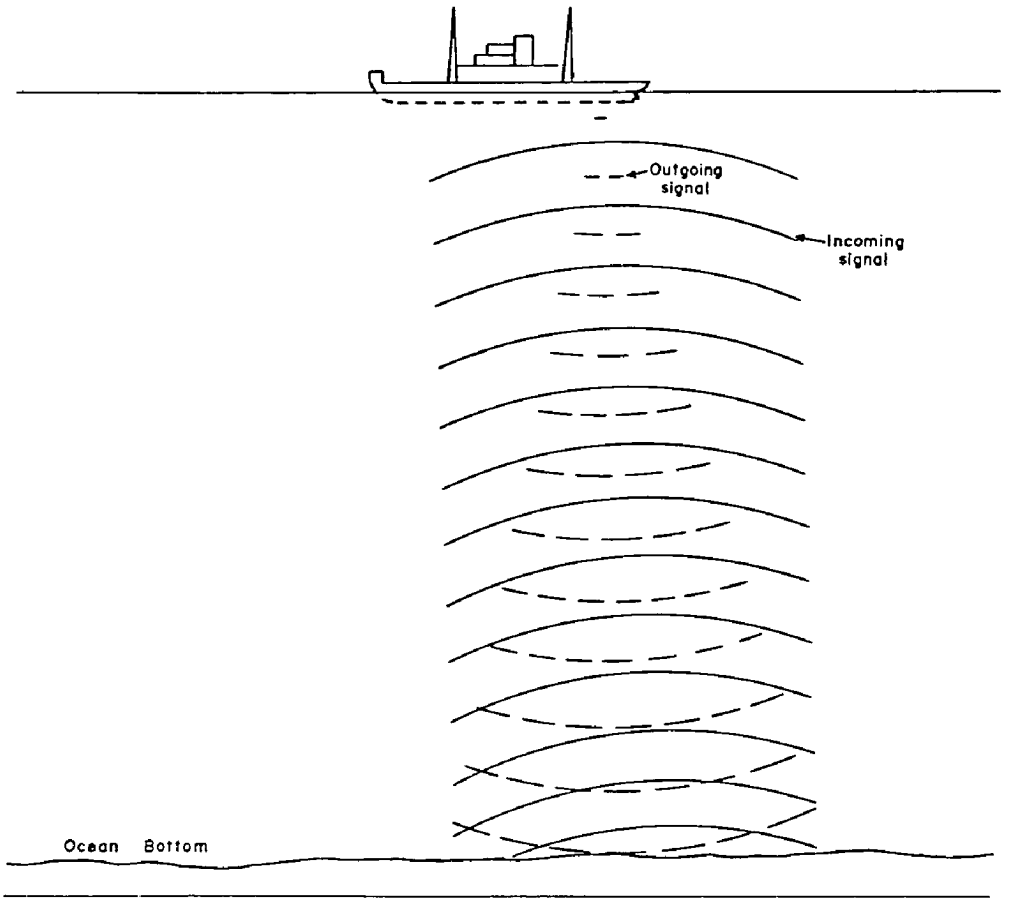

Figure 2 – OPERATION of the ECHO SOUNDER

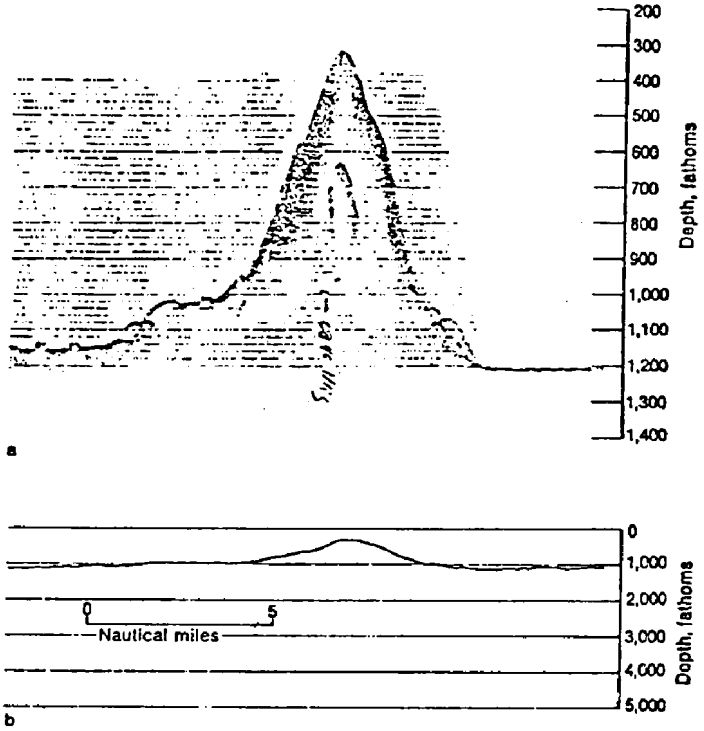

Figure 3 (a) Echo-sounding record made over a large hill, which is probably a submerged volcano. The vertical exaggeration of this record is 12 times. (Photograph courtesy of Woods Hole Oceanographic Institution.) (b) The same data shown with no vertical exaggeration.

3.3 Sounding Pole

A sounding pole is usually a pole 15 feet long made of 1½ inch round lumber, capped with a metal shoe at each end and sometimes weighted. It is marked symmetrically from each end. Between soundings it is turned end for end without removing it from the water. It is generally used for engineering work (bridges, etc.) where the water depth is less than 12 feet and the current velocity is low.

3.4 Lidar Bathymeter

LIDAR (Light Detection and Ranging) offers advantages of speed and mobility over a vessel mounted echo sounder in the same manner that the acoustic echo sounder offered these advantages over the lead line. A Lidar is an active optical measuring device which uses electromagnetic radiation in the visible spectrum to sense the position of remote objects - in this case both the water surface and the bottom. It is active because it supplies its own source of light - the laser. As is the case with an acoustic sounder, the idea is to measure the time differences from the transmission of signal to the detection of reflected pulses.

Refer to figure 6 for a graphical illustration of the system concept. The laser, on board the aircraft at "A", fires a short pulse of laser light downward at an angle θ. At the water surface, a portion of the incident pulse energy is reflected upward while the remainder refracts into the water at an angle θ_r. The refracted pulse undergoes scattering and absorption within the water column. Depending on water quality and depth, a portion of this pulse eventually reaches the bottom and is scattered upward. The optical receiver at "A" thus receives a pulse corresponding to the surface reflection and a short time later receives the bottom reflected pulse. The time difference between surface and bottom pulse receipt can then be

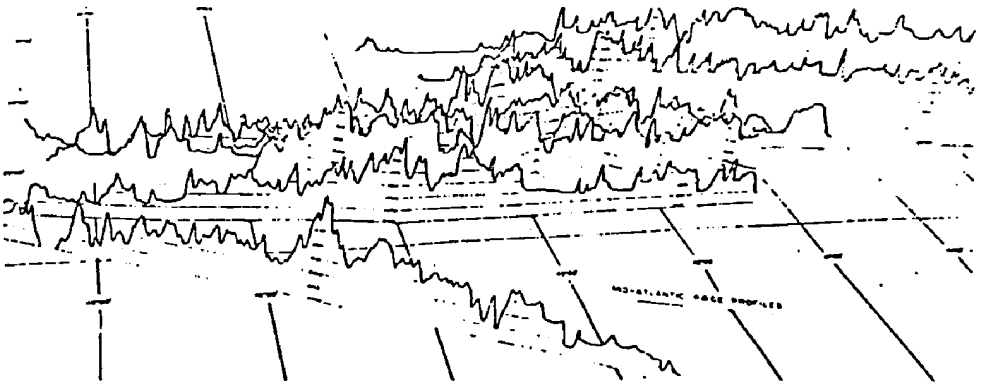

Figure 4 Model of a small portion of the Mid-Atlantic Ridge. Numerous echo-sounding records were used to construct this model. (Model constructed by R. M. Pratt.)

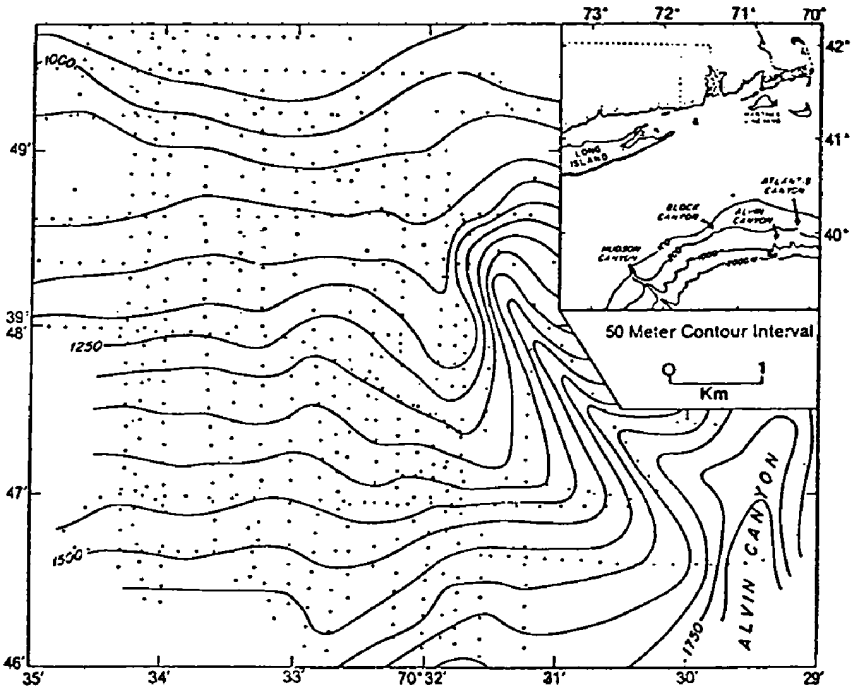

Figure 5 Bathymetric chart of part of the continental slope off the east coast of the United States. The small dots are the individual depth readings used to construct the chart. The insert chart shows the area surveyed. (From K. O. Emery and D. A. Ross, *Deep Sea Research* 15 [1968].)

used to calculate the depth of water. As far as the airplane itself is concerned, positioning is accomplished with a Microwave Ranging System and a Radar Altimeter. Relative positioning is controlled by an inertial attitude sensor and shaft encoders on the Lidar device itself.

The Lidar Bathymeter system is a Canadian development designed for shallow water use and is scheduled to be deployed in Canada in the fall of 1984. It can be deployed independently or in conjunction with a standard acoustic survey (echo sounding). Lidar, although a major technological break-through in its field, does, however, have its limitations. Some of these include its ability to give accurate

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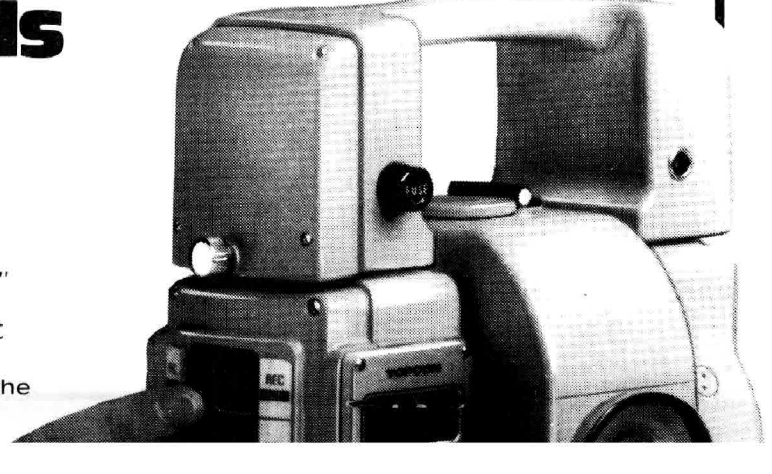

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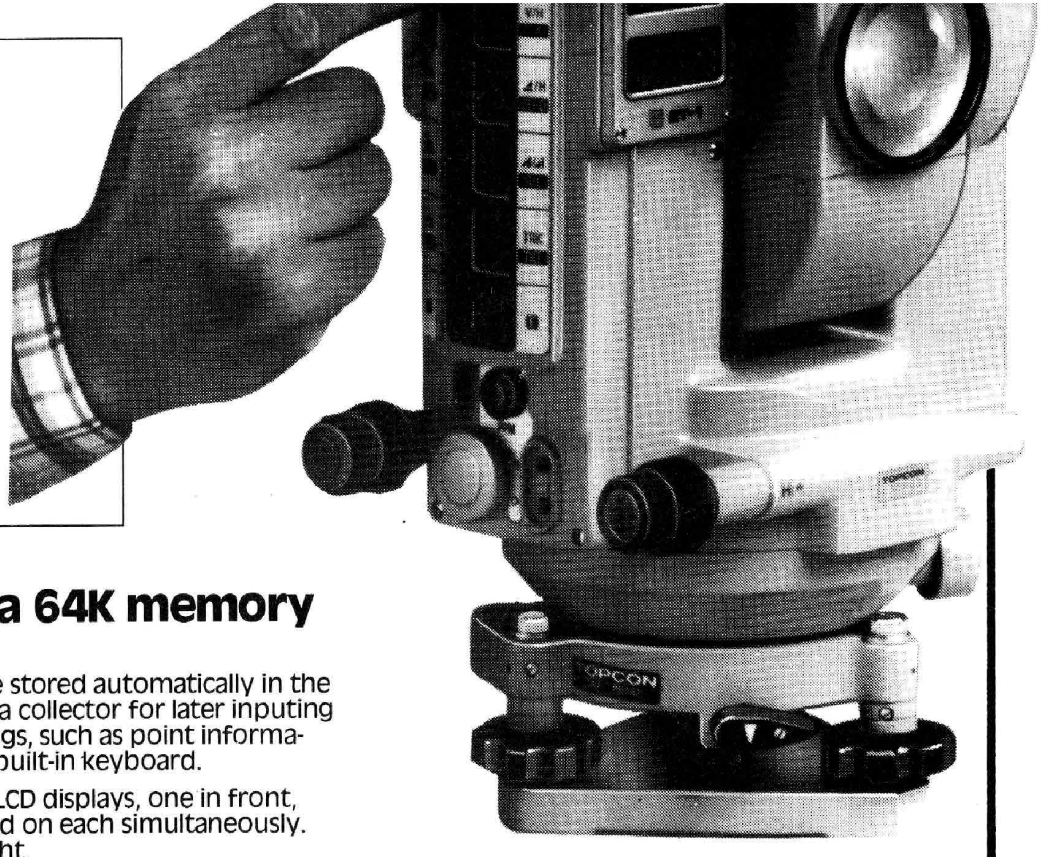

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depths only in relatively shallow water and its limited operational distance from the base landing strip, since it is mounted on a short range DC - 3 aircraft. Also, there are still a number of technical problems with the system itself which must be overcome to make full and efficient use of Lidar.

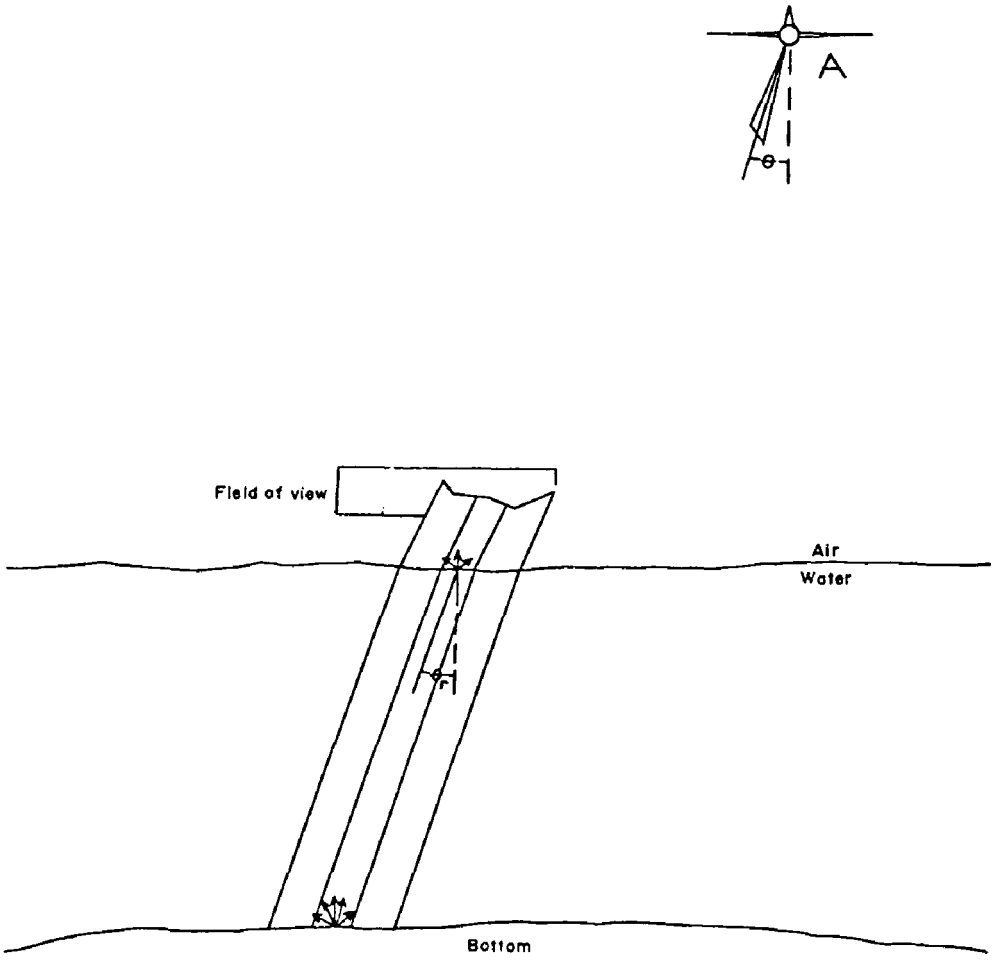


Figure 6 — LIDAR BATHYMETER

3.5 Reduction of Soundings

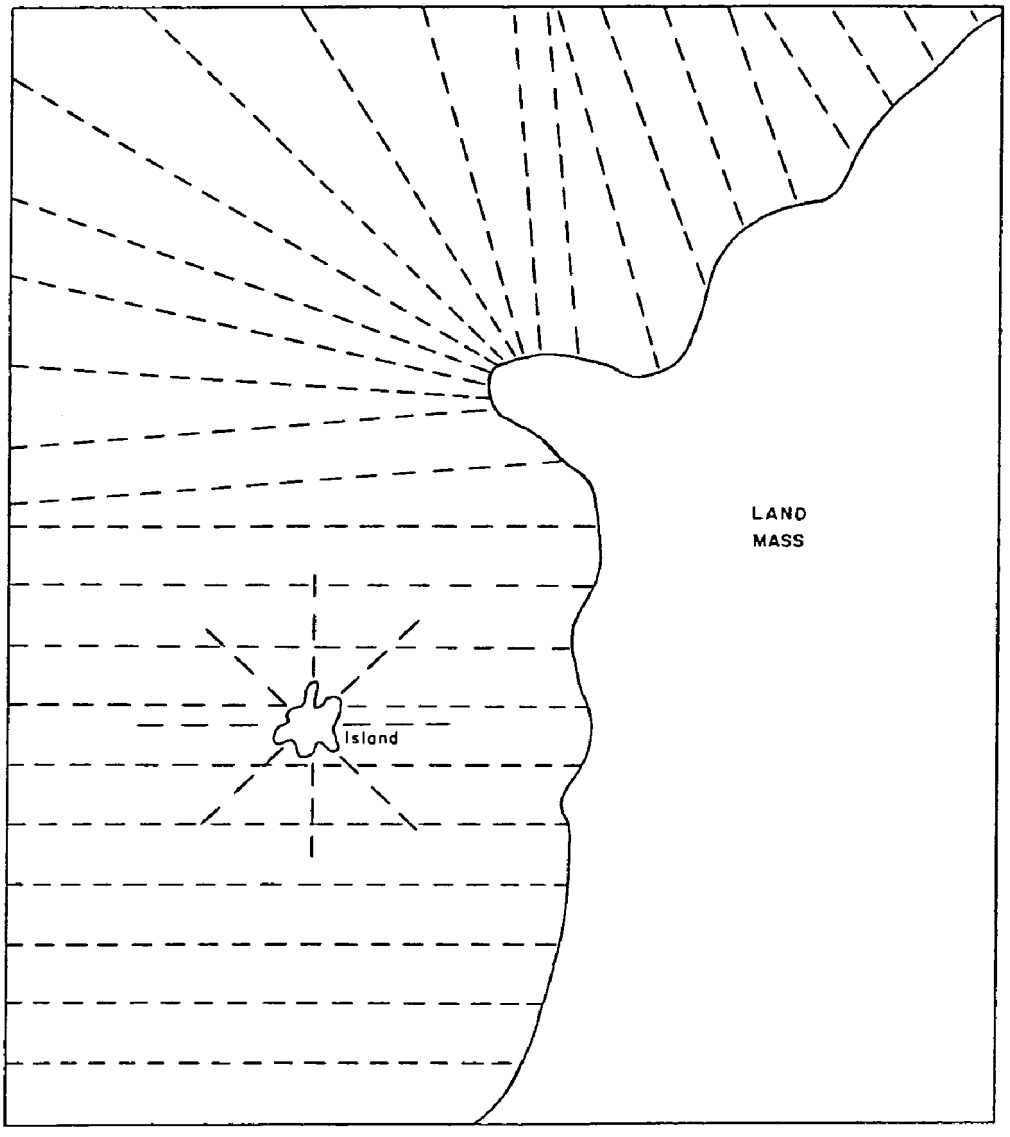
Soundings can be carried out at any tide, but they must be reduced to a standard reference plane. This is done by subtracting them from the height of the tide at the time they were taken. The rise and fall of the tide in the survey area must be observed on a tide gauge or pole while sounding is being carried out. It is then possible to plot a curve showing the actual variation in the water level, and to reduce the soundings to a suitable reference plane. The depths are then reduced, usually to low tide depths, when they are charted in the office.

4. LINES OF SOUNDINGS

4.1 Number and Location of Sounding Lines

In theory, there is no limit to the number of soundings which might be considered necessary to make certain that the contours of the sea bed are accurately represented on a chart. It is possible that, even if soundings only 10 feet apart were taken over the entire water area, important irregularities might be missed. However, except in isolated cases, for example, more or less enclosed basins and harbours of very small size, it would be impracticable to attempt any such detailed examination. In practice, the density of soundings must be dependent on the scale and nature of the survey.

The normal method of sounding an area is to run lines of soundings approximately at right angles to the trend of the coast (see figure 7). The fathom lines, or contours connecting isometric depths, are generally parallel to the coast line.



LINES OF SOUNDINGS

Figure 7

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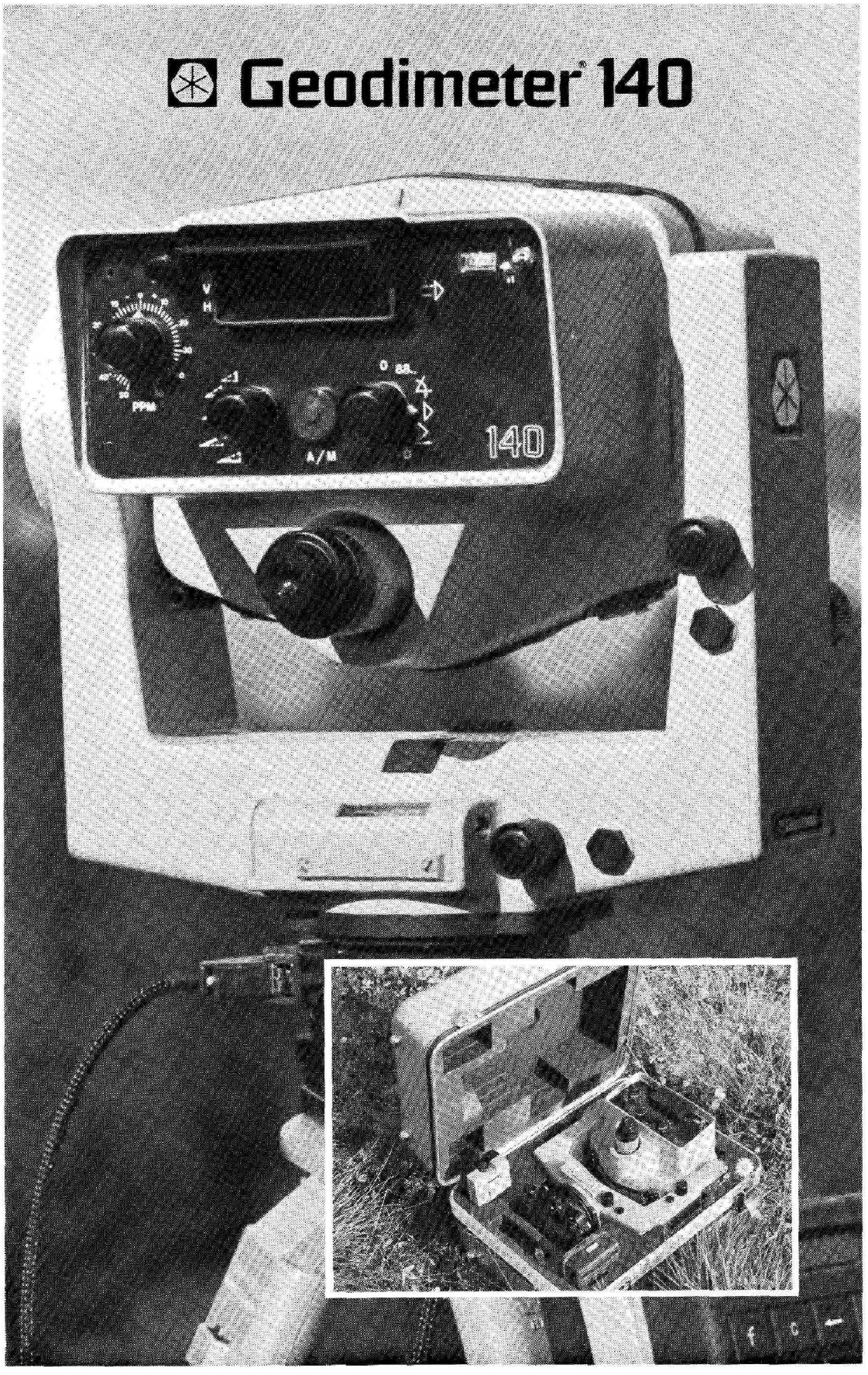

The drawing of fathom lines on the chart is made easier by running the sounding lines perpendicular to them. It would be next to impossible to fix every individual sounding so the method used is to fix the position at regular intervals by sextant angles to bench marks on shore or floating beacons. Assuming that the ship or boat is properly handled, speed and course between successive fixes will be reasonably constant, so that intermediate soundings can be plotted by interpolation with all required accuracy. When echo sounding apparatus fitted with an automatic recorder is used, the record of depths along the coast line is continuous, because the soundings are taken so quickly that there is no appreciable interval between them. If a hand lead, or any type of mechanical sounding equipment is used, there must be some interval between consecutive soundings. This interval would depend on the personal error and the efficiency of the machine.

4.2 Spacing of soundings - spacing in shallow water

(a) The usual procedure in depths of 20 fathoms or less is to adjust the speed of the vessel according to the scale of the survey so that at least as many soundings are taken as can conveniently be shown on paper. With the echo sounder the depth record is continuous and the speed of the ship is only limited by the ability of the surveyor to fix and plot his position quickly enough as the work proceeds.

The distance between adjacent lines of soundings is normally dependent on the scale of the survey. In depths of 20 fathoms or less, it is customary to run the lines 0.20 inches or 0.25 inches apart on the paper. The distance to travel on the water could then be computed by applying this paper distance to the scale to be used.

(b) Spacing in deeper water

In deeper water of over 20 fathoms, it is customary to open out the lines on the paper to 0.40 inches or 0.50 inches apart. This, in most cases, will provide a detailed enough examination. This practice is sometimes followed in very shallow water where navigation will be confined to small boats and an extensive examination would be impractical. In depths of over 100 fathoms, running lines of soundings is usually abandoned because it is not justified by navigational requirements nor is it feasible. Sufficient soundings are taken in such depths, at more or less regular intervals, to provide a general picture of the sea bed. Also, to ensure that no great irregularities exist on large scale plans, the sounding should be confined to a relatively small area in order for the data to be plotted on the plotting sheet.

4.3 Straightness of sounding lines

(a) Consequences of crooked lines

Lines of soundings should be run reasonably straight. The only permissible exception to this is when the sounding lines are regular curves running along lines of constant radar range, constant decca, or hydro dist reading. There are two reasons for this:

(1) Unless the lines are straight, it will not be possible to space them evenly, and gaps will be left in the work. These would have to be filled in later with interlines or crosslines.

(2) More important, the surveyor who runs crooked lines cannot be certain just what path his ship has followed between fixes for it isn't likely that his path will be truly represented by a straight line, or even a smooth curve joining the two fixes.

(b) Correct and incorrect method of sounding the same area

"Figure 8 shows two attempts at sounding the same area; in both cases the dashed lines represent the planned lines of sounding. In Figure 8A the surveyor has concentrated on keeping his lines as straight and evenly spaced as possible, and has used the planned lines as a guide, rather than trying slavishly to follow them. Although the lines are not completely straight, it can be assumed that his vessel has

moved along the solid lines joining the fixes. Note how after fix 15 he has made attempt to regain either of the planned lines. He decided to run a straight line paralled to those already run, and then filled in the gap by running fixes 22 to 28. He has covered the area economically and methodically. In Figure 8B, the surveyor tried too hard to keep exactly on planned lines resulting in frequent and gross alterations in course. At best, he has left awkward gaps in his work which will have to be covered later."(4)

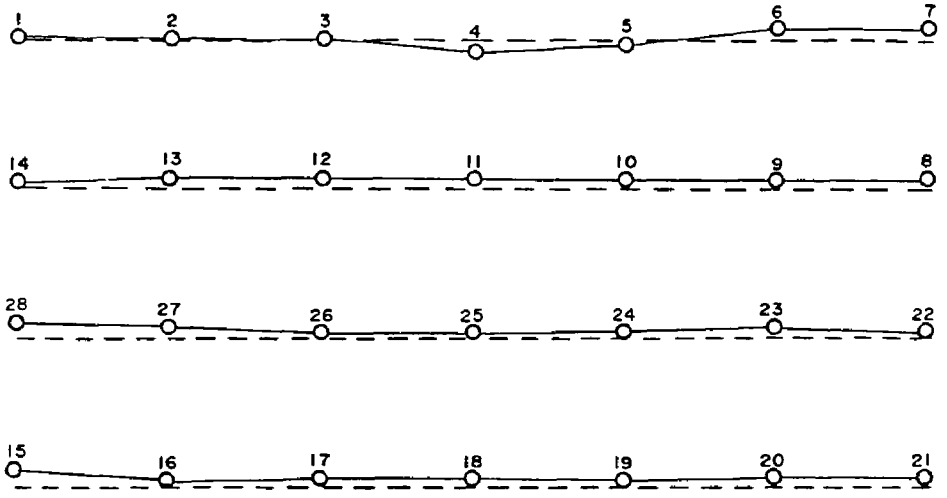

Figure 8(a)

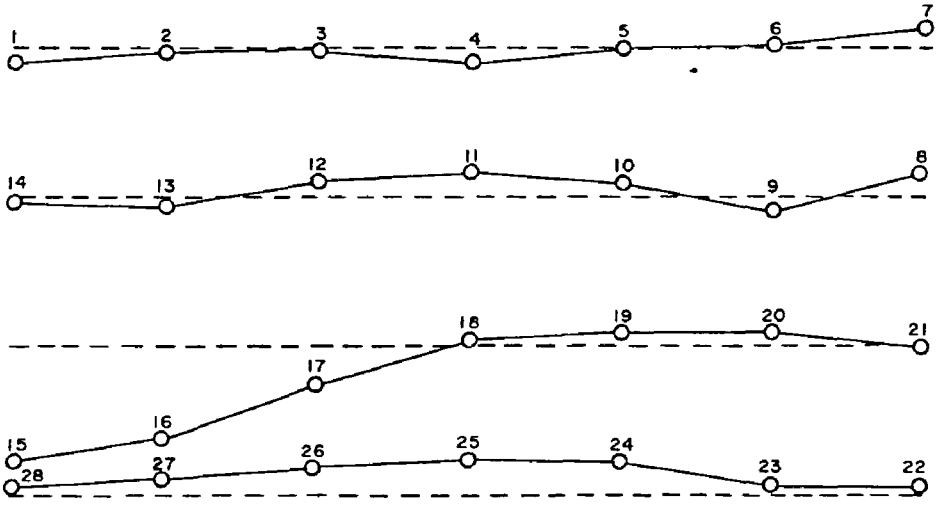

Figure 8(b)

FOLLOWING PLANNED LINES of SOUNDINGS

(4) *Admiralty Manual of Hydrographic Surveying, Volume II, Queen's Printer, London, England, 1967, Pg. 93 - 94.*

(c) Five considerations for proper coverage

"In summation, there are 5 basic considerations that are needed to achieve satisfactory coverage of the sea bed with maximum economy:

(1) The scale of the survey appropriate to the precision and thoroughness required.

(2) The spacing of the sounding lines.

(3) The interval between fixes along a line.

(4) The speed of the vessel while sounding.

(5) The direction in which lines are to be run.[5]

4.4 Interlining

An interline is an additional line of soundings inserted between two previously run lines, usually so that it bisects the space between them. Interlines are run for three main reasons:

(1) To fill a void in the work caused by bad management of the sounding vessel in the original run.

(2) To improve the thoroughness with which a particular area is sounded out.

(3) To investigate an indication of possible shoal water.

(a) Interlining to fill in gaps in the work

The aim of every sounding team should be to run straight and evenly spaced lines of soundings. At times, even an experienced surveyor will not be able to do this. The tidal streams may change suddenly and unexpectedly and fixing may be difficult. The result will be that his work does not satisfy the requirements of the sounding plan. Provided that the lines are run reasonably straight, gaps may be filled in with interlines. These should be run so that at no point are the actual lines of soundings more than 1½ times as far apart as the planned lines. It is not always easy to determine if a poorly followed line is straight enough to be acceptable. To decide this, the surveyor must be certain that his plotted track, especially the parts between the fixes, actually represents the ship's path during the original run.

(b) Interlining to improve the thoroughness of the work

The roughness of the bottom topography is sometimes underestimated when the scale of an original survey is decided upon. When this occurs, the thoroughness of the routine sounding may be doubled by running interlines. Interlining is also advisable in important shipping channels and similar places where the depths of the water is barely sufficient for safe navigation, and small irregularities on the sea bed might be dangerous.

(c) Interlining when shoal water is indicated

Except in rock and coral infested waters, it is very unlikely that a shoal dangerous to navigation will be able to lie upon a base small enough to escape detection on one or the other of two adjacent sounding lines, provided the scale of

(5) A. E. Ingham, *Hydrography for the Surveyor and Engineer*, Crosby, Lockwood, Staples, London, England, 1974, Pg. 11 - 12.

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the survey has been properly chosen. The nearest line to a shoal should always give an indication of its presence. There will be an interruption in the slope of the sea bed, usually in the form of a sharp projection on the echo trace, but sometimes in the form of an unexpected deep sounding. If there is any doubt at all, an interline should be run.

4.5 Cross lines

Cross lines are lines of sounding run at an angle (usually about 90^{0}) to the normal lines in a sounding plan. They are usually run for one of the following reasons:

(1) To check work already carried out.

(2) To ensure that the narrow tongues of shoal ground do not extend at right angles to the shore off a point or headland.

(3) To show a fathom line accurately, where, for some reason, the normal lines fail to do this.

(4) To show a shoal more carefully than can be done by interlining.

4.6 Delineating danger lines before starting to sound

"Although normal lines of sounding are generally run at right angles to the trend of the fathom lines, this can sometimes lead the surveyor into trouble. A ship travelling across fathom lines in uncharted water will sooner or later run aground without much luck. To avoid this, a danger line, beyond which a ship must proceed with great caution, may be delineated on the sounding board before the main lines are run. If a chart of the area already exists, the danger line may be taken from it, but it should be remembered that the reason for the new survey being ordered may be that the current chart is inadequate."(6)

4.7 Special sounding lines

(a) Open lines of sounding

It is not always necessary to run lines of soundings at the normal spacing of 0.20 or 0.25 inches apart. For instance, no ship is likely to set her course over drying banks next to a navigable channel or across a large expanse of drying foreshore. The surveyor may, therefore, confine his efforts to defining the drying line around these banks accurately, and obtaining enough soundings over them to show their maximum height above chart datum and their general configuration. This can usually be done by running lines across the banks at double the normal spacing, or by zig-zagging backwards and forwards across them.

(b) Test lines

In some areas, the navigation channels are so important, and change their configuration so quickly, that regular resurveys are required. In others, the need for a proper resurvey can best be determined by running test lines from time to time. These lines will generally be very open, and their positions must be carefully selected so that they will give a good picture of the general configuration of the bottom.

(c) Leading and clearing lines

Leading and clearing lines are very useful aids to navigation and the surveyor should be constantly on the lookout to recognize any that may be of value.

(6) *Admiralty Manual of Hydrographic Surveying*, Volume II, Queen's Printer, London, England, 1967, Pg. 96.

Before they are charted or recommended for use, such lines should be carefully sounded over. Where the survey is incomplete or the sea bed is very irregular, it might be advisable to sweep along them as well as sounding. They must be easily recognized by a stranger.

4.8 Examinations

When an indication of shoal water has been found, and followed up by interlining and cross lining, the need for a detailed examination of a relatively small area is sometimes revealed. Such an examination must be carried out on a scale larger than that of the main survey. A selection of the soundings obtained can then be inserted in the appropriate place in the main work. To carry out an examination properly, the surveyor must be able to run very closely spaced lines of soundings, in extreme cases these may be as little as 10 feet apart. It is not necessary to fix at regular intervals, but an accurate fix must be obtained whenever it is needed.

4.9 Proper navigation of a sounding vessel

The efficient and proper management of a sounding vessel comes mainly from experience. However, there are three basic considerations to be taken into account, as far as sounding boat operation is concerned.

(a) Speed of sounding: Fixing Interval

Fixes should be spaced about half an inch apart on the sounding board. Their actual distance apart will depend on the scale of the work; the greater the scale, the closer they will be.

(b) Speed control: Fixing at changes of speed

While the speed of the ship can be varied during sounding, the speed of the echo sounder record paper remains fixed. The echo sounder trace is one of depth against time. If, as is usual, this trace is handled as though it were a plot of depth against distance, the speed of the boat must not be varied between fixes. When the surveyor has to reduce speed on approaching shoal water, he should always do so at a fix. If a sudden reduction in speed is necessary, a fix should be obtained immediately. Increases in speed should always be made at a fix.

(c) Fixing on a particular fathom line

In channels or rivers, it may be important that a particular fathom line should be fixed with special accuracy, as it will form a danger line for shipping. In such cases, a fix should be obtained on or very close to this line each time it is crossed. This is not possible without a reliable set of tidal predictions.

4.10 Keeping on line by compass

On scales larger than about six inches to the mile, most ship sounders use the ship's compass to control their progress along the planned lines of soundings. The only real way to get proficient at this method is by practice. The surveyor, at the beginning of a line, estimates the course to steer and modifies it when necessary as he goes along. On scales larger than about six inches to the mile, it isn't necessary to run straight lines by the compass method. Unless the scale is very large and the area to be sounded relatively small, artificial transits for each line would not be practical. With practice, natural transits, or points of change, can be picked out which will provide delicate control to keep the ship on the various planned lines of sounding.

4.11 Sounding in special circumstances

(a) Sounding in a river

When sounding across a river, a surveyor must be careful not to displace his inshore soundings towards the middle of the river.

(b) Sounding in an estuary

In an estuary, the salinity of the water could vary greatly during the course of a few hours. Particular attention must be paid to matching the speed of the echo sounder to the velocity of sound in the water.

(c) Interlacing of sounding lines

If the best fix available is not very strong, it will be wise to interlace lines of sounding. This is done by running lines at double the normal spacing and then interlining to fill in the gaps.

(d) Sounding on very large scales

When the scale is so large that the length of the boat is more than one-tenth of an inch on the plot, special care must be taken. The echo sounder paper speed should be as fast as possible and the fixes must be marked on the paper with special care.

5. METHODS OF CONTROL

5.1 Control in Coastal and Inland Waters

5.1.1 Horizontal control

Horizontal survey control must be established on shore from which to indicate positions to take soundings and also to determine the actual positions of the soundings when they are made. For surveys requiring less accuracy, the control may be a stadia or plane-table traverse. More precise work requires a closed traverse when concerned with small areas. For large sounding areas where great precision is required, the control is based upon a system of triangulation. Long, narrow rivers or inlets, with shore conditions favourable to traversing, are usually surveyed from a single traverse line on one shore. If the body of water is more than one-half mile wide, it would be more economical to traverse both shorelines and to connect both traverses by frequent cross ties. Where the shore lines of rivers and lakes are obscured by woods and cannot be traversed economically, triangulation is used. In addition to a measured base line at the beginning and end of the survey, check base lines are measured every 10 or 15 miles as the work progresses. The control for large lakes and ocean shore lines consists of a network of connected triangles on shore. These are supplemented where necessary to traverse lines along the shore.

5.1.2 Vertical control

Usually tide or water stage gauges are used to establish the common datum and to give the height of the water surface when each sounding is taken. Vertical control must be established to connect these gauges with shore elevations and with each other. Usually a set of bench marks are located near the shore line running between tide gauges. It is essential that the elevations of the water surface be tied to the shore level net. At least one and preferably several bench marks of this net should be established on firm ground near the water gauge. Usually a staff gauge is established in connection with the tide gauge. The elevation of the zero of the staff gauge should be determined from these bench marks at frequent intervals.

Various datum levels are established from the tides. The more widely used ones are as follows:

(a) Mean sea level is the average of water heights taken every hour. It is used as a datum for geodetic levels but plays little part in hydrographic surveying.

(b) Mean low water is the average of all the heights of each low water. It is the datum to which depths are referred on the Atlantic and Gulf Coasts of the U. S.

(c) Mean lower low water (MLLW) is the average of all heights of the lower of the two low waters that occur in each lunar day. It is used as a reference for depths on the Pacific Coast of the U. S.

(d) Lower low water - large tide (LLW - LT) is the average of the lower of the two low waters that occur at the maximum bimonthly large tide. It is used on Canada's East Coast.

The depth of a sounding is referred to water level at the time it is made and is later corrected to the appropriate datum.

5.2 Offshore Control

5.2.1 Horizontal Control

Offshore positioning is accomplished by using various electronic control equipment. Some of these systems are outlined below:

(1) Raydist - The determination of distance by the Raydist system is based on the measurement of a phase difference in two radio signals, one emanating from a transmitter aboard ship and the other from a transmitter at one of two fixed stations ashore. This method is reliable to distances of 100 miles or more.

(2) Shoran and Loran - both methods are based on the measurement of elapsed time between the transmission of a radio pulse from the sounding ship and the reception of a return signal from one of two fixed stations ashore. Shoran is accurate for distances up to 50 nautical miles and Loran is for distances up to 1000 nautical miles.

(3) Doppler - Satellite System - A doppler - Satellite positioning system fixes position by measuring the doppler shift of satellite signals.

5.2.2 Vertical Control

Off shore soundings are referenced to mean sea level since these depths need not be so precise. For this reason, no vertical control is necessary when making deep sea soundings.

5.3 Determining the positions of soundings

Soundings can be located by any one or combination of the following methods:

(1) Intersecting range lines - when the object of the survey is to determine changes in the bottom due to silt or to determine the quantity of the material removed by dredging, soundings must be repeated at the same points. Fixed range lines are located on shore so that they intersect at approximately right angles and are permanently marked. The ship proceeds to the intersections and takes soundings as desired.

(2) Graduated line or wire - this method is used to sound a small stream. Stakes are set opposite each other on both shores where bottom profiles are required. They are tied into the shore traverse. The zero end of the graduated line is held over one stake while the line is held over a second stake on the opposite bank with a weighted and graduated pole suspended from the wire. The graduated wire gives the distance from each stake and the pole reading gives the water depth.

(3) One range line and one angle read from shore - the range line can be fixed either by two flags or signals on shore or by one flag on shore and a buoy set in position offshore. The locations of all range signals must be known and plotted on the map before sounding locations can be plotted. If the soundings are made with a rod or a line, each individual sounding must be referenced by angle readings. If a continuously recording echo sounder is used, the location of the ship is determined by angle readings taken at intervals with an identifying mark being made on the chart each time a reading is made.

(4) Two angles read from shore, two transits are set up at points on the shore traverse which provide good visibility and intersections (close to 90^{o}). Each instrumentman turns off from a known azimuth to the sounding rod at the vessel. When the sounding signal is given, both men observe and record the horizontal angle to the sounding vessel and the time of the reading.

(5) One angle and a stadia or E.D.M. distance from shore, one transit is set up and a horizontal angle is turned from a known azimuth and a distance measured to the sounding rod or line when the sounding signal is given. The time of the reading is also taken.

(6) Two angles (measured with sextants) from the vessel to three or four signals or buoys, this method is essentially a form of triangulation with two angles of a triangle being measured. The signals or buoys form a known "base line" and thus the third dimension needed to solve the triangle.

(7) Range line and time intervals, this method is used where extreme accuracy is not required. The first and last soundings on a range line are located by angle readings from the shore or the ship and the intermediate readings are interpolated according to the time intervals.

ROLE OF THE SURVEYOR

The Nova Scotia Land Surveyor, as a professional person and an expert in measurements, has an important role to play in the field of hydrographic sounding. As ships become larger, ports expand and water traffic increases, the need for more accurate mapping of the land mass under the water is necessitated. It is a substantial tribute to the surveyor that he is often the first professional to be contacted with regards to conducting a sounding operation. The Nova Scotia Land Surveyor is most often involved in small scale sounding jobs for such engineering projects as harbour improvements, bridges, wharves and docks, although he could be engaged to sound a river, lake, or gauge a stream for water flow.

The first undertaking of the surveyor when execuzing a sounding operation is that of a preliminary survey. This consists of both horizontal and vertical control work. The horizontal control could consist of a closed traverse or triangulation in order to indicate the positions at which to take soundings and to determine where they were actually taken. In addition, most hydrographic surveys require the location of all irregularities in shore line, all prominent topographical features, and all lighthouses, buoys, etc., in order that these points may be used for references in range, line and sounding work. Although these details are generally mapped by photogrammetric methods, they could be located by stadia, plane - table or other

means in the field. Tide gauges are set up and/or maintained for purposes of vertical control. These gauges establish a common datum or reference plane and give the height of the water when each sounding is taken. The surveyor establishes vertical control to connect these gauges with shore elevations and each other. A single control survey is carried out on shore to serve for both soundings and shore detail.

As far as fixing the location of soundings is concerned, the surveyor may choose from numerous methods. To accomplish this, a number of methods are often combined, depending on the individual project itself. These procedures were previously discussed under Section 5 of this report entitled "Methods of Control."

The Nova Scotia Land Surveyor who undertakes to perform a hydrographic survey also accepts a great responsibility. His completed plan or bathymetric chart may be used by commercial vessels, naval ships and pleasure craft to guide their safe passage and plan their routes. Any mistakes or oversights on the part of the surveyor in the execution of his survey or the preparation of his plan or chart could result in tragedy. An overlooked shoal or sandbar or a misplaced fathom line could cause expensive property damage to a vessel or, more importantly, loss of life. Thus the surveyor must accept responsibility and may be forced to assume liability for any accidents resulting from his negligence or lack of thoroughness. For these reasons, care, common sense and skill should be exercised by the surveyor when performing a hydrographic survey.

7. CONCLUSIONS

As the population of the world increases, so does the production of manufactured goods, food stuffs and so on. Along with increased production comes a greater demand for reliable transportation to move these goods, a great portion of which are carried by ships. With this increasing water traffic arises an even greater need for a reliable knowledge of the depth of the water and location of the bottom, a need that can only be satisfied by hydrographic sounding. Although the lead line and echo sounder have served this purpose well in the past, and will continue to have their applications for years to come, the future belongs to modern technology and remote sensing techniques such as Lidar to provide for safe navigation through our waterways. Also, the ever increasing search for offshore oil and gas dictates the necessity for accurate and efficient sounding of vast areas of ocean, a job that is best left to modern technology.

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** FROM THE FIELDBOOK **

by Marcellin S. Chiasson (#355)

June 22, 1984

A recent survey of the age of our membership reveals the following:

Age:	21 - 25 = 3	51 - 55 = 29
	26 - 30 = 25	56 - 60 = 29
	31 - 35 = 43	61 - 65 = 23
	36 - 40 = 49	66 - 70 = 8
	41 - 45 = 48	71 = 1
	46 - 50 = 39	

* * * * *

We welcome the following new members to our membership:

#542 - Gary Wadden, Westville
#543 - V. Douglas MacLeod, Truro
#544 - Carl Kenneth Hartlen, Lower Sackville

We note the loss of a life member, A. Howard Murray (#116).

* * * * *

Congratulations to E. J. (Ted) Webber, #349, on his election as President of the Association of Metropolitan Land Surveying Consultants.

The Registry of Joint Stock Companies advises that a name has been approved for a new group being set up in Cape Breton.

* * * * *

Plan now to attend the C.I.S. annual meeting to be held May 28th - 31st, 1985 in Edmonton. Clarke Beatty is one of the top organizers of this event.

* * * * *

The Provincial Subdivision regulations are scheduled to come into effect August 6, 1984.

* * * * *

The President of APENS is John G. (Jack) Hemming of Halifax.

* * * * *

Achievements for our members:

(a) Wayne Hardy (#432), besides his many other association and community activities, is President of the Sydney Wisemen's Club and will be going to the International Convention in Grand Rapids, Michigan.

(b) Russell MacKinnon (#504), will be the Liberal candidate in the Cape Breton West riding in the next Provincial election.

(c) Lloyd Taylor (#437), obtained his Business Degree from St. F. X. University in May.

(d) Russell Atkinson (#350) is on leave from Canadian British and is on special assignment with the Federal Department of Public Works.

(e) Harold Lively (#418), who has a Beagle Kennel, has entered his dogs in a number of Maritime trials and he also finds time to plumb the derrick of an oil rig anchored in Halifax Harbour.

* * * * *

At the time of writing this article, Leonard Harvey (#78) was recovering from a heart problem, Roy Dunbrack (#247) from kidney stones and Douglas MacDonald (#275) from a bout with chicken pox. Glad to hear they're on the mend.

* * * * *

New Brunswick implemented compulsory liability insurance for members in private practice as of January 1, 1985.

* * * * *

Cape Breton hosted two excellent events this summer:

(a) C.I.S. (N. S. Branch) meeting held at Iona, Cape Breton - Dr. John Reid gave excellent presentation on "Parade of Sails" - Thanks, Dennis Jones and Jim Gunn!

(b) Seminar by Lorraine Petzold, Executive Director of O.L.S. - It was well attended by surveyors, lawyers, real estate personnel, etc. Thanks, Paul Harvey!

* * * * *

From Robert's Rules of Order - "When there is a tie vote, the motion fails, unless the Chairman gives his vote for the affirmative, which he is at liberty to do, as he has a right to vote whenever his vote will affect the result. Where his vote in the negative will make a tie, he can cast it and thus defeat the measure."

* * * * *

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* * * * *

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** HIGHLIGHTS OF COUNCIL MEETING - JUNE 2, 1984 **

by E. J. (Ted) Webber, Councillor Zone 6

There were 12 members in attendance with 2 absentees. The minutes of the March 17, 1984 council meeting were approved.

Proposed Amendments to N.S.L.S. Act - Letters were received from Murray Banks, Chairman of Statutes Committee and from Fred Crooks, Solicitor for APENS. It was the consensus of council that the Statutes Committee be directed to continue discussions with APENS and have the Proposed Amendments for membership approved at our annual meeting in November, 1984.

Provincial Subdivision Regulations - The Pictou County Zone sent a letter to Hon. Thomas J. McInnis, Minister of Municipal Affairs, expressing their concerns with the proposed definition of subdivisions in Pictou County. The proposed definition would allow the creation of three lots not subject to subdivision regulations.

Liability Insurance - Insurance is mandatory in New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan and Alberta. C.C.L.S. will sponsor a Liability Insurance seminar to be held in Toronto, September, 1984.

L.R.I.S. - A letter will be written to the Board of Directors, Council of the Maritime Premiers emphasizing the need for more maintenance and densification of the Nova Scotia Coordinate Monuments.

A motion was passed stating that the secretary send registered letters to all students informing them of their status in both academic and article time requirements.

A letter was received from M.R.M.S. indicating that their expertise is in air photo interpretation as it adds another dimension to the evidence being presented. (The status of "expert witness" in cases of boundary disputes was questioned during the January 21, 1984 council meeting).

Public Relations - A draft copy of the new brochure was received from Wayne Hardy, Chairman of the Public Relations Committee. Councillors were asked to forward comments to the Association office.

* * * * *

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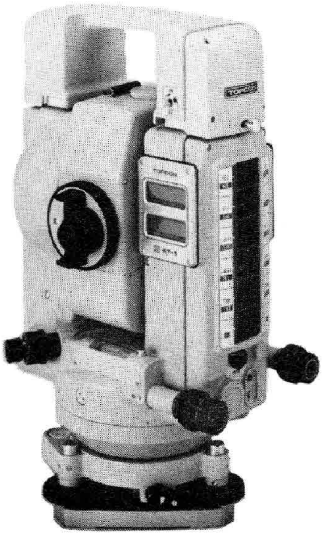

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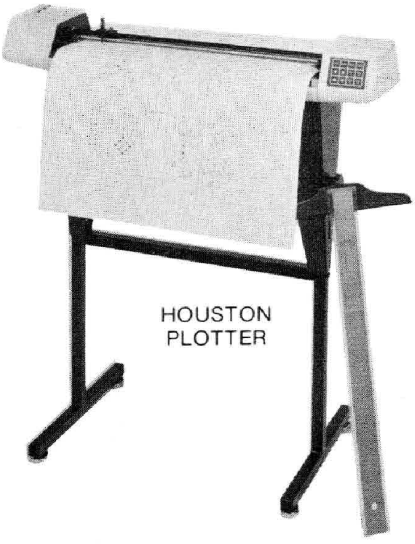

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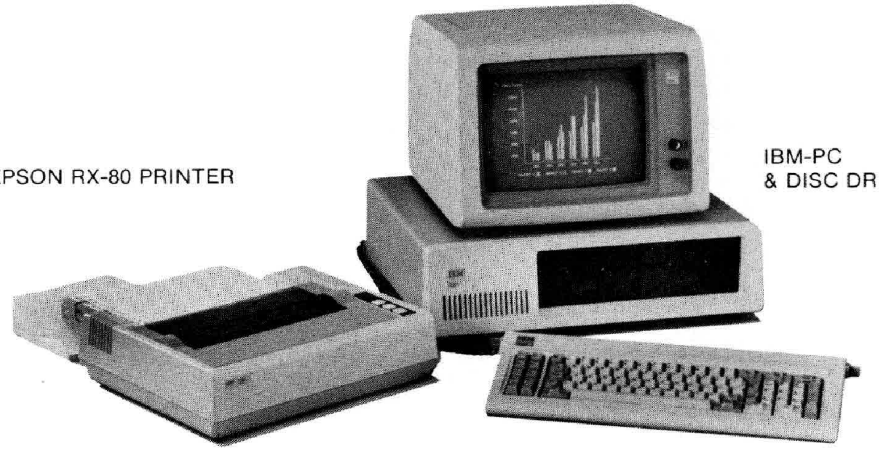

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